Engaging Dutch citizens in the decision making of district heating networks

Comparing the effects of a Public Value Evaluation and a survey

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By

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in partial fulfilment of the requirements for the degree of

Master of Science

in Construction Management and Engineering

at the Delft University of Technology,

to be defended publicly on Friday July 7, 2023 at 15:30 AM.

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An electronic version of this thesis is available at http://repository.tudelft.nl/.

Preface

This thesis is written for the graduation of the Master of Science, Construction Management & Engineering at the TU Delft.

I would like to thank the thesis committee members, Dr. T. (Thomas) Hoppe, Dr. Mr. N. (Niek) Mouter MSc, K. (Kevin) Goes MSc & S. L. (Shannon) Spruit for their feedback and advice provided during the different phases of my graduation. This has allowed me to keep making progress and deliver this thesis.

In addition to the support provided by my thesis committee, I would also like to express my gratitude to the staff members of Populytics. They have guided me through the complexities of online public participation, enabling citizens to engage in the policymaking process. Observing this first-hand has been a truly rewarding experience, and it has inspired me in establishing my own research.

In addition, I would like to express my gratitude to the interviewees for dedicating their time in sharing their experiences and insights regarding the heat transition and public participation. Their contributions have enriched the depth of this research.

And last but definitely not least, I would like to thank my family, friends and girlfriend for their support during my time as a student in Delft.

Rotterdam, 30 June 2023,
Joost van den Berg

Executive summary

The Dutch national government is committed to transitioning to a low-carbon economy. A part of this transition is the thermal energy transition which entails making the built environment natural gas-free. The goal is to make 1.5 million homes more sustainable by 2030 and disconnect them from the natural gas grid by 2050. The densely populated and intertwined residential areas in the Netherlands makes the thermal energy transition technical and societal challenging.

The Netherlands has high residential density and there are (potentially) sufficient heat sources available to provide a large number of houses with heat. Therefore, district heating networks are considered valuable for the heat transition. However, for a district heating network to be financially viable, enough users are needed to share the fixed costs. Homeowners connecting their homes to district heating networks can help in reaching enough users of a district heating network to be financially viable and in accelerating the thermal energy transition.

Reasons for this research

Disconnecting a household from the natural gas grid has a significant impact on citizens' lives. This can be an impact physically in their house, financially or in their routine. As a result, citizens may be vocal and opposed to the proposed changes. To make the energy transition successful, it is important to engage citizens.

These homeowners are often critical about connecting their home to the district heating network. Public participation can lead to increased acceptance, better policies and the possibility for citizens to have a voice in the District Heating Network decision making and development. However, there is a risk of certain groups being overrepresented, which can reduce the legitimacy of the process. There is a need for effective and equitable ways to involve citizens in district heating network decision-making and development that identifies the opinion of the citizens in the neighbourhood. The novel Participatory Value Evaluation (PVE) method demonstrates its potential in achieving this objective. However, limited knowledge exists regarding the comparative performance of a PVE and a simpler consultation method in the same context.

Scope of the research

This research focuses on engaging citizens in the decision making of district heating networks in urban areas with existing buildings. It excludes considerations of new construction and project development involving housing associations. The primary objective of this study is to contribute to the existing body of knowledge by providing insights into the different abilities of a Participatory Value Evaluation (PVE) and a general survey with to engage citizens while incorporating the goals of stakeholders involved in the development of district heating networks.

Therefore, the main research question is: 'To what extent do a Participatory Value Evaluation and a survey differ in incorporating the goals and perceived advantages and disadvantages of the involved stakeholders in the decision-making of district heating networks?'

Research approach and methodology

The research approach encompasses multiple components, including 12 stakeholder interviews, the design and use of a Participatory Value Evaluation (PVE) and survey and subsequent analysis. The survey and PVE were even and randomly distributed across 2700 citizens of the neighbourhood Blijdorp in Rotterdam. This led to 138 completed PVE's or surveys. As a last step the results of the two different consultations were analysed in terms of reaching the stakeholders goals.

Results

The research findings indicate that a Participatory Value Evaluation and survey have different results in incorporating the goals of the involved stakeholders. The PVE was able to create more detailed input for the stakeholders and was better in creating understanding of the complexity of the problems the stakeholders are facing. However, it is important to acknowledge that respondents in the PVE took longer to complete the evaluation and the PVE was rated more challenging than the survey. As a result, the response rate for the PVE was only half as much as the survey.

Recommendations

This study provides three recommendations towards practitioners to enhance the effectiveness of participatory evaluations in engaging homeowners in the development of district heating networks. The recommendations focus on professionals that develop PVE's for government organisations and civil servants that want to use a PVE to engage with the community. Firstly, designers of a PVE should carefully consider the trade-off between the difficulty of the consultation and the collected insights. Secondly, implementing a dynamic PVE approach, tailored to respondents' preferences in terms of involvement level, duration, and input types, can increase engagement and reduce drop-off rates. Finally, policymakers should view the PVE as an opportunity for ongoing community engagement. By seeking respondents' consent for future involvement, providing feedback on results, and fostering dialogue, a sense of ownership and collaboration can be established, leading to more impactful and sustainable participatory evaluations. These recommendations contribute to the knowledge on effectively involving homeowners in district heating network development through PVE methodologies.

Scientific contribution

This research contributes to the field of research into public participation in multiple ways. Firstly, the PVE has been applied in a new context. It has been shown that a PVE can be utilised to address the challenges of engaging citizens in the establishment of heat networks. Secondly, most studies on a PVE as a participatory method lack comparative research. This study demonstrates that a PVE and survey have distinct advantages and disadvantages. The identified advantages and disadvantages have been compared to findings from other studies on PVE. While some align with existing research, others present contrasting results.

Further research

For further research, it is recommended to conduct interviews with both completing and non-completing respondents of consultations to gain deeper insights into their perspectives and experiences. Additionally, it is suggested to explore the effects of a dynamic consultation approach that allows participants to determine their desired level of detail and involvement. Such research would provide insights into tailoring consultation processes to meet the preferences of respondents. Moreover, to address selection bias in future studies, it is recommended to improve respondent recruitment methods through strategies such as targeting specific demographic groups or providing incentives. These approaches would enhance the reliability and applicability of research findings.

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1. Introduction

In this chapter, section 1.1 provides an overview of the context, while section 1.2 discusses public participation in the energy transition. Section 1.3 introduces the method of Participative Value Evaluation (PVE), followed by the discussion of the knowledge gap in section 1.4, and the formulation of the research questions in section 1.5. The structure of this thesis is outlined in Section 1.6. Additionally, section 1.7 highlights the relevance of this study to the field of Construction Management and Engineering and section 1.8 introduces the hosting company for this research project.

1.1 Context

The transition to a low-carbon economy, also known as the "energy transition", is a critical step in addressing the global threat of climate change. One key aspect of this transition is the thermal energy transition which focusses on making the built environment natural gas-free. The will to become independent from Russian gas and the high energy prices make the thermal energy transition even more relevant.

The government of the Netherlands has committed itself in the National Climate Agreement goals to making 1.5 million homes more sustainable by 2030, the goal for 2050 is that all the homes are disconnected from the gas grid (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2022a). To reach the goal of 2030, municipalities have policies in place that aim to insulate 620,000 homes and disconnect 880,000 homes from the natural gas grid (De Jonge, 2022).

Implementing these plans brings forward multiple challenges on a technical but also societal level. This is partly because the Netherlands is densely built-up and energy systems are heavily intertwined in existing built environments (Lund et al., 2012). But also, because disconnecting a home from the natural gas grid impacts the way citizens live to a large extent. The impacts are so big because either citizens need to organise a technical solution themselves and invest in it (Hoving & Eigen Huis, 2022), they need to switch to a heat grid operator and pay for the connection costs or they need to start or join an energy cooperative to organise a collective way to provide energy for their neighbourhood (*Wat Is Een Energiecoöperatie - Energie Samen*, n.d.). As a result, homeowners are often very vocal about the thermal energy transition and sometimes strongly opposed to the proposed changes.

1.2 Public participation in the energy transition

According to the Netherlands Environmental Assessment Agency (Planbureau voor de Leefomgeving), citizen engagement is considered necessary for the development of a better, more effective, and equitable environmental policy. The active participation, ideas, and commitment of citizens, along with societal support and acceptance of policies, are essential for addressing the significant transformation challenges faced by the Netherlands in becoming future proof. This engagement is crucial for various areas such as achieving fossil-free energy, climate adaptation, addressing housing shortages, and promoting nature-friendly agriculture. By involving citizens in decision-making processes, policymakers can benefit from diverse perspectives and collective

intelligence, leading to the development of more robust and sustainable solutions for the complex societal challenges at hand (Plan bureau voor de Leefomgeving, 2023).

In the vision of the Dutch government, citizen engagement plays a significant role in the energy transition. Minister Rob Jetten aims to provide better clarity for the Dutch population and strives for increased predictability and coherence nationwide. Moreover, he emphasises the importance of embracing new forms of participation that can effectively involve diverse groups of citizens. Recognising that 'the citizen' is not a homogeneous entity, it becomes crucial to address individual differences when designing, organising, and implementing participatory processes. Minister Rob Jetten emphasises his commitment to engaging a diverse range of citizens in every policy process or project. Furthermore, he highlights the importance of involving young people in the energy transition and emphasises his efforts to engage youth through digital participation, serious games, and other suitable approaches.

1.3 Participatory Value Evaluation

The National Government's Policy and Regulatory Knowledge Centre mentions a novel approach to engage large groups of citizens and evaluate policy options. This method, known as Participatory Value Evaluation (PVE), is aimed at facilitating citizen participation in decision-making processes. The Policy and Regulatory Knowledge Centre highlights:

"Participatory Value Evaluation (PVE) is a novel method for evaluating policy options and facilitating the participation of large groups of citizens. The essence of a PVE lies in providing citizens with an accessible way to provide advice on a government's decision-making question. They are metaphorically placed in the seat of the decision-maker. In an online environment, they can see the choices facing the decision-maker, along with a comprehensive overview of the specific advantages and disadvantages (or effects) of the available options and any constraints (such as limited budget or mandatory goals) in place. Subsequently, they are asked to provide their advice to the decision-maker. Finally, citizens articulate their choices, thereby providing a clear understanding of their preferences and considerations." (*4.2 Overzichtspagina Analyse-methoden | Kenniscentrum Voor Beleid En Regelgeving*, n.d.). (Translation by the author)

Mouter et al. (2021) use the PVE method to facilitate public participation on a large scale. The authors signal concerns among elected officials regarding the representativeness in public participation practices. Their objective is to address the limitation of an overrepresentation of individuals who perceive the issue as directly impacting their interests. Their developed solution is an online PVE where a diverse group of citizens can provide advice to the government. To investigate the working of this solution, the study conducted a real-world experiment in the Netherlands to explore how PVE could effectively engage citizens in the energy transition. By aligning the PVE with stakeholder goals, the study achieved three out of five defined objectives, including facilitating participation of underrepresented groups, minimising time investment for civil servants, and producing decision-relevant outcomes. Partial success was observed in increasing citizens' awareness of energy transition decisions and ensuring meaningful

participation. The findings contribute to understanding the potential of PVE as a tool for effective citizen engagement in policy-making processes.

1.4 Knowledge gap

The question at hand is to what extent these successes are attributed to the nature of the Participatory Value Evaluation (PVE) or simply to the fact that it is an online consultation. Limited knowledge exists regarding the effects of a PVE as opposed to an online consultation that seeks input on the same topics in a shorter period. It was observed that participating with a representative group of citizens is important for multiple stakeholders in the energy transition. At the same time there is proof that online forms of public participation can have positive outcomes. However, no evidence is there how the characteristics of an online consultation influence the representativeness and the quality of the advice given. Therefore, it is relevant to examine the differences in effects between a more extensive form of online public consultation, namely PVE, and a simpler form of public consultation, such as a survey.

1.5 Research questions

This chapter aims to formulate the research questions. First, the main research question is explained. Lastly, the sub-questions needed to answer the main research question are shown.

Main research question

The Netherlands is facing a significant challenge in transitioning to a low-carbon economy. A part of this transition can be realised in connecting privately owned houses to district heating systems. The use of the new method PVE demonstrates its potential to engage a large group of citizens in this decision-making processes. Further investigation is needed to compare the effects of a PVE to those of a survey. Therefore, the main research question is:

'To what extent do a Participatory Value Evaluation and a survey differ in incorporating the goals and perceived advantages and disadvantages of the involved stakeholders in the decision-making of district heating networks.'

Sub-questions

To answer this research question, four sub-questions have been formulated. They are presented in this section.

Understanding what information implementers need from citizens to disconnect houses from the natural gas grid is essential for conducting this research. By identifying for heat network operators, municipalities, public participation experts and thermal energy transition advisors what goals they have for the public participation in the development of heat networks, design input for the PVE can be made. Next to that information about the perceived strengths or weaknesses of the use of PVE in this field can aid in the design process of the PVE. Therefore, the first sub-question is:

Sub question 1: 'What are the goals, perceived strengths and weaknesses of using a Participatory Value Evaluation for the development of district heating according to stakeholders?'

In the PVE citizens are asked to evaluate different policy options from the viewpoint of the governmental organisation. For the design of the PVE it is crucial to know what kind of policy options need to be evaluated. Therefore, the second sub-question is:

Sub question 2: 'What are relevant questions to ask citizens to advise on in a Participatory Value Evaluation and a survey about the development of district heating in their neighbourhood?'

It is interesting to understand is how citizens value the different consultation methods. Insights into this could possibly help in improving the methods in the future. The third sub-question is:

Sub question 3: 'What is the experience of citizens in the use of the Participatory Value Evaluation and survey in terms of representativeness, completion time and perceived quality?'

It is essential to examine who the PVE and survey differ in creating valuable input for the stakeholders. This examination can aid in evaluating the extent to which the PVE and survey has met its intended goals and objectives. Furthermore, any discrepancies between perceived strengths and weaknesses and actual outcomes can provide valuable insights into the perceptions and understanding of stakeholders regarding the PVE and its possible use. Therefore, the last sub-question is:

Sub question 4: 'How do the Participatory Value Evaluation and survey differ in creating valuable input for the involved stakeholders?'

The sub-questions outlined above provide a basis for addressing the main research question. The methods employed to address these sub-questions and ultimately answer the main research question is discussed in detail in chapter 3 of this thesis.

1.6 Thesis outline

In this section, the structure of the thesis is discussed. The main research questions and their corresponding sub-questions are ultimately answered in Chapter 7. To arrive at these answers, the sub-questions are addressed and answered across different chapters. The contextual framework of this study is presented in Chapter 2, the literature review. The methodology used is explained in Chapter 3. The first sub-question is addressed in Chapter 4, the interview results. This chapter presents and analyses the outcomes of the stakeholder interviews. The second sub-question is addressed in Chapter 5, building upon the information gathered from the interviews and the literature review. In Chapter 5, the considerations and designs of the PVE and survey are presented. The third and fourth research questions are addressed in Chapter 6. In this chapter the experiences of

the respondents in the PVE and survey are examined and the inputs provided by the different methods are analysed. Lastly in Chapter 7, the findings are discussed and the conclusions are presented. A graphical representation of the distribution of questions across chapters is shown in Figure 1.

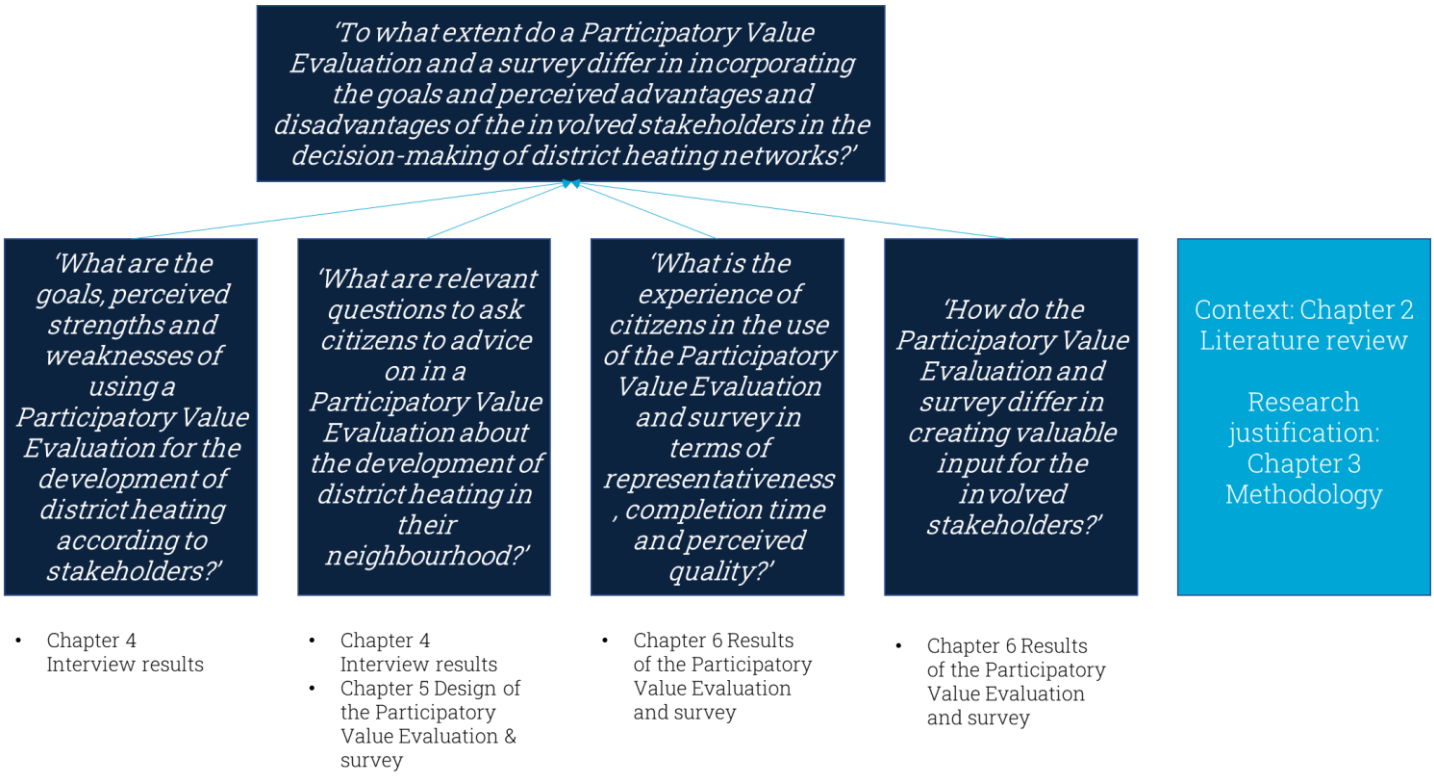

Figure 1 Graphical representation of structure of the thesis

1.7 Relevance for the MSc Construction Management & Engineering

This thesis is relevant to the study of Construction Management and Engineering (CME) because it aligns with the program's goals and focus. CME aims to address the need for change in the construction industry by preparing students for the complexities of managing large engineering projects. This research directly contributes to this by exploring the potential of the Participatory Value Evaluation (PVE) method in engaging citizens in construction decision-making. By comparing the effects of PVE with traditional survey methods, this study provides insights into how participatory approaches can improve collaborative design, project management, and stakeholder involvement in construction projects. This research aligns with the CME programme by showcasing innovative practices usable in the construction industry and their application in real-world scenarios. Furthermore, this thesis demonstrates the integration of engineering knowledge, management skills and legal aspects, which are crucial for success in construction projects.

1.8 Introduction to Populytics

The startup company Populytics serves as the host organisation for the execution of this thesis. The company originated as a spin-off from TU Delft in 2020. Populytics is dedicated to fostering citizen engagement in the creation of government policies.

With three core pillars, Participation, Evaluation and Communication Populytics employ structured and efficient methods to involve a large and diverse group of residents in addressing various societal issues. Populytics conducts evaluations to analyse which choices align best with residents' preferences and the value considerations crucial to the given issue. PVE is one of the methods they use in their evaluations and participation projects. Their comprehensive analyses offer overview of residents' values, preferences, and beliefs regarding the specific matter. Furthermore, effective communication strategies employed by Populytics facilitate mutual understanding, as residents immerse themselves in complex issues, fostering empathy and comprehension of policy dilemmas. Simultaneously, the residents' insights assist policymakers in better empathising with the residents' perspectives.

During the execution of the thesis project, there will be ongoing communication with the employees of Populytics to enhance the quality of the thesis. Consideration will be given to how the content of this thesis can contribute both to the academic domain and to the company Populytics. Given that the activities of Populytics are founded on scientific research to engage citizens, and their work closely aligns with the academic domain, it is not anticipated that this collaboration will pose any issues.

2. Literature review

2.1 Policy plans and frameworks for the energy transition

At different levels of government, policies are developed to guide the thermal energy transition towards a natural gas free energy system in 2050. These policies start very broadly with national targets and become increasingly specific to plans on how neighbourhoods can be made natural gas-free.

2.1.1 National plans

At the national level, the national climate agreement states that the municipalities are taking the lead in disconnecting 1.5 million homes from the natural gas grid before 2030 and all houses before 2050 (Ministerie van Econonische Zaken en Klimaat (EZK) et al., 2019). In this agreement, municipalities are not assigned a specific number of houses that need to be disconnected (Programma Aardgasvrije Wijken, n.d.-c.). The Programme Natural Gas Free Neighbourhoods also facilitated Natural Gas-Free pilot projects where municipalities got the opportunity to pioneer and experiment with a neighbourhood to make them gas free (*Proeftuinen Op De Kaart - Programma Aardgasvrije Wijken,* n.d.). In addition, at the national level, there is the National Insulation Programme where the goal is to insulate 2.5 million homes in the period up to 2030. With a focus on the 1.5 million poorly insulated houses that have label E, F and G (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2022b). Lastly, from 2026 on, there is also the obligation for citizens to move to a sustainable form of heating their house when replacing their central heating boiler. The most promising options for this include a hybrid heat pump, full electric heat pump or connecting to a district heating network (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2022c).

2.1.2 Regional plans

At the regional level, Regional Energy Strategies are developed, as part of that the Regional Strategy Heat is developed which is of most importance for the local thermal energy transition (Verboom & Regionale Energiestrategie, n.d.). In the Regional Structure Heat, it is ensured that unique heat sources are not used twice in different (local) Heat Transition Visions of two different municipalities, and all heat sources are taken into account.

2.1.3 Local plans

At the local level each municipality is required to develop a Heat Transition Vision and neighbourhood implementation plans. Some municipalities decided to facilitate a Natural Gas Free Pilot project with the funds made available by the Programme Natural Gas Free Neighbourhoods. Next to these national coordinated or mandatory policy plans, municipalities often have additional policy plans to govern and facilitate the thermal energy transition.

Transition Vision Thermal Energy

The Heat Transition Vision describes the prioritisation for the disconnection of the natural gas grid for all the neighbourhoods. Furthermore, it describes the possibilities for each neighbourhood to be disconnected from the natural gas grid.

In a Letter to Parliament, Minister De Jonge (2022) stated that the current Heat Transition Visions are planning to make over 1.5 million houses more sustainable by 2030. The planning is that 660,000 houses are thermally insulated and 820,000 are disconnected from the natural gas grid. The plans also describe how houses will be disconnected from natural gas. These ways differ from different variations heat networks, individual heat pumps or green gas variants.

Neighbourhood implementation plans

The neighbourhood execution plans describe in more detail which solution is selected and how this will be implemented. According to this background note (Ministerie van Economische Zaken en Klimaat, 2019a) and the webpage about the neighbourhood execution plans (Wat Is Een Uitvoeringsplan? - Programma Aardgasvrije Wijken, n.d.) the implementation plan serves as a concrete follow-up step of the heat transition vision and outlines how the municipality intends to execute or coordinate the neighbourhood-oriented approach in specific neighbourhoods or districts. The background note highlights that the implementation plan presents the sustainable alternatives to be adopted by one or more neighbourhoods, along with the timeline and necessary measures to achieve the desired situation. Additionally, the background note emphasizes that the systematic insulation of residential and other buildings may be included within the neighbourhood execution plans. It further states that the implementation plan provides an extensive overview, outlining the collective steps to be taken by various stakeholders to realise the insulation strategy and/or the chosen alternative to natural gas for a particular neighbourhood or district. The background note emphasizes the collaborative nature of the implementation plan, which is developed in cooperation with residents, building owners, and stakeholders such as network operators and housing corporations.

Natural Gas-Free pilot project

Municipalities were also given the chance in 2018 to start with a neighbourhood as a Natural Gas-Free pilot project to pioneer in the thermal energy transition. There was guidance and funding available from the Natural Gas-Free Neighbourhoods Programme. There are 66 active pilot projects.

2.2. Techniques for heating residential buildings

For large parts of the Netherlands, where residential density is high and heat sources are present, heat networks are considered to be the cheapest way to achieve the thermal energy transition (Rijksdienst voor Ondernemend Nederland, 2019). In the national policy program on accelerating sustainability of the built environment (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2022d) the goal is stated to realise 500,000 district heating connections before 2030. On a local level, the Expertise Centrum Warmte (2022) collected all the available Transition Visions Heat of the municipalities and created an overview of the chosen technology for residential areas. They identified that

of all the plans that present a solution, 54.3% indicates that the preferred solution is a district heating network or a combination of a district heating network and another technology.

For the development of a district heating network, a sufficient amount of clients of the potential network are needed to share the fixed costs and make the heat network financially viable (Expertise Centrum Warmte, 2021). The reason for this is because the fixed costs are relatively high and the variable costs per connection are relatively low.

The assumption that homeowners choose to join a heat network as soon as it is cheaper than their current option of heating their house is not always true. This is because citizens often do not choose the option that provides them with the most material value (Frederiks et al., 2015). It can be the case that people do not want the hassle to change to a different system or that they just do not recognise what material value a certain option can bring. For every household that does not opt-in for connecting to the heat network the costs per connection rises. This results in a price increase for the citizens that do want to connect to the heating grid. If this increase becomes too high, the proposition for connecting to the heat grid gets less attractive. Probably increasing numbers of citizens will decide not to connect to the district heating network. The end result could potentially be that the heat system operator will not be able to construct a grid because he cannot spread fixed costs over a large enough number of customers.

Housing associations and system operators or local heat companies often work closely together in the development of district heating networks (Heeger et al., 2022). The reasons for this, is that they own 29% of the houses in the Netherlands and these homes are often in densely populated areas and are clustered together (Centraal Bureau voor de Statistiek, 2022). This makes these homes suitable for connecting to a district heating network. Together with the possibility to negotiate with one stakeholder about connecting multiple homes to a district heating network makes them an interesting partner in the development of district heating networks.

Next to this, the housing associations and five heat companies made agreements through the so-called Start Motor Framework to connect 55,000 houses to district heating networks (Ministerie van Economische Zaken en Klimaat, 2019b). The agreement was created through a collaboration between Aedes, on behalf of more than 30 housing associations, and the heat companies Eneco, Vattenfall, Ennatuurlijk, Stadsverwarming Purmerend and HVC. The framework provides tools for housing corporations and heat companies to reach an agreement on connecting homes to a heat network more quickly at local level.

However, the type of owner that owns most of the houses in the Netherlands are the private homeowners. They own 57% of the homes in the Netherlands (Centraal Bureau voor de Statistiek, 2022). This makes private homeowners an important partner to reach the goal of disconnecting 1.5 million houses of the natural gas grid before 2030. The dialogue about switching to a district heating network with the homeowners is different from the negotiations with the housing associations. This is partly caused because for every connection a separate agreement needs to be made.

2.3. Involving citizens in the thermal energy transition

The importance of public participation in the thermal energy transition, has been widely acknowledged in the academic literature. However, a systematic method for facilitating public participation in the development of district heating networks has yet to be implemented.

The Natural Gas-Free Neighbourhoods Programme recommends involving citizens in drawing up neighbourhood implementation plans. The reason given for this is a combination of instrumental, substantive and normative motivations (Programma Aardgasvrije Wijken, n.d.-b). These rationales are further elaborated on in 2.3.1.

In the heart of the national democracy there is also attention for public participation, at the request of the House of Representatives, a study (Brenninkmeijer et al., 2021) has been conducted on the possibilities of using a citizens' forum in the energy transition. In this study it is recommended to give citizens more of a voice so that more widely supported climate policies can be made. A citizens' forum is an example of a mini public where a group (20-250) of randomly selected citizens discuss about a political topic to formulate policy recommendations (Itten & Mouter, 2022). On the other hand, there are maxi publics which are open for everyone who want to participate. A participation method that is focussed on a maxi public is more inclusive although often implemented on a larger scale, resulting in a reduction of nuanced discussions and interactions.

2.3.1. Rationales for citizen involvement

The rationales for public participation can be divided into three different categories, namely instrumental, substantive and normative (Mouter et al., 2021). When a governmental organisation decides to employ public participation in decision-making processes, it is likely driven by one of those rationales. Those three rationales can also be found in the thermal energy transition, this is described in the next paragraph.

The motivation to use public participation in policy making is instrumental if a certain goal needs to be realised, for example creating more support the policies that a municipality wants to implement (Liu et al., 2019). Since there are ambitious goals in place and the success depends partly on the willingness of citizens to switch to new energy solutions, it can be expected that governmental organisations use public participation to increase the support for the Heat Transition Visions.

If the rationale for public participation is to make better policies this can be described as a substantive rationale (Beierle, 2005). In the making of the plans for the thermal energy transition insights obtained from citizens can help in making sound policies. Examples can be information about the insulation of houses, problems in the neighbourhood that can be coupled in policy plans or existing heat sources that are forgotten by the municipality.

The normative rationale for public participation means that it is believed be the democratic thing to do (Delgado et al., 2010). By asking input from affected citizens, they get involved in a directly democratic way. For the thermal energy transition, this rationale can be present because this transition will have a great impact in the houses

and therefore lives of citizens and politicians and administrators think that they should be able to influence these policies.

2.3.2. Challenges with regard to involving citizens

However, the use of maxi publics in public participation can lead to poor representation of those who are the subject of policies. People who are better at making themselves heard and standing up for their own interests are often overrepresented in offline public participation (Innes & Booher, 2005). Over the years a lot of studies have proven that a certain group was overrepresented. Verba et al. (1978) discovered that there was no equality between men and women in political participation. According to Hartmann (1998), in traditional public participation practices there was an overrepresentation of environmentally concerned citizens. More recently Hendriks (2008) discovered that there is still an overrepresentation of men and older citizens in public participation.

Contrarily, there are instances where inclusive public participation has been implemented. An example where the use of a mix of traditional and innovative participation methods led to an inclusive participation is the envisioning of the 2035 strategy of a city in Australia (Cochrane, 2015). There are also examples of public participation in the energy transition where an attempt at more inclusive participation is known.

2.4. Participatory Value Evaluation in the energy transition

The PVE is acknowledged as a useful tool to engage with citizens when shaping a low carbon heated community. Itten et al. (2020) describe the use of a PVE in this context in the work package 2 (WP2) as part of the SHIFFT project. This is an Interreg 2 Seas project that focuses on cross-border cooperation between the Netherlands, France, Belgium, and the United Kingdom. The project aims to promote the adoption of low-carbon heating technologies in existing buildings. It consists of three technical work packages (WP) that explore different approaches to achieving this objective. The WP2 focusses on attaining the highest level of community involvement in the creation of local low carbon heating solutions. In this light, they also indicate that the PVE can be a useful addition to engage residents in the thermal energy transition.

An example where researchers use the PVE in the thermal energy transition is in Utrecht, the Netherlands. Mouter et al. (2021) used a PVE to incorporate the needs of the citizens in the Heat Transition Vision. The respondents could allocate points to the four policies, which are; 1) low cost strategy; 2) hands off strategy; 3) strategy that maximises CO_2 reduction; 4) strategy which starts the thermal energy transition in the more affluent areas.

In the study of Mouter et al. (2021) five goals were formulated together with the civil servants from which the researchers successfully achieved three goals. Those goals were engaging respondents that normally do not participate (especially younger citizens), little time investment of civil servants and outcomes of a PVE that are useful for decision-making. Two goals were partly achieved. Those goals are that the PVE

increases awareness about decisions and implications regarding the energy transition and that participation should be meaningful to citizens.

The researchers also discovered that only 3% of the respondents thought that the municipality should not involve the public in the selection of the strategy for the phasing out of the natural gas. Next to that they found that 69% thought that the municipality should use the PVE more often in making policy decisions and 10% answered that they did not thought this was a good idea.

In another study involving citizens in local energy policy, a PVE with a climate assembly (Itten & Mouter, 2022). The authors discuss the use of climate assemblies and other forms of mini-publics to involve citizens in climate policymaking and address political challenges. To overcome potential issues such as co-option and losing touch with the broader public, the article suggests combining synchronous deliberations of small citizen groups with online participation procedures for a larger audience. The authors present a three-step combination model implemented in Súdwest-Fryslân (NL), where a mini-public drafted policy alternatives, which were then presented to the wider public through a digital participation tool. The outcomes were translated by a citizens forum into policy recommendations, ultimately approved by the municipal council. The paper examines the findings and evaluates the strengths and weaknesses of this combined approach to participatory decision-making.

Hossinger et al. (2023) investigated citizen preferences for climate policies in the transport sector. Using a PVE, respondents were able to mix different policies to reduce CO2 emissions. The study found that respondents favoured well-balanced policy bundles and achieved significant CO2 reduction. Factors such as car affinity, self-concern, political trust, solidarity, fairness, and climate concern influenced policy choices. The research offers insights for policymakers on decision-making tools and effective policy bundles. The researchers demonstrated the applicability of the Public Value Evaluation (PVE) in various domains in the energy transition.

The research of Juschten & Omann (2023) evaluates the PVE based on the CRELE framework. This framework assesses the tool's scientific credibility, political and societal relevance, and societal legitimacy. A qualitative content analysis of 601 open text survey responses, supplemented by descriptive statistics of the survey participants, reveals that the PVE is a credible, relevant, and legitimate tool for assessing policy options. Participants appreciated its ability to effectively visualise the impacts of selected policies, increasing awareness of climate change and the need for policy action. However, there were mixed views regarding the social fairness of the included measures and the preferred complexity of the tool.

3. Methodology

The aim of this chapter is to present the research methods that will be used to answer the main research question and the sub-questions. In 'Literature research' (3.1), 'Interviews' (3.2), 'Design of the PVE and survey' (3.3), 'Conducting the PVE and survey' (3.4) and 'Analysis of the PVE and survey' (3.5) it is explained how the different methods will be used to answer the corresponding question or questions. In Table 1 the research questions and the corresponding methods are shown.

Table 1 Research questions and corresponding methods

Question	Method
MRQ: 'To what extent do a Participatory Value Evaluation and a survey differ in incorporating the goals and perceived advantages and disadvantages of the involved stakeholders in the decision-making of district heating networks.'	Combination of all the methods below
SQ1: 'What are the goals, perceived strengths and weaknesses of using a Participatory Value Evaluation for the development of district heating according to stakeholders?'	Literature research & Interviews
SQ2: "What are relevant questions to ask citizens to advise on in a Participatory Value Evaluation and a survey about the development of district heating in their neighbourhood?'	Literature research, interviews and design of the PVE and survey
SQ3: 'What is the experience of citizens in the use of the Participatory Value Evaluation and survey in terms of representativeness, completion time and perceived quality?	Conducting the PVE and survey and result analysis
SQ4: 'How do the Participatory Value Evaluation and survey differ in creating meaningful input for the involved stakeholders?'	Conducting the PVE and survey and result analysis

3.1. Literature research

This study employed an exploratory and iterative approach to conduct a literature review on the chosen topic. The goal was to gather relevant information and insights by utilising a combination of search strategies and online resources. The following steps outline the methodology employed in this exploratory literature research:

Initial Search

The literature search process began with conducting initial searches using general keywords and phrases related to the research topic. This involved using search engines and academic databases to explore a wide range of sources.

Snowballing Technique

The snowballing technique, including both backward and forward snowballing, was employed to expand the scope of the literature search. Backward snowballing involved examining the reference lists and bibliographies of the identified sources to identify additional relevant studies and sources. This process helped to uncover works and key references that were not captured through the initial search. Forward snowballing, on the other hand, involved exploring the works that have cited the identified sources to find newer publications and research that built upon the existing knowledge. This iterative process of snowballing allowed for the discovery of additional scholarly resources that may not have been easily accessible through traditional search methods.

Iterative Searching

Based on the initial search results and needed information for the research further searches were conducted iteratively by using new keywords, related terms, and variations to refine the search and discover additional relevant sources. This iterative process was repeated multiple times to gather a diverse range of information.

Information Synthesis

The information gathered from various sources was synthesised by organising and categorising the findings based on relevant themes, concepts, or arguments. This process involved identifying commonalities, contradictions, and gaps in the literature to develop a comprehensive understanding of the research topic.

Critical Analysis

The gathered information was critically analysed to evaluate the credibility, reliability, and relevance of the sources. The researcher considered the authority of the authors, the publication venue, and the supporting evidence presented in the literature to assess its quality and validity.

3.2. Interviews

The goal of the semi-structured interviews is to find goals and perceived advantages and disadvantages for the design of the PVE. There will be interviews with civil servants of a municipality, employees of heat grid operators, municipal council members, energy cooperatives and energy transition public participation experts. The goal is to interview at least two persons of each organisation or category. Preferably they are interviewed at the same time to ensure the interview is about the preferences of the organisation instead of the personal preferences of the interviewee.

Table 2 Interviewees, requirements and ways to find them

Interviewees	Requirements	How to find them?
City council members	Their municipality needs to have plans to develop district heating networks	Via desktop research and/or personal connections

Civil servants of a municipality	Working at a municipality that plans to develop a heat grid in one of their neighbourhoods	Personal connections, connections via Populytics, via interviewed city council members and/or literature research
Employees of heat grid operators	Involved in the development of Currently in the exploratory phase of the development of a heat grid in a neighbourhood	Via Populytics and/or personal connections
Energy cooperative employee	The municipality is planning to develop a heat grid in their neighbourhood	Via civil servants/council members, desktop research and/or Populytics
Energy transition Public Participation experts	Involved in district heating network development	Via Populytics and/or desktop research

3.2.1. Structure of the interview

During the interviews a physical or digital collaboration board is used where notes are placed when a goal, advantage or disadvantage is mentioned by the interviewee. The notes will be made in collaboration between the interviewer and interviewee to ensure the note is understood the same by both parties. The identified possible goals, advantages and disadvantage found in the literature study are used to test if the interviewee experiences these. This can be seen as a deductive way of interviewing and interpreting the results.

The interviews are semi-structured, what means that upfront questions are prepared but there is still the possibility to deviate from this during the interview. The interviewer can ask more questions about areas the interviewee seems more interested in and less about areas of less interest. The interview questions are shown in appendix A.

3.2.2. Analysis of the interviews

The info that is structured on the collaboration board is the main input for the design of the PVE. The online interviews are also recorded in Microsoft Teams and automatically transcribed. The interviews that take place physically will be recorded with an audio recorder on the laptop of the interviewer. If goals, advantages or disadvantages that were mentioned in the interview are missing on the board, the recording and transcription can be used to identify the missing goals, advantages or advantages.

The interviews will be recorded and automatically transcribed afterwards. The transcriptions will not be included in the report or the appendices. The main output of the interviews are the post-it's notes collected in the interview. If necessary supporting quotes of the interview can be used in the report. After the thesis the recordings and transcriptions will be deleted. This approach has been tailored to ensure compliance with the Human Research Ethics (HREC) guidelines (Delft University of Technology, 2016) and the General Data Protection Regulations (GDPR) guidelines (Delft University of Technology, n.d.).

The initial phase entails collecting all the post-it notes of different respondents. The answers of all the interviewees were divided in three categories. The categories correspondent with the first sub question and are the goals and perceived advantages and disadvantages. Every respondent will have a unique colour coding scheme. In this way the answers of a respondents can be recognised across different categories. Per category, the input is organised into clusters and analysed. The clusters were selected in way that the main idea of each cluster can be easily summarised in one or two sentences. As a result, there are clusters with around five post-it notes, as well as clusters with more than 15 post-it notes. This clusters are used as input for the design of the PVE and survey.

3.3. Participatory Value Evaluation and Survey

3.3.1. Design of the Participatory Value Evaluation and Survey

In the design phase, the PVE and survey will be formulated by utilising the insights gained from the interviews, adhering to principles of valuable participation, and incorporating structured knowledge about the development of district heating networks. These inputs will also be used to formulate the strategies that respondents of the PVE will evaluate.

The draft PVE and survey will be discussed with experts on public participation as well as the thesis committee. This evaluation will be based on their experiences in public participation, the principles found in the literature where a participation tool should be based on and experiences in scientific research. The recommendations from these sessions will lead to the last adjustment of the PVE and survey.

Following the regular part of the PVE, an evaluation component will be added to assess the effectiveness of the method. This evaluation will include questions designed to test whether the respondents feel that the goals of the stakeholders have been achieved, as well as their perceptions of the PVE process itself, including whether they felt it was an effective way to involve the public in the construction of heat networks.

3.3.2. Conducting the Participatory Value Evaluation and Survey

For the PVE and survey, the neighbourhood Blijdorp in Rotterdam was selected. The reason for the selection of this neighbourhood was twofold. The first reason is that the municipality plans to install a district heating network after 2025. The second reason is that in this neighbourhood, a mix of different nationalities, ages, education levels and family compositions live.

2,700 letters were posted to the homes of residents in Blijdorp. Two types of letters were used for the survey and PVE, although the content of the letters was exactly the same, the link and QR code referenced were different. As a result, the respondents were randomly assigned to either version. The research team does not know which version was delivered to each household, ensuring the random distribution of the letters.

Of the initially distributed 2,700 letters, a total of 48 PVEs and 90 surveys were ultimately completed. The detailed progression can be observed in Figure 2. The residents within

the selected area received a single letter. It is unknown which households responded to the survey and which did not. No reminders were sent to the residents.

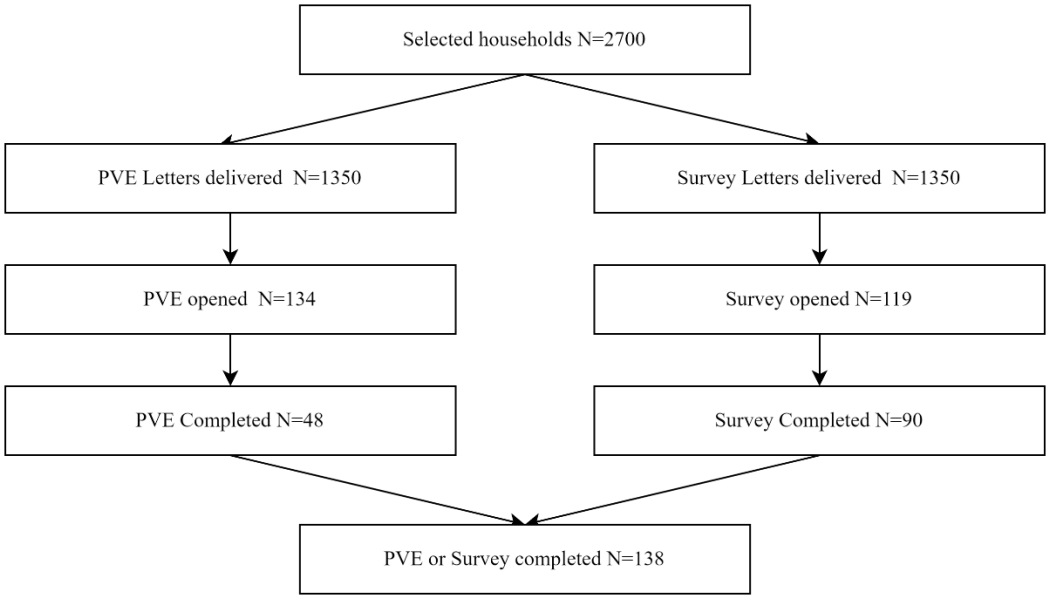

Figure 2 Progression of reactions on PVE's and surveys

3.3.3. Analysis of the Participatory Value Evaluation and survey

The analysis of the PVE and survey includes an examination of the differences in drop-off rate and completion time, representativeness, perceived quality and appreciation, distribution of responsibilities, behaviour before and after the consultation and advice given with the PVE and the survey. This section discusses the tests used to perform the analysis and the conditions that need to be met. The dataset utilised for these analyses consists of the combined completed PVEs and surveys. The analyses are conducted using SPSS.

Differences in drop-off rate and completion time

The drop-off rates and completion time are compared using an independent samples t-test. Additionally, the data is assessed to determine whether it meets the assumptions of the test. The assumptions checked include the normality of distributions and homogeneity of variances. This is accomplished through the use of a QQ plot and Levene's test, respectively.

Differences in representativeness

To analyse the difference in representativeness, six characteristics of the sample are examined: gender, age, education, daily life occupations, net income, family composition, and connectivity with neighbours. An independent samples t-test is performed for each characteristic to assess whether the data meets the assumptions of the test. The assumptions checked include the normality of distributions and homogeneity of variances. This is accomplished through the use of a QQ plot and Levene's test, respectively.

Differences in perceived quality and appreciation.

To facilitate a comprehensive comparison of how respondents perceive the PVE and survey, multiple validity questions were included. These questions serve as an assessment of the quality of the consultation from the respondents' perspective. The same set of questions, presented in an identical manner and order, were used for both consultations, enabling direct comparisons between the two. The specific questions are elaborated upon in the design of the PVE and the survey.

The responses to these questions are compared using an independent samples t-test, with examination of whether the data satisfies the assumptions of the test. The conditions assessed include the normality of distributions and the homogeneity of variances. These evaluations are performed using a QQ plot and Levene's test, respectively.

Differences in distribution of decision-making responsibilities

After respondents complete the divergent section of the PVE or survey, they are asked to indicate which stakeholder should have the most decision-making authority over a specific responsibility. These responses can provide insights into whether individuals perceive different actors as responsible for a particular task depending on whether they are completing the PVE or survey.

Respondents are given the opportunity to allocate four actors to four positions for each responsibility. The actors to be distributed among the positions are: residents of the neighbourhood where the heat network is being developed, the municipality, the (heat) network operator, and the heat supplier. The positions are ranked from highest to lowest responsibility. This question is presented in an ordering format. The allocation of points is outlined in Table 3.

Table 3 Points per place of responsibility

Decision-making authority regarding responsibility 1	Points in the analysis
Most responsibility	4
Second most responsibility	3
Third most responsibility	2
Fourth most responsibility	1

This approach enables the comparison of the two consultations in terms of the level of responsibility assigned by respondents to the stakeholders. For each responsibility and each respondent, each stakeholder is assigned a certain number of points. This allows for the description of the average assigned responsibility position for each actor. However, it is not possible to determine the statistical significance of these differences as the magnitude of the differences between the positions in the ranking is unknown.

Differences of the advice given with the PVE and the survey

Due to the different manner in which the data is collected, a direct comparison cannot be made. In the PVE, a pick mode PVE was chosen, where individuals indicate whether

or not they want to select an option. This choice was made due to the presence of options in the PVE that require a binary selection rather than a gradation. In the survey, respondents are asked to rate the extent to which they perceive an option to be a good idea, allowing for more nuanced responses.

To compare these options, the number of individuals who strongly agree or agree with a measure in the survey is compared with the number of individuals who select the measure in the PVE. This comparison can only be made numerically.

Differences between the PVE and survey method in differences in behaviour before and after the consultation

At the beginning and end of completing the PVE and survey, respondents are asked about their behaviour, and these two can be compared. This allows for an examination of whether the PVE and survey have different effects on survey respondents.

A new variable is calculated based on the difference between the pre- and post-responses provided by the respondents. The levels before and after are assessed on a Likert 5-point scale. Subtracting the level of the question after from the level of the question before yields a new variable.

The difference of this new variable between the PVE and survey group is analysed an independent samples t-test, with examination of whether the data satisfies the assumptions of the test. The conditions assessed include the normality of distributions and the homogeneity of variances. These evaluations are performed using a QQ plot and Levene's test, respectively.

3.4. Validity and reliability of the study

An important aspect regarding the reliability of this study is the presence of selection bias, primarily due to the low response rate. It is possible that participation bias and attrition bias may occur in this study.

Participation bias, also known as non-response bias, occurs when those who do not respond to a survey or research differ from those who do respond in ways that are crucial to the research objectives. This often happens in survey research when respondents are unable or unwilling to participate due to factors such as lack of necessary skills, time constraints, or feelings of guilt or shame related to the topic (Scharwächter, 2023).

Attrition bias, also referred to as selective dropout bias, occurs when respondents who discontinue their involvement in a study systematically differ from those who continue to participate. One reason for this bias may be that respondents who find the experiences unpleasant or challenging may drop out, potentially influencing the results (Bhandari, 2022).

Various measures were implemented to address these challenges. Firstly, a physical letter was chosen over an online distribution method. This was done to ensure that

people with poor digital literacy also could receive the invitation. The language used in the letter was adjusted to a B1 reading level. The vast majority of the population can comprehend texts at B1 level, including individuals without a higher education. A text at B1 level consists of common, easy-to-understand words and is composed of short, straightforward, and active sentences (Ministerie van Algemene Zaken, 2023). Lastly, the timing of the letter's delivery was carefully planned to coincide with the weekend, allowing individuals with weekday commitments to have adequate time to engage with the consultations.

Furthermore, the consultations were written in B1 language as well. The design of the consultations allowed individuals to participate without any prior knowledge of the subject matter. However, it is important to note that the nature of the Participatory Value Evaluation (PVE) format may require respondents to make thoughtful considerations and spend more time reflecting on their responses. As a result, there is a possibility of respondents dropping out, as individuals whose participation preferences do not align with this format may be less inclined to take part.

These potential selection biases may have influenced the representativity of the sample. Stakeholders have expressed concerns regarding the representativeness of the study. Therefore, the representativity is seen as an result of the PVE and survey. This is discussed in Chapter 6.

4. Interview results

This chapter presents results and insights obtained from interviews with various stakeholders involved in the development of district heating networks. The interviews aimed to explore the perceptions, goals, challenges and benefits associated with utilising a Participatory Value Evaluation (PVE) approach to engage private homeowners in the development of district heating networks.

At the end of each interview, a workshop session was conducted, during which respondents were asked to create post-it notes highlighting the goals, challenges and benefits of using a PVE in involving private homeowners in district heating network development. These workshop responses were then clustered and analysed. A colour-coding system (Figure 3) was used to distinguish the different interviewees.

The following sections present the clustered findings derived from the workshop responses. The analysis focuses on identifying common themes, understanding variations in viewpoints among different stakeholders, and exploring the implications of these insights for effectively engaging private homeowners in the development of district heating networks.

By examining these stakeholder perspectives, this chapter aims to shed light on the perceived benefits and challenges of employing a PVE approach in engaging private homeowners. Understanding the diverse viewpoints and experiences of the stakeholders provides valuable insights that can shape future strategies and initiatives aimed at fostering meaningful and inclusive community involvement in the transition to district heating networks.

Figure 3 colour coding system for the interviewees in the interview boards

4.1. Stakeholder goals for using Participatory Value Evaluation

Gathering input from citizens

During the interviews, stakeholders from various categories expressed their goals regarding the development of a district heating network. They stressed the importance of gathering input from citizens and obtaining information about their perspectives. It was noted that the specific information sought from residents may vary among stakeholders, reflecting different objectives. Furthermore, a representative from an energy cooperative acknowledged the significance of mapping the input from residents, going beyond mere information gathering. Their principle is that citizens should determine the design and structure of the district heating network. The reason given for gathering input is to ensure that it can be incorporated into policy-making and tailored offerings for the benefit of residents.

These goals encompass several key aspects. First, stakeholders want to understand residents' perspectives and preferences to gain insight into how they see the development of the district heating network. By involving residents and considering their input, stakeholders aim to make decisions and adjust policies based on their feedback. This collaborative approach aims to determine which parts residents want to be involved in and what they find important. Gathering input from residents helps stakeholders tailor their plans and offerings to meet the community's needs and aspirations. Additionally, stakeholders aim to uncover residents' underlying motivations for connecting or not connecting to the district heating network and gather their views on the pros and cons of such a connection.

Figure 4 Stakeholder goal: Gathering input

Creating awareness and understanding

Stakeholders from various groups have expressed the importance of creating awareness and understanding of dilemmas related to the development and operations of district heating networks. They believe that utilising a Participatory Value Evaluation (PVE) can provide valuable insights to citizens, enabling them to comprehend the challenges, dilemmas, and consequences associated with the thermal energy transition.

By actively involving citizens in this process, they can not only make choices that align with their long-term interests but also contribute informed perspectives and advice, having a deeper understanding of the societal challenges at hand. This active participation empowers citizens and allows them to feel a sense of ownership in shaping the transition.

During stakeholder interviews, several key points emerged regarding the importance of informing and involving residents in the context of district heating networks. Stakeholders stressed the significance of providing information about the different choices available in relation to district heating networks, along with highlighting the environmental benefits associated with such networks. They also emphasised the need to explain the rationale behind decision-making and the necessity of making choices. Furthermore, stakeholders underscored the importance of encouraging residents to think critically and consider factors beyond technical aspects and costs.

By providing insights into both the positive and negative effects of district heating networks, residents can better understand the consequences of their choices and develop a broader understanding of the overall transition process. Additionally, stakeholders emphasised that effective communication efforts in this regard fosters understanding and support for policymaker decisions while also serving as a means to raise awareness and engage the public on the topic. Overall, stakeholders believe that these efforts not only inform and create awareness but also prompt individuals to actively make choices and consider the impact of their decisions.

Figure 5 Stakeholder goal: Creating awareness and understanding

Division of responsibilities and roles

Five stakeholders highlight that a primary objective of Participatory Value Evaluation (PVE) can be to understand the preferences of citizens in terms of the division of responsibilities and roles. This understanding enables stakeholders to be more supportive and take a more active role in a neighbourhood. If a neighbourhood shows a preference for cooperative initiatives, it is important to create opportunities for such initiatives. This issue is relevant because Minister of Economic Affairs and Climate Policy mr. Rob Jetten stated that at least 51% of district heating networks should be owned by the public (*Het Jetten-proof Warmtenet: Verschillende Vormen Om De Governance Te Organiseren*, n.d.). There are still various ownership options available, such as a combination of cooperative, public, and private ownership of infrastructure, or the separation of infrastructure and heat supply, which allows for different ownership arrangements within the heat supply sector.

Stakeholders stress the importance of presenting various options and involving residents in the decision-making process. By clearly explaining different actors and their responsibilities, citizens can gain a better understanding of the challenges and complexities associated with the thermal energy transition.

Figure 6 Stakeholder goal: Division of responsibilities and roles

Individual choice versus collective heat supply

Maintaining a natural gas network for a limited number of gas connections presents financial challenges, as revealed in interviews conducted with various stakeholders. The cost structure of a network involves fixed costs that are spread across the customer base. However, with a decrease in the number of connections, these fixed costs become distributed among a smaller group of users. This results in a potential increase in fixed fees for each customer or the need to socialise the costs. Therefore, the economic viability of sustaining a gas network for a small customer base becomes a matter of concern.

To address this issue, stakeholders emphasise the potential cost-saving benefits of compelling the remaining natural gas users to transition to alternative energy sources. By discontinuing gas services to a small group of customers, the expenses associated with maintaining the gas network could be reduced or eliminated altogether. This approach aligns with the broader objectives of achieving energy transition goals and improving overall system efficiency. However, it also raises important considerations regarding individual freedom of choice versus collective decision-making and cost-sharing.

Considering the upcoming legislation that empowers municipalities to enforce the transition away from gas for residents, stakeholders want to know how individuals perceive the use of such regulatory measures. This possible shift towards a more coercive approach raises questions about the acceptance, willingness, and attitudes of residents towards mandatory transitions. Exploring the public's perception of this instrument can provide insights into the societal implications, potential challenges, and opportunities for effective implementation of the energy transition policies at the local level. By considering the perspectives of residents, policymakers can make informed decisions and develop strategies that strike a balance between individual choices and the collective goals of sustainability and energy efficiency.

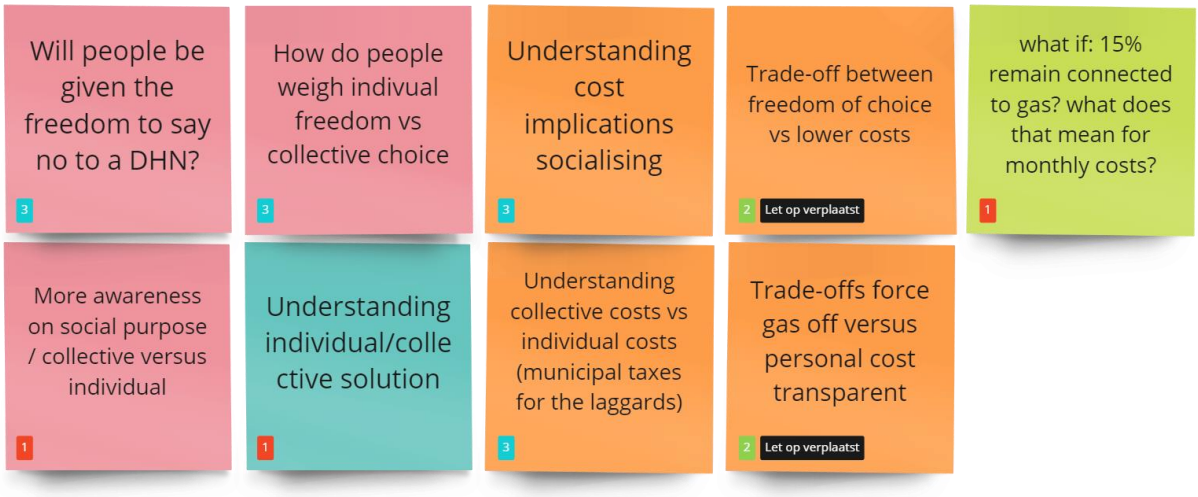

Figure 7 Stakeholder goal: Individual choice versus collective heat supply

Thermal Insulation

Two stakeholders emphasised the importance of incorporating questions related to insulation in the Participatory Value Evaluation (PVE) process. They highlighted that one of the goals of the PVE should be to provide citizens with insights into the effects of insulation.

The stakeholders expressed their desire to enhance citizens' understanding of various aspects related to insulation. This includes the cost-benefit analysis of insulation, highlighting the potential energy savings resulting from effective insulation measures, and fostering awareness that the degree of insulation directly impacts the desired comfort levels within their house and costs regarding the heating of their house. This enhanced understanding can enable residents to make more informed decisions and actively engage in the development of district heating networks with a greater awareness of the role of insulation in achieving their desired comfort and energy efficiency goals.

Figure 8 Stakeholder goal: Thermal Insulation

Additional technical aspects

In addition to their focus on citizen engagement in the development of district heating networks, three stakeholders identified several other technical aspects that they believe

should be addressed within the Participatory Value Evaluation (PVE). These stakeholders recognised the significance of including citizens' input on various technical details related to the district heating network.

The first aspect highlighted by the stakeholders is the sustainability of energy sources. They believe that citizens should have the opportunity to provide advice and insights regarding the environmental impact and long-term sustainability of the energy sources used in the district heating network.

Furthermore, stakeholders stressed the importance of citizen input on the optimal temperature levels and heat distribution strategies. They recognise that citizens' preferences and requirements may differ, and therefore, involving them in decisions about the temperature levels and heat delivery methods can ensure the system aligns with their needs and expectations.

Another technical aspect highlighted by the stakeholders is the physical space required for the district heating infrastructure. They believe that citizens' perspectives should be considered when considering the spatial requirements and potential implications for their living environment.

Lastly, stakeholders emphasised the importance of considering "meekoppelkansen" (in English: linkage opportunities; translation by the author) which refers to the opportunities for synergistic integration of the district heating network with other aspects of the physical living environment, such as urban planning and infrastructure development. They believe that citizens' insights and advice in this regard can contribute to creating a more sustainable and harmonious living environment.

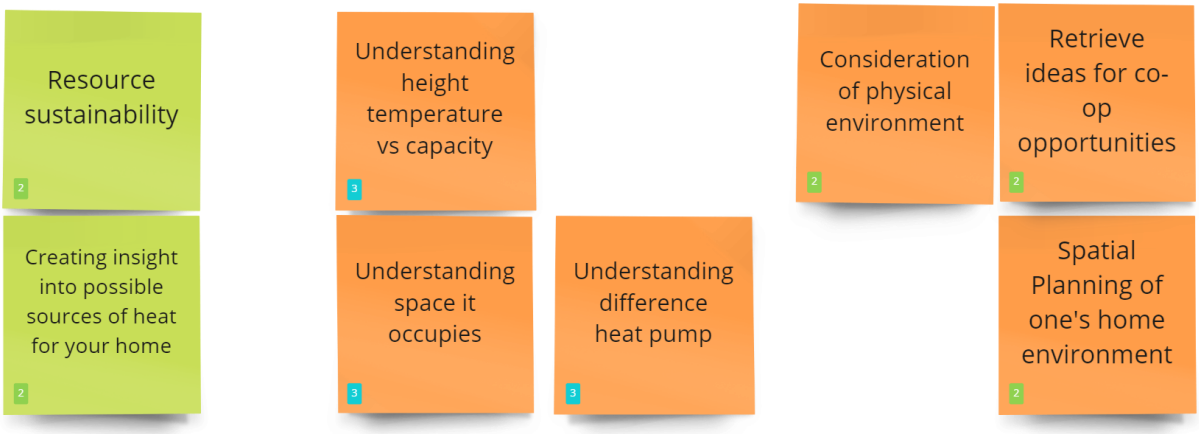

Figure 9 Stakeholder goal: Additional technical aspects

4.2. Stakeholders' challenges for using Participatory Value Evaluation

This section presents the challenges perceived by stakeholders in the use of a PVE for involving citizens in the development of district heating networks. The challenges associated with the use of a PVE primarily revolve around reaching the appropriate target group effectively. Stakeholders have identified various obstacles that can hinder the participation of a broad range of respondents. These challenges include issues related to language, digital skills of respondents, and the complexity of the PVE tool. Overcoming

these challenges is crucial to ensure inclusive participation and enhance the effectiveness of the PVE in engaging diverse stakeholders. The following section will provide an exploration of these challenges.

Representativity

Six stakeholders specifically highlight challenges related to the representativity of respondents in the Participatory Value Evaluation (PVE). They express concerns about the inclusivity and diversity of the PVE respondents, recognising that certain characteristics may lead to the exclusion of specific groups, thus compromising the representativeness of the target population. Additionally, stakeholders express a general uncertainty regarding how to effectively measure diversity and representativeness in this context. It is acknowledged that even if the participating group appears diverse, there is a possibility that only individuals who are already interested in the topic choose to engage, raising doubts about the representativeness of the advice provided. Addressing these challenges and ensuring a more inclusive and representative participation remains a crucial aspect in the design and implementation of the PVE.

Figure 10 Stakeholder challenge: Representativity

Language

Stakeholders emphasise the challenge of maintaining accessible language throughout the process. Given that a large share of the individuals in the Netherlands struggle with language, particularly when it comes to complex topics, it is crucial to explain the information in a clear and understandable manner, ideally at a B1 level. However, there is a tension between making complex aspects of the energy transition comprehensible and ensuring simplicity of language. At times, a choice may need to be made between

providing a more detailed explanation that includes nuanced or complex terms or simplifying the language and potentially losing some level of nuance or complexity. Striking a balance between these two considerations is essential, as it acknowledges the need for accessibility while maintaining the integrity of the information being conveyed.

Figure 11 Stakeholder challenge: Language

Digital literacy

Stakeholder's express concerns regarding the potential challenges faced by individuals with limited digital skills in effectively utilising the PVE tool. Given that the PVE is primarily designed for online completion, stakeholders anticipate difficulties for those with lower digital literacy. To address this issue, alternative approaches such as conducting PVE sessions in the community using tablets have been suggested to ensure inclusivity and enable participation among individuals with lower digital proficiency. One stakeholder specifically raises concerns about older adults facing potential obstacles when engaging with the PVE process.

Figure 12 Stakeholder challenge: Digital literacy

General reason for dropping out of participation

Furthermore, there are reasons why some individuals will not participate in the public consultation process at all. Two stakeholders highlight that a lack of time and energy can be a significant deterrent for participation. Financial constraints, for instance, may contribute to individuals being unable to dedicate the necessary time to engage in the process. It is essential to recognise and address these barriers to ensure that participation opportunities are accessible and inclusive, allowing for a more representative and comprehensive engagement process.

Figure 13 Stakeholder challenge: general reasons for dropping out of participation

Coordination of the process around the PVE

According to the perspectives of stakeholders, there are also identified challenges regarding the role of a PVE within the wider participation process. These challenges are mentioned by eight stakeholders. Firstly, they highlight the importance of effectively following up on the results and providing feedback to respondents. Secondly, stakeholders express the view that participation should go beyond the confines of a PVE, encompassing additional forms of engagement and interaction. Lastly, stakeholders stress the need for a clear understanding of the purpose and objectives of the PVE. From their standpoint, it is not sufficient to solely conduct a PVE; rather, there should be subsequent actions, ongoing communication, and a comprehensive approach that extends beyond the PVE itself. This stakeholder perspective underscores the significance of post-PVE activities and broader communication efforts in ensuring meaningful and impactful participation throughout the decision-making process.

Figure 14 Stakeholder challenge: Coordination of the process around the PVE

Realistic & simple PVE

A simple and realistic PVE is also important for some stakeholders. The PVE should contain realistic and concrete options. Additionally, three stakeholders identify the challenge of creating a PVE that is simple and user-friendly. This emphasises the importance of designing the PVE in a way that is accessible, intuitive, and easy to navigate for respondents, considering their varying levels of digital literacy and technical proficiency. These viewpoints underscore the significance of balancing the comprehensiveness of the PVE with its usability, ensuring that it effectively captures relevant input while remaining approachable and engaging for respondents.

Figure 15 Stakeholder challenge: Realistic & simple PVE

Additional challenges

In addition to the challenges identified within the aforementioned clusters, there are also additional hurdles that do not fit into any specific category. These challenges are shown in Figure 16.

Figure 16 Additional stakeholder challenges

4.3. Advantages of using Participatory Value Evaluation

In this section, the perceived benefits of stakeholders regarding the use of a PVE in public consultation are presented. Notably, these benefits often align with the goals previously mentioned. When such alignment exists, it will be explicitly indicated. This connection underscores the significance of integrating goals and advantages, using the positive synergy between desired results and the potential benefits associated with the adoption of a PVE. By acknowledging and highlighting these matched benefits, a more effective design of the PVE can be established.

Understanding & awareness

Seven stakeholders see an advantage in using a PVE to foster understanding and awareness of the decisions made by policymakers. They believe that a PVE is suitable because it clearly illustrates the effects of different choices. Additionally, the PVE also sets limitations on the respondents, helping them understand that it is not possible to always fulfil all the wishes. Sometimes, difficult choices need to be made, and certain decisions may cause discomfort. The stakeholders believe this can be shown and communicated with the PVE. This aligns with one of the identified goals of the PVE, which is to promote awareness and insight.

Figure 17 Perceived advantage: Understanding & awareness

Reaching a broader public

Four stakeholders highlight the advantage of reaching different groups of people through a PVE compared to traditional forms of participation. By combining various tools, a broader audience can be reached. It allows for engagement with individuals who may have limited time, such as busy citizens or parents with young children. The silent majority, who may not typically attend in-person meetings, can also participate by completing a PVE. Furthermore, for those who prefer to express their opinions anonymously, a PVE provides a suitable platform to do so.

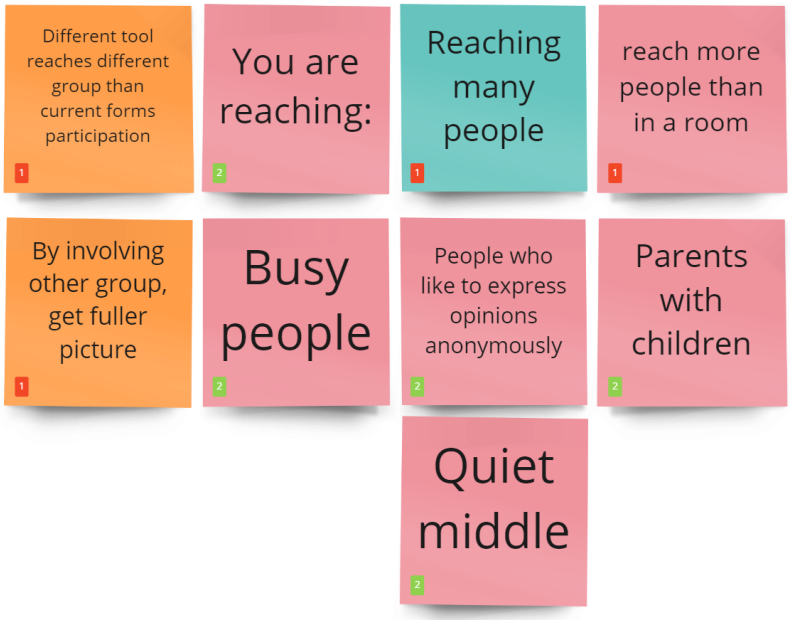

Figure 18 Perceived advantage: Reaching a broader public

Gathering input & way of asking questions

Five stakeholders highlight the benefits of the way questions are asked in a PVE, as it compels individuals to make choices and provide nuanced responses at the same time. They observe that traditional resident meetings often attract only those who are angry or have sufficient free time. PVE attempts to combine the advantages of surveys and resident meetings while minimising their drawbacks. By allowing respondents to give nuanced answers, the PVE goes beyond a simple questionnaire, enabling respondents to comprehend the consequences of their choices. It also encourages individuals to make decisions and offers a combination of accessibility and depth in its questioning methodology.

Figure 19 Perceived advantage: Reaching a broader public

Additional advantages

These stakeholders identify additional advantages that do not fit into existing clusters. These advantages include the ability to address a diverse range of topics, and the potential for the PVE process to yield broad outcomes that are usable in the decision-making process. The PVE also offers the opportunity to present multiple options for consideration, serves as an initial step in enhancing citizen engagement, and allows for a focus on orienting heat projects in new neighbourhoods compared to traditional public consultations conducted by municipal authorities.

Figure 20 Additional advantages

4.4. Conclusions from the interviews

The key points from this chapter are as follows. The various stakeholder groups raise similar points, with few points being unique to a single stakeholder. This pattern holds up across different stakeholder categories as well. Two important process goals of the PVE are gathering information and creating awareness and understanding. Achieving these goals is expected to require substantial depth in the consultation process and sufficient time for completion. However, this may conflict with stakeholders' desire to reach a large number of individuals and achieve a representative sample. Additionally, stakeholder's express concerns that the consultation may pose a barrier for individuals with limited language or digital skills, further complicating the achievement of the two process goals.

5. Design of the Participatory Value Evaluation & survey

In this chapter, the goals and design of the Participatory Value Evaluation (PVE) and the survey are discussed. First, the goals incorporated in the design of the PVE and the survey are presented. Subsequently, the design of the PVE is introduced.

5.1. Design goals for the Participatory Value Evaluation & survey

The primary goal found in the interviews of the PVE and survey is twofold: to gather input and to create awareness, understanding, and insight into the dilemmas regarding the implementation of district heating networks. The gathering of input can be considered a substantive goal, while the creation of insight, understanding, and awareness can be seen as an instrumental goal. Additionally, the PVE & survey aim to be accessible in terms of language and usability, ensuring the participation of a large and representative group of respondents. Furthermore, the PVE is designed to compel individuals to make choices between specific dilemmas, which is often referred to as decision discomfort or choice aversion.

To measure the extent to which the PVE achieves these goals, the respondents are divided into two groups. Each group receives a different treatment. Group 1 engages in the PVE that aims to achieve the aforementioned goals, while Group 2 completes a survey that is designed to achieve the same goals as the PVE. The effects of participating in the PVE are compared with the effects of participating in the survey.

The PVE addresses the following topics related to district heating:

- Choice between retaining gas connections and the costs of district heating
- Allocation of costs versus the feasibility of district heating (including subsidies, individual contributions, and reinvestment in the community)
- Disruption caused by the construction of district heating networks (impact on nature, the neighbourhood, and customers) versus the costs of district heating
- Selection of the heat source type (sustainable versus waste heat)
- Trade-off between the risk of outages and the costs of district heating

For each of these five topics, ten policy options are formulated for respondents to choose from. These options have implications for the effects. The effects have specific restrictive goals that need to be achieved. The three effects presented in the PVE are the costs for the customer of the district heating network, the costs for the taxpayer, and the feasibility of the district heating system.

The dilemmas included in the PVE & survey

Regarding the five topics that are intended to be addressed in the PVE, further elaboration is provided below. These topics pertain to the deliberation surrounding the development of a district heating network, and for each topic, it is indicated whether the aim is to make citizens think or to gather input for policymaking, or a combination of both.

Choice between retaining gas connections and the costs of district heating

Within the framework of the PVE, respondents have the option to select a choice that introduces the possibility of forced disconnection. This choice entails allowing the

compulsory disconnection of the remaining gas users from the gas network. If respondents choose to endorse this option, they will observe an increase in feasibility and a decrease in costs for both the taxpayer and customers of the district heating network. Conversely, if respondents choose not to grant coercive powers to the municipality, there will be limited scope for selecting measures that enhance the attractiveness of the district heating network.

This measure is likely to be implemented, and by prompting respondents to contemplate and express their opinions on it, two advantages can be attained. Firstly, by making the positive effects of the measure evident, respondents may develop a favourable stance towards its implementation. Secondly, policymakers can gain insights into public perceptions of this measure, enabling them to consider public sentiment when implementing it.

Distribution of costs vs. feasibility of the district heating network

The PVE includes options that allow for a different distribution of costs. The costs are divided among three parties: customers, taxpayers, and the heat company. By providing respondents with this insight, the aim is to make them aware that someone ultimately bears the costs. Additional subsidies for district heating networks are ultimately paid by the taxpayer. This mechanism is made transparent to respondents in the PVE.

Nuisance from heat grid construction (nature, neighbourhood & customers) vs costs of heat grid

Stakeholders frequently emphasise that residents seek more than just an appealing cost proposition; they also prioritise the mitigation of various forms of inconveniences. However, reducing these inconveniences may come at a financial cost. The PVE aims to provide insight into the trade-off between cost and inconvenience. Respondents participating in the PVE are presented with three options to reduce three different types of inconveniences. The first option addresses inconveniences experienced by residents within the *neighbourhood*. Additionally, respondents have the opportunity to choose options that minimise inconveniences for customers connected to the district heating network. Lastly, there is an option to mitigate inconveniences imposed on the natural environment.

Type of heat source (residual heat vs. sustainable sources)

A district heating network requires a heat source to supply warm water to households. Various options are available, including fossil fuels, sustainable sources, and waste heat. In the context of the energy transition towards reducing dependence on fossil fuels, this study focuses on sustainable sources and waste heat. Within the PVE, respondents are given the choice between connecting to a sustainable source or utilising waste heat. This approach aims to provide insights into the considerations and trade-offs individuals make when deciding on their preferred heat supply option. By examining these factors, valuable insights can be gained to inform the development of warmth networks.

Downtime risks vs. costs of the district heating network

In the PVE, another aspect that is addressed is the trade-off between installing additional heat capacity. When designing a warmth network, the capacity of heat sources is

matched with the number of connections. By installing extra capacity, the risk of disruptions during cold days is reduced. However, this comes with additional costs. By presenting this option to respondents, policymakers can gain insights into the importance that respondents place on the reliability of heat supply. This information is valuable for decision-making and ensuring the delivery reliability of the warmth network.

5.2. Design of the Participatory Value Evaluation & Survey

In the two different consultations, respondents are asked about their behaviour both before and after participating. This allows for measuring whether the participation in the PVE or the survey influences the respondents' behaviour. The post-participation questions are based on the questions commonly used by Populytics in consultations, enabling comparison with other consultations. Some questions have been modified, removed, or added to measure the stakeholders' objectives.

In addition, data on the usage of the two consultation methods is also collected. This includes the duration of the consultations and the number of respondents who terminate prematurely.

The following are the questions asked before and after:

- How would you rate your knowledge about the construction of warmth networks?
- Would you like to be informed if there are plans to develop a warmth network in your neighbourhood? This could be done through methods such as an information session, website, or flyer.
- Would you be interested in participating in the planning process of the warmth network if there are plans to develop one in your neighbourhood? This could involve methods such as attending a public consultation or participating in an online survey.
- Would you like to have a say in the decision-making process of the warmth network if there are plans to develop one in your neighbourhood? This could include methods such as a referendum or participation in an energy cooperative.
- Would you be willing to connect your house to a district heating network if one were to be developed in your neighbourhood?

The above questions can be answered using a Likert scale with 5 levels ranging from very unlikely to very likely.

The five trade-offs mentioned above lead to a PVE that presents the following 10 policy options. This are the 10 policy options:

- The district heating network should be connected to sustainable heat sources.
- The district heating network should use heat that is not used in the industry.
- Additional heat sources should be connected to prevent disruptions.
- There should be the possibility of mandatory switching of the last gas users in a neighbourhood to a renewable solution
- More subsidies should be allocated for the establishment of district heating networks.

- Customers of the district heating network should contribute more to its development.
- The environment should not be negatively impacted by the construction and operation of the district heating system.
- Customers of the district heating system should experience minimal inconvenience during its construction.
- Residents of the neighbourhood should experience minimal disruption during the construction of the district heating system.
- Profits from the district heating system should be partially reinvested in local facilities.

Group 2 receives a survey that differs from the PVE by one page. The page containing the substantive part of the PVE is replaced with a page of survey statements. These statements are identical to the policy options in the PVE The constraints that were present in the PVE are not applicable in this manner of questioning. Additionally, respondents cannot see the effects of their choices. Respondents are free to select all possibilities without any limitations.

The section after the section that is different for the PVE and survey focuses on the allocation of responsibilities, and its objectives are twofold. Firstly, it addresses an important point raised during the interviews, which emphasises the significance of encouraging residents to reflect on and provide input regarding the distribution of responsibilities among stakeholders. Secondly, it presents an opportunity to compare the effects of the PVE and the survey. Respondents who have participated in a longer and more complex consultation process may allocate responsibilities differently among the stakeholders, providing valuable insights for analysis and comparison. The tasks that the respondents need to distribute across the stakeholders are:

- Who do you think should decide on the type of heat source to be connected? Rank the following parties in order of importance, from most important to least important.
- Who do you think should decide on the technical design of the district heating network? Rank the following parties in order of importance, from most important to least important.
- Who do you think should be responsible for coordination among different parties involved in works conducted in and around the homes? Rank the following parties in order of importance, from most important to least important.
- Who do you think should decide on the planning of the district heating network? Rank the following parties in order of importance, from most important to least important.

Additionally, there are questions that are only asked afterwards to assess residents' experiences with the consultation process. These questions are as follows:

“In this consultation, we seek advice from a large group of residents. The government also seeks advice from independent experts. Which advice do you consider most important?”

The citizens can choose one of the following answer options:

- Only the advice of residents is important; the advice of experts is not important.
- The advice of residents is more important than the advice of experts.
- The advice of residents is equally important as the advice of experts.
- The advice of residents is less important than the advice of experts.
- The advice of residents is not important at all; only the advice of experts is important.

In the following question, people are asked to indicate the extent to which they agree with a specific statement.

- The consultation influenced my choices in a certain direction.
- I trust that this is a fair survey.
- I found it important to express my opinion on this topic.
- I found the consultation difficult to understand.
- Residents should be involved more frequently in the development of district heating networks.
- This method is suitable for involving residents in the development of district heating networks.
- By participating in this consultation, I have learned about the decisions the government needs to make regarding this topic.
- If the government involves residents more often in this way in decision-making processes, I will have more confidence in government decisions.

The final set of questions pertains to whether respondents have previously provided advice on this subject and their assessment of the quality of the consultation. This allows for a comparison to be drawn in this aspect as well.

- Have you ever expressed your opinion to the government on this topic?
    - Checkboxes for indicating the medium through which the opinion was expressed.
- On a scale of 1 to 10, how would you rate this consultation?
- What do you think went well in this consultation?
- What do you think could be improved in this consultation?

These questions will help evaluate the respondents' experience of participating in the PVE and the survey. Based on this, the final research question can be answered, which relates to the differences of incorporating goals of the stakeholders' in the PVE or survey.

5.3. Conclusions on the goals and design of the PVE and survey

In this chapter, the goals and design of the PVE and the survey are discussed. The primary goals incorporated in the design of the PVE and survey are twofold: to gather input and to create awareness, understanding, and insight into the dilemmas regarding the implementation of district heating networks. The PVE and survey aim to be accessible in terms of language and usability, ensuring the participation of a large and representative group of respondents.

The dilemma's addressed in the PVE and survey are the choice between retaining gas connections and the costs of district heating, the allocation of costs versus the feasibility of district heating, the disruption caused by the construction of district heating networks versus the costs, the selection of the heat source type (sustainable versus waste heat), and the trade-off between the risk of outages and the costs of district heating.
By asking the same questions before and after both types of consultations, it is possible to compare the consultations. The pre- and post-participation questions provide insights into the change of the respondents' knowledge, preferences, and attitudes regarding the development of district heating networks. Additionally, gathering feedback on the consultation process itself allows for the assessment of residents' experiences and suggestions for improvement.

6. Results of the Participatory Value Evaluation and survey

This chapter aims to compare two methods used in the study: the Participatory Value Evaluation (PVE) and the survey. The objective is to assess the extent to which the stakeholders' goals can be achieved through the PVE and evaluate the strengths of each method. Several aspects will be examined, including the difference in respondent drop-off rates and completion times, which provide insights into the perceived complexity of the survey. Additionally, the potential differences in the groups' representation are explored.

Furthermore, it is investigated if respondents in the two groups had varying perspectives on the consultation process. This analysis will consider the quality of the consultation and respondents' responses to eight statements assessing their perceptions of the process. The distribution of responsibilities among stakeholders is also assessed to identify any differences between the distribution between the two different groups.

Moreover, the respondents' knowledge, preferences for participation, and willingness to connect to the proposed district heating network between the PVE and survey groups is compared. Additionally, the possible differences in the substantive advice of the PVE and survey group is analysed. This will make clear if there is a difference in the ability of collecting input between the two methods.

By conducting this comparative analysis, the aim is to gain a comprehensive understanding of the strengths, differences, and outcomes of the PVE and survey methods. This knowledge will inform future decision-making regarding stakeholder engagement in similar district heating network development projects.

6.1. Drop-off rate & completion time

The drop-off rate in the sample was found to be 66.4% for respondents who started the PVE but did not complete it, while 25.2% of the sample started the survey but did not complete it. These drop-off rates can be found in Figure 21. The response ratio based on the initial sent letters is 2.22% for the PVE and 6.60% for the survey.

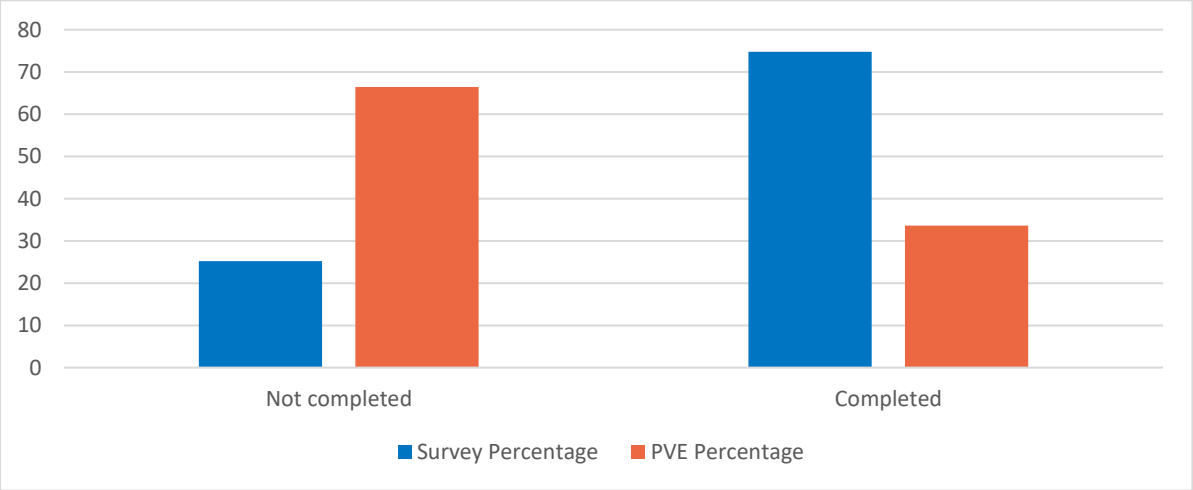

Figure 21 Histogram of completion and type of consultation

An independent samples t-test was performed to evaluate whether there was a difference between the drop-off ratio in the PVE and in the survey. The results indicated that drop-off rate for the PVE respondents (M = [0.34], SD = [0.474]) was significantly different of the drop-off rate of the survey respondents (M = [0.75], SD = [0.436]), t([251]) = [7.165], p < [.001]. The whole test output of SPSS can be found in appendix B.

On average, respondents spent 13.4 minutes completing the survey, while the PVE required an average time of 22.5 minutes. An independent samples t-test was performed to evaluate whether there was a significant difference between the completion time (in seconds) in the PVE and in the survey. The equal variances were not assumed. The results indicated that the completion time for the PVE respondents (M = [1350.39], SD = [643.313]) was significantly higher of the completion time of the survey respondents (M = [801.921], SD = [573.665]), t([70.670]) = [4.663], p < [.001].

6.2. Representativeness

This section examines the representativeness of the Participatory Value Evaluation (PVE) compared to the survey. For each characteristic, the analysis investigates whether there is a statistically significant difference between the PVE group and the Survey group. The outcomes of the independent sample T-tests are presented in Table 4. The results are further discussed in the sections below.

Table 4 Overview of independent sample T-tests for representativity

	Group	Mean	Standard deviation	Levene's Test	df	t	p
Gender	Survey	0.51	0.503	0.020	132	-1.278	0.203**
	PVE	0.62	0.490				
Age	Survey	3.92	1.529	0.862	135	1.799	0.037*
	PVE	3.43	1.440				
Education	Survey	1.87	0.343	<0.001	129.695	-2.667	0.004*
	PVE	1.98	0.147				
Daily life occupations	Survey	0.78	0.420	0.198	132	-0.627	0.266*
	PVE	0.82	0.387				
Net income	Survey	1.84	0.678	0.218	108	-2.185	0.016*
	PVE	2.15	0.760				
Money left at end of month	Survey	3.93	0.985	0.596	120	-2.117	0.018*
	PVE	4.29	0.716				
Family composition	Survey	0.27	0.447	<0.001	110.428	1.998	0.048**
	PVE	0.13	0.344				
Connectivity neighbourhood	Survey	3.10	0.865	0.291	136	-0.604	0.547**
	PVE	3.20	0.957				

*One-sided p ** Two-sided p

Gender

Figure 22 shows a histogram with the percentages of men and women that completed the survey and the PVE. This histogram shows that the PVE was completed by a relatively large number of men compared to the survey. An independent samples t-test was performed to evaluate whether there was a significant difference between the gender in completing the PVE and survey. The equal variances were assumed with the Levene's test for Equality of Variance's. The results indicated that the percentage of men who completed the PVE (M = [0.62], SD = [0.490]) did not significantly differ of the percentage of men who completed the survey (M = [0.51], SD = [0.503]), t([132]) = [-1.278], p = [.203].

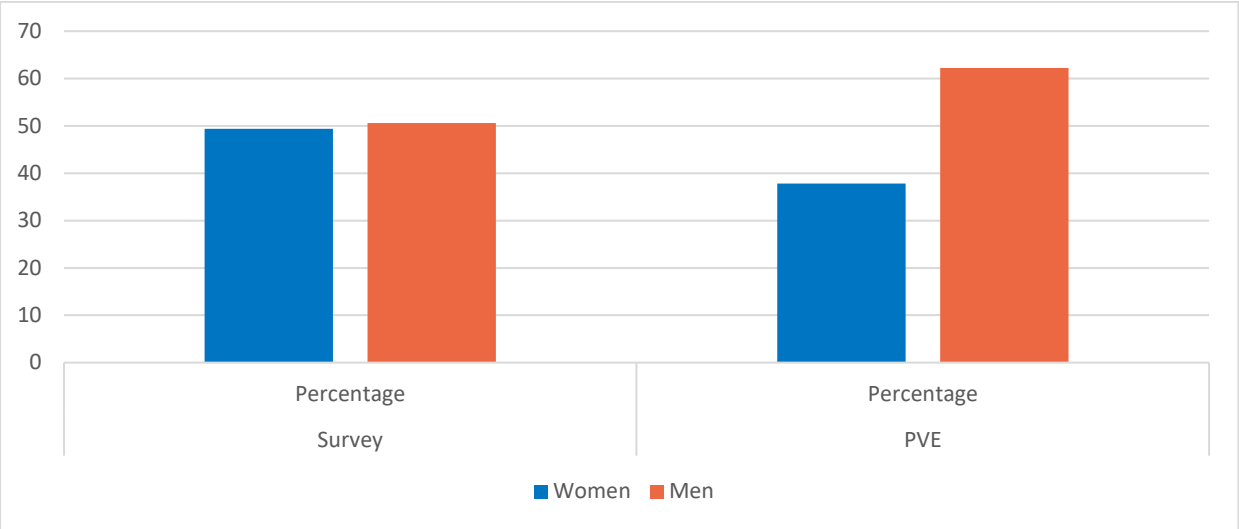

Figure 22 Histogram: gender and type of consultation

Age

Figure 23 shows a histogram of the type of consultation and the age. As can be seen in the figure the PVE was completed by less citizens with an older age than the survey. An independent samples t-test was performed to evaluate whether there was a significant difference between the age of the respondents completing the PVE and survey. The equal variances were assumed with the Levene's test for Equality of Variance's. The results indicated that the age of respondents who completed the PVE (M = [3.43], SD = [1.440]) was significantly lower than the age of the respondents who completed the survey (M = [3.92], SD = [1.529]), t([135]) = [1.799], p = [.037]. The output of SPSS of this test is presented in appendix B.

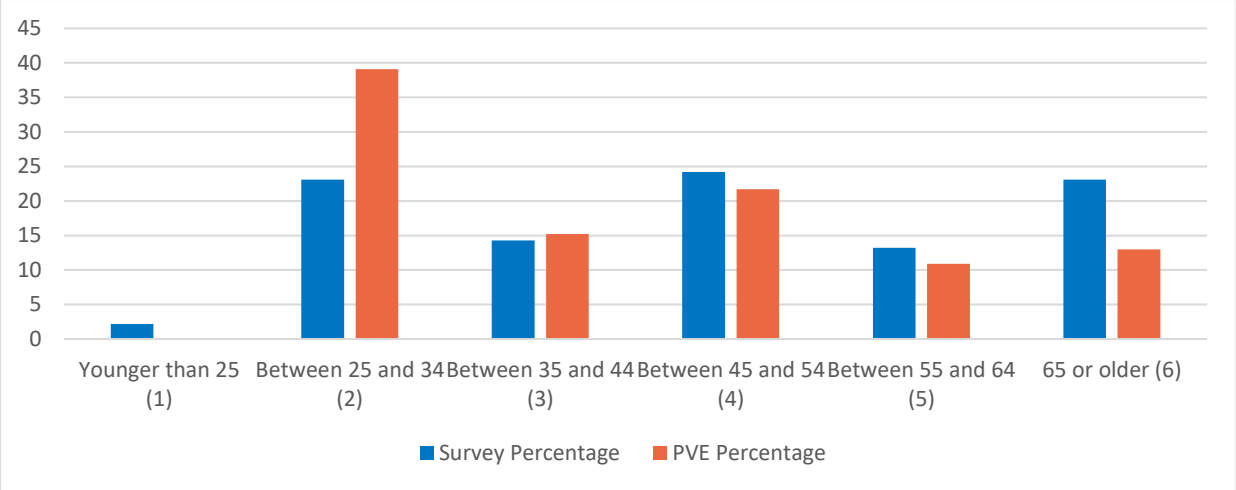

Figure 23 Histogram: age and type of consultation

Education

A frequently mentioned concern by stakeholders is that the PVE is too complicated for middle- and low-educated people. The PVE and survey ask for eight levels. The groups were merged according to the division in three levels (Centraal Bureau voor de Statistiek, 2023). Figure 24 shows a histogram of the type of consultation and the education level.

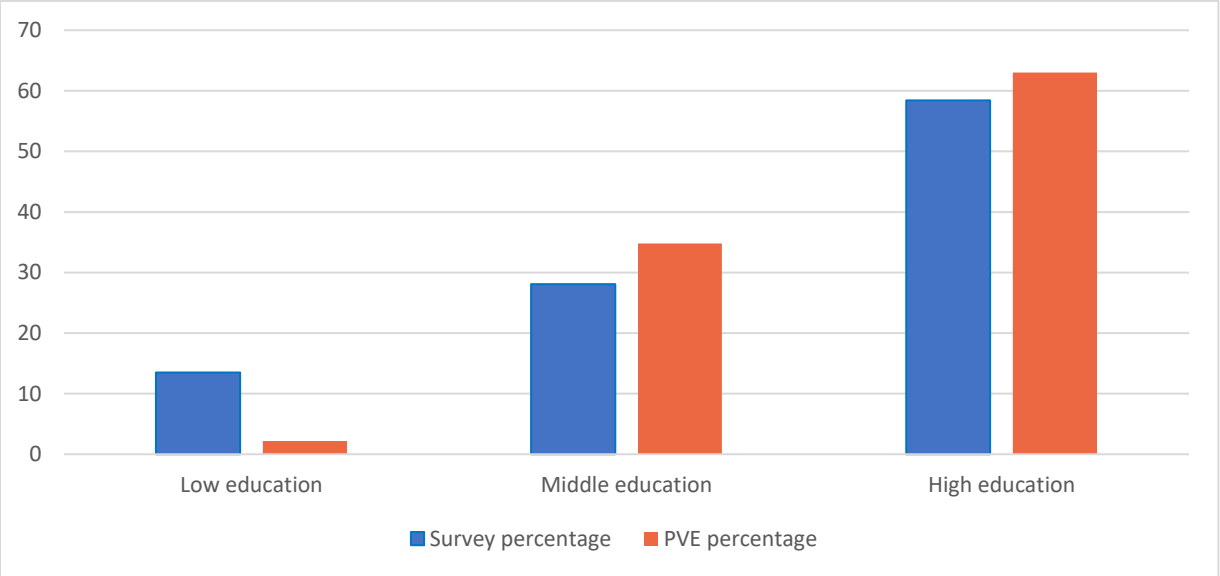

Figure 24 Histogram of education level and type of consultation

An independent samples t-test was performed to evaluate whether there was a significant difference between the age of the respondents completing the PVE and survey. The equal variances were not assumed with the Levene's test for Equality of Variance's. The results indicated that the education level of respondents who completed the PVE (M = [1.98], SD = [0.147]) was significantly higher than the education of the respondents who completed the survey (M = [1.87], SD = [0.343]), t([129.695]) = [-2.667], p = [.004]. The output of SPSS of this test is presented in appendix B.

Daily life occupations

In the consultation respondents could answer 5 different categories of daily life occupations. The data was reformed into a dummy variable if people were employed or not. In Figure 25 a histogram is shown. In this histogram it is observable that the differences are small.

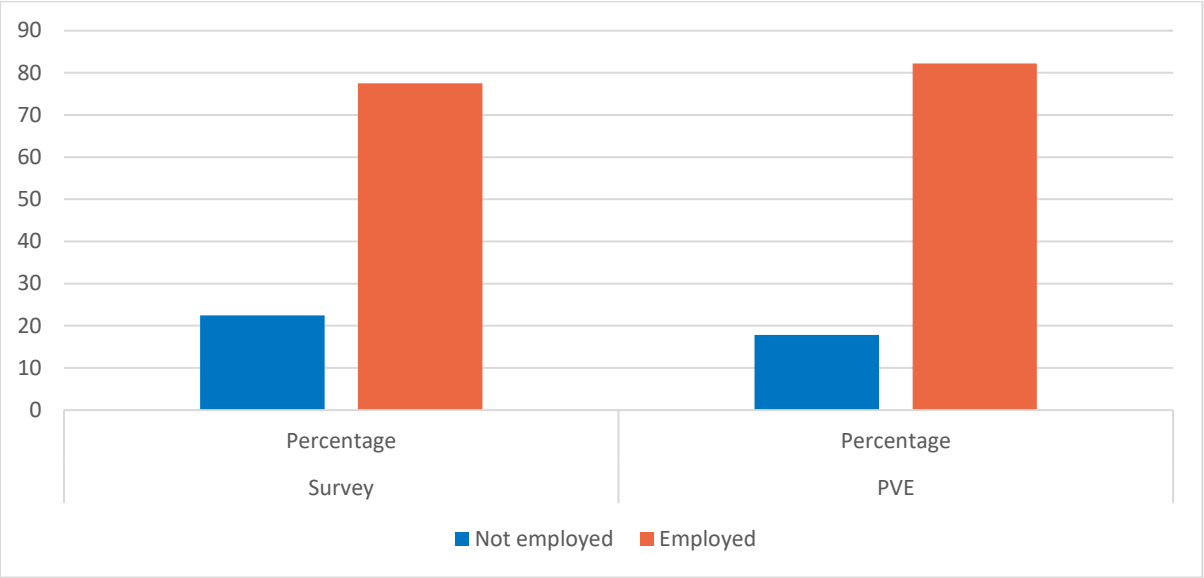

Figure 25 Histogram of employment and type of consultation

An independent samples t-test was performed to evaluate whether there was a significant difference between the employment of the respondents completing the PVE and survey. The equal variances were assumed with the Levene's test for Equality of Variance's. The results indicated that percentage of employed respondents who completed the PVE (M = [0.82], SD = [0.387]) was not significantly different than the percentage of employed respondents who completed the survey (M = [0.775], SD = [0.420]), t([132]) = [-0.627], p = [.266]. The output of SPSS of this test is presented in appendix B.

Net income

The PVE is more commonly filled out by individuals with a higher net income. From the respondents who completed the PVE, 36.6% had a household net income exceeding 6000 euros, while for the survey, this percentage was 15.9%. The histogram with all the relevant percentages is shown in Figure 26.

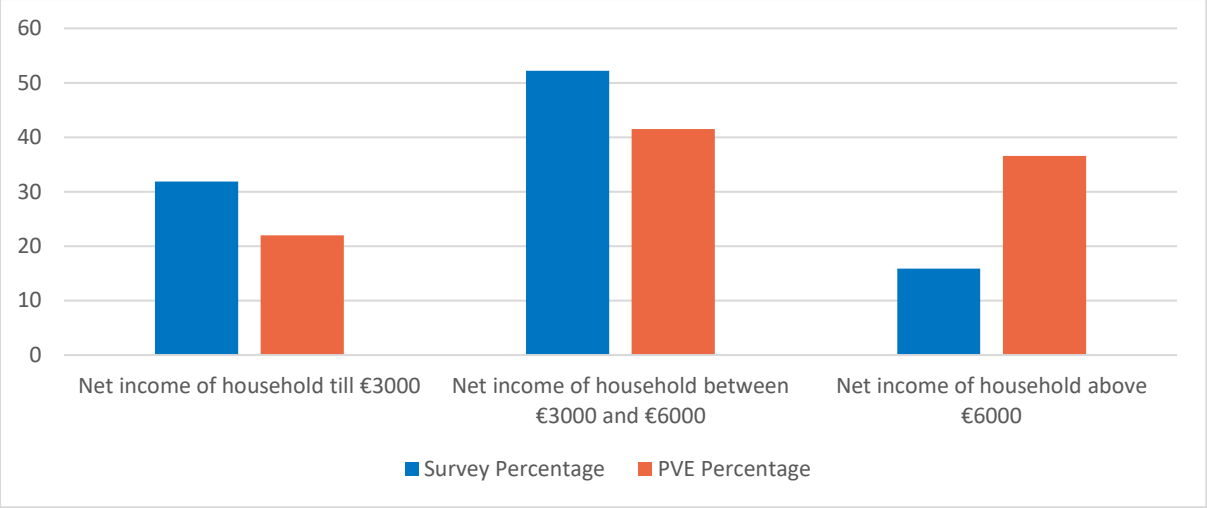

Figure 26 Histogram of net income and type of consultation

An independent samples t-test was performed to evaluate whether there was a significant difference between the height of the net income of the respondents completing the PVE and survey. The equal variances were assumed with the Levene's test for Equality of Variance's. The results indicated that the net household income of respondents who completed the PVE (M = [2.15], SD = [0.760]) was significantly higher than the net household income of respondents who completed the survey (M = [1.84], SD = [0.678]), t([108]) = [-2.185], p = [.010]. The output of SPSS of this test is presented in appendix B.

Amount of money left at the end of the month

The lifestyle one leads, the income received, and any financial obligations one has play a significant role in determining the surplus or deficit of money at the end of the month. It is important to note that individuals with higher incomes may still face challenges in saving money. Thus, considering this aspect, the question regarding financial circumstances has been incorporated into the consultations. Respondents are provided with the opportunity to indicate their financial situation using five levels. The corresponding levels are presented in Figure 27.

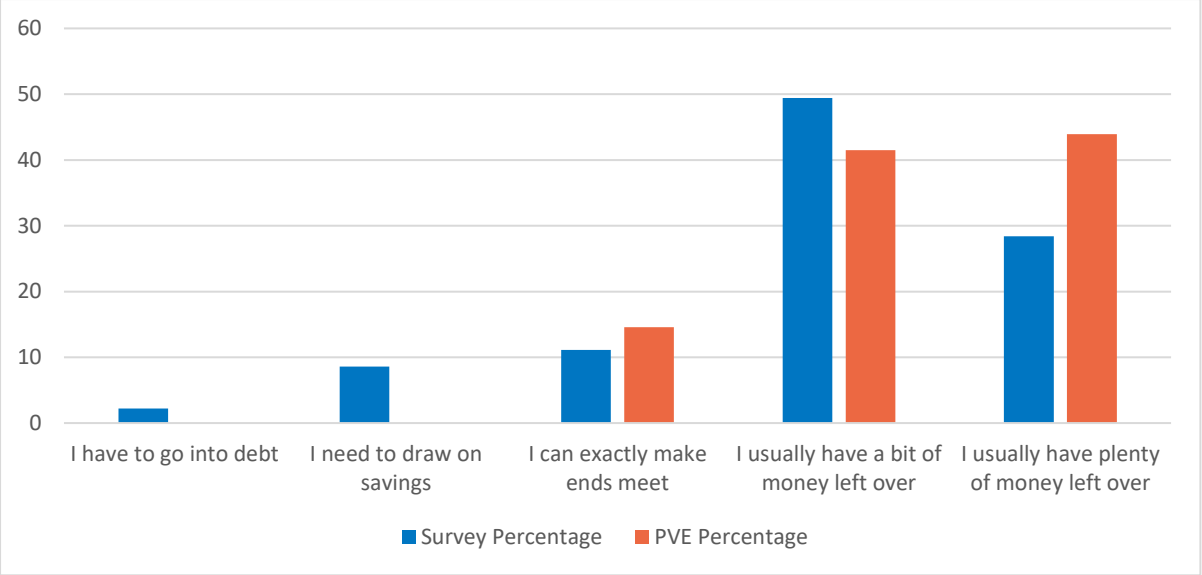

Figure 27 Histogram of amount of money left at the end of the month and type of consultation

An independent samples t-test was performed to evaluate whether there was a significant difference between the amount of money left at the end of the month of the respondents completing the PVE and survey. The equal variances were assumed with the Levene's test for Equality of Variance's. The results indicated that the amount of money left at the end of the month of respondents who completed the PVE (M = [4.29], SD = [0.716]) was significantly higher than the amount of money left at the end of the month of respondents who completed the survey (M = [3.93], SD = [0.985]) , t([120]) = [-2.117], p = [.018]. The output of SPSS of this test is presented in appendix B.

Family composition

In Figure 28 a histogram is shown where it is displayed how the distribution of households with and without children is across the two different types of consultation. the histogram shows that PVE is more commonly filled out by households without children.

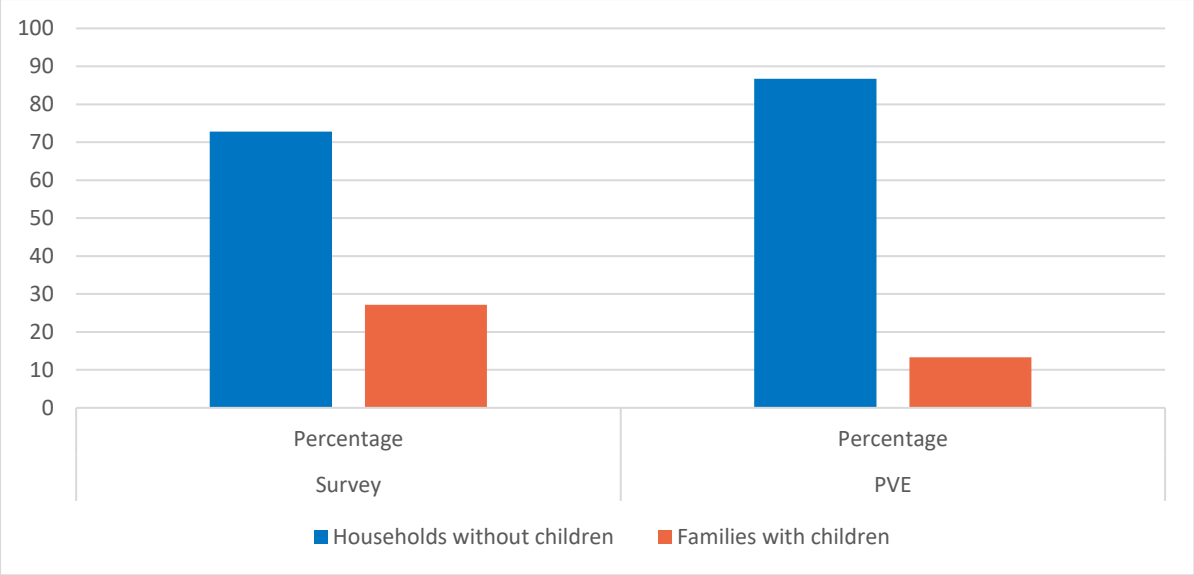

Figure 28 Histogram of household with children and type of consultation

An independent samples t-test was performed to evaluate whether there was a significant difference between the percentage of respondents with children in completing the PVE and survey. The equal variances were not assumed with the Levene's test for Equality of Variance's. The results indicated that the percentage of respondents with children who completed the PVE (M = [0.13], SD = [0.344]) was significantly higher than the percentage of respondents with children who completed the survey (M = [0.27], SD = [0.447]), t([110.428]) = [1.998], p = [.048]. The output of SPSS of this test is presented in appendix B.

Connectivity neighbourhood

The histogram of the type of consultation and the connectivity with the neighbourhood (Figure 29) shows little differences between the two types of consultation. An independent samples t-test was performed to evaluate whether this small difference was significant. The equal variances were assumed with the Levene's test for Equality of Variance's. The results indicated that connectivity with their neighbours of respondents completed the PVE (M = [3.20], SD = [0.957]) was not significantly different than the connectivity with their neighbours of respondents who completed the survey (M = [3.10], SD = [0.865]) , t([136]) = [-0.604], p = [.547]. The output of SPSS of this test is presented in appendix B.

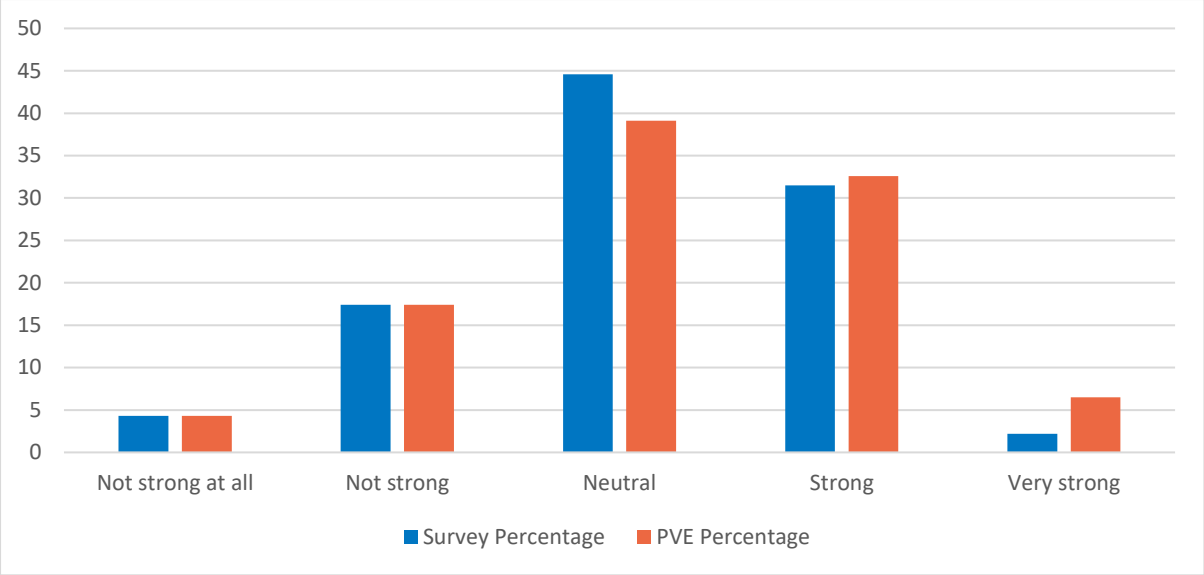

Figure 29 Histogram of neighbourhood connectivity and type of consultation

6.3. Rating of the consultation

In the sample, respondents gave the survey an average of a 4.62 and the PVE a 4.58. This rating is between average and above average. The spread of ratings divided between the two different consultations is shown in Figure 30. An independent samples t-test was performed to evaluate whether this small difference was significant. The equal variances were assumed with the Levene's test for Equality of Variance's. The results indicated that the rating given by respondents who completed the PVE (M = [4.58], SD = [1.196]) was not significantly different than the rating given by the respondents who completed the survey (M = [4.62], SD = [1.143]), t([132]) = [0.970], p = [.850]. The output of SPSS of this test is presented in appendix B.

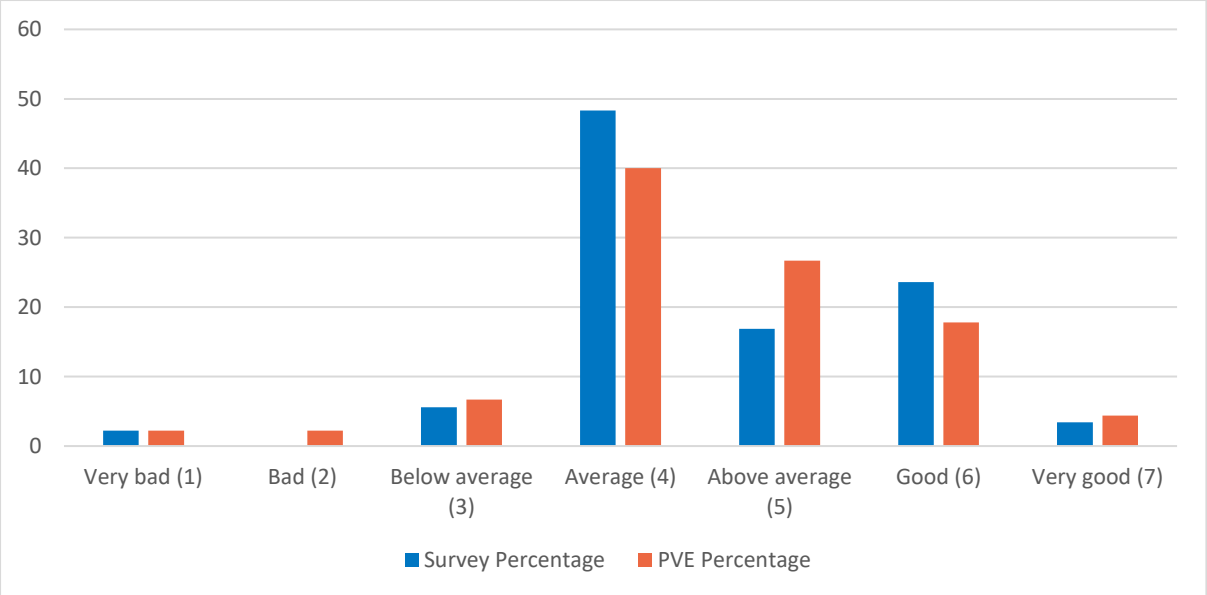

Figure 30 Histogram of ratings and type of consultation

Comparison of the validity questions

According to the results of the 8 validity questions posed to the respondents, it was found that respondents perceived the PVE as significantly more challenging and reported significantly greater learning from government choices. The outcomes of the 8 validity questions are presented in Table 5. The results of the independent sample t-tests are displayed in Table 6.

Table 5 Statements in the consultations with results

Statement	Result of independent sample t test
The research steered my choices in a certain direction	No significant difference
I trust this research is fair	No significant difference
This was an important topic to give my opinion on	No significant difference
I found this research hard to understand	The respondents valued the PVE as significantly more different than the survey
Residents should be more involved in the development of DHN's	No significant difference
This method is suitable for involving residents in the development of DHN's	No significant difference
Because I am participating in this research, I have learnt about the choices the government has to make on this issue	The respondents answered that they learned significantly more about the government's decision in the PVE than in the survey
If the government allows residents to participate in these kinds of choices in this way, I will have more trust in the government's decisions	No significant difference

Table 6 Results of the independent sample t tests for the validity questions in the consultations

Type of question	Type of consultation	Mean	Standard deviation	Levene's Test for Equality of Variances	df	t	One-Sided p	Two-Sided p
Research steering	Survey	2,53	0,95	0,963	130	-0,529		0,597
	PVE	2,62	0,98					
Trustworthy research	Survey	4,00	0,73	0,054	131	-0,638		0,524
	PVE	4,09	0,82					
Important topic	Survey	4,02	0,78	0,273	132	-0,302		0,763
	PVE	4,07	0,84					
Difficult research	Survey	1,91	0,89	0,048	77,45	-3,573	< 0,001	
	PVE	2,56	1,03					

Involve residents in development of DHN's	Survey	3,93	0,83	0,269	126	1,136		0,257
	PVE	3,75	0,87					
Method suitable for involving citizens	Survey	3,37	0,90	0,949	128	-0,086		0,931
	PVE	3,39	0,89					
Learnt about decisions of government	Survey	2,91	1,02	0,441	129	-1,776	0,039	
	PVE	3,24	1,05					
Trust will raise if this method is used more often	Survey	3,33	1,10	0,219	128	-0,549	0,292	
	PVE	3,43	0,93					

6.4. Difference in distribution responsibilities

In the questions regarding the allocation of responsibilities, respondents were able to rank the four stakeholders by dragging them into a specific order. The first stakeholder received 4 points, the second received 3 points, the third received 2 points, and the last stakeholder received 1 point. Table 7 presents the results of this ranking, indicating the distribution of points among the stakeholders.

Table 7 Responsibilities distributed by respondents

Subject	Type of consultation	Residents	Municipality	Heat grid operator	Heat supplier
Type of heat source	Survey	2.80	3.19	2.39	1.62
Type of heat source	PVE	2.64	3.20	2.51	1.64
Technical design	Survey	1.76	2.56	3.37	2.30
Technical design	PVE	1.56	2.58	3.53	2.33
Coordinating works in homes	Survey	2.13	3.21	2.79	1.87
Coordinating works in homes	PVE	1.98	3.29	2.96	1.78
	Survey	2.30	3.46	2.73	1.51
	PVE	2.11	3.47	2.82	1.60
Average	Survey	2.25	3.11	2.82	1.83
Total	PVE	2.07	3.13	2.96	1.84

It is notable that respondents who completed the PVE assign fewer decision-making responsibilities to the residents. Conversely, the network operator receives greater responsibilities from respondents who completed the PVE. The differences for the municipality and heat supplier are minimal. One possible reason for this could be that respondents realise that the issues at hand are more complex than initially anticipated, leading them to prefer less involvement from citizens and more reliance on an independent technical entity.

6.5. Differences in behaviour before and after the consultation

This section examines the changes in behaviour, knowledge, and participation needs. The differences between pre- and post-responses are compared between the survey and PVE, essentially assessing whether the difference in the difference is significant. The information before and after is known because the same set of questions was asked at the beginning and end of the consultation. These questions include three items on differences in participation needs, one item on respondents' perceived knowledge of heat network construction, and one item on their willingness to be connected to a heat network if developed in their neighbourhood. A multiple regression model was constructed for all five dependent variables. The independent variables included the type of consultation received by the respondents and the demographic characteristics that were found to differ between the PVE and survey. The results of the multiple regression model are shown in Table 8. The models will be discussed in the sections below.

Table 8 Multiple regression models for difference in difference variables

Variable	Difference in perceived knowledge (1)	Difference in information need (2)	Difference in need to think along (3)	Difference in need to co decision (4)	Difference in willingness to connect to a DHN (5)
Intercept	0,956	-0,280	0,450	-0,478	-0,831
	(0,56)	(0,449)	(0,684)	(0,784)	(0,476)
Group_number	-0,332	0,605	1,130	2,284	1,141
	(1,15)	(0,922)	(1,405)	(1,608)	(1)
Age	-0,021	0,058	-0,035	-0,029	0,064
	(0,053)	(0,043)	(0,065)	(0,075)	(0,046)
Age*group1	0,045	0,025	0,017	0,060	-0,074
	(0,1)	(0,08)	(0,122)	(0,145)	(0,089)
Education level	-0,112	0,002	-0,191	0,017	0,137
	(0,123)	(0,099)	(0,15)	(0,176)	(0,109)
Education level * group1	0,050	-0,017	-0,084	-0,360	-0,143
	(0,3)	(0,24)	(0,366)	(0,429)	(0,28)
Money left at end of month	-0,254*	0,140	-0,074	0,196	0,134
	(0,103)	(0,082)	(0,126)	(0,146)	(0,087)
Money left at end of month * group1	0,121	-0,284	-0,079	-0,488	-0,057
	(0,196)	(0,157)	(0,239)	(0,286)	(0,174)
Net income of household	0,143*	-0,147*	0,057	-0,089	-0,047
	(0,071)	(0,057)	(0,086)	(0,102)	(0,061)

Net income of household *group1	-0,174	0,148	-0,089	0,109	-0,052
	(0,102)	(0,082)	(0,125)	(0,145)	(0,09)
Dummyfamily	-0,771**	-0,043	0,093	0,025	-0,153
	(0,201)	(0,161)	(0,245)	(0,286)	(0,175)
Dummyfamily * group1	0,970*	0,041	-0,229	0,210	0,328
	(0,378)	(0,302)	(0,461)	(0,535)	(0,323)

* Indicates p<0.05 ** Indicates p<0.01

Difference in the perception of knowledge

In the group that completed the survey, the average level of knowledge increased by 0.023. On the other hand, for the group that completed the PVE, their knowledge decreased by 0.2. This means that approximately 1 out of 5 individuals perceive themselves to have one scale lower understanding of the installation of district heating networks after completing the PVE. In the PVE group nobody chooses a higher knowledge level than before the consultation. This can be seen in Figure 31.

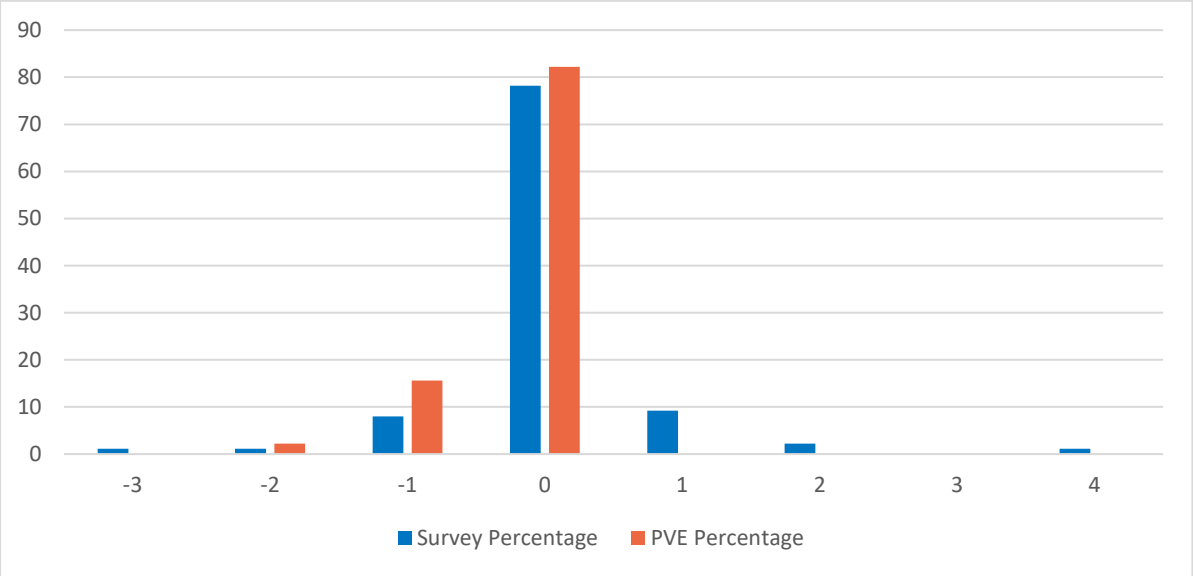

Figure 31 Histogram of difference in perceived knowledge and type of consultation

The multiple regression model reveals that the type of consultation does not have a significant effect on the difference in perceived knowledge. However, three demographic characteristics and one interaction effect show a significant impact on the difference in perceived knowledge. For the amount of money left at the end of the month, the coefficient is -0.254, indicating that individuals who have more disposable income experience a greater decrease in perceived knowledge compared to those with less disposable income. The coefficient for net income is 0.143, suggesting that households with higher income tend to have an increase in perceived knowledge after the consultation. The dummy variable representing whether participants have children has a coefficient of -0.771, indicating that families with children experience a relatively greater decrease in perceived knowledge. The interaction variable for the interaction effect between the family dummy variable and group 1 has a coefficient of 0.970,

suggesting that individuals with children who participated in the PVE experience an increase in perceived knowledge.

It is important to note that interpreting a decrease in knowledge in this context can be challenging. It is difficult to perceive a decrease in knowledge when being presented with information. Therefore, it is expected that individuals who report a decrease in knowledge may have actually realised the complexity of the issue, which can be seen as an increase in knowledge. Consequently, the conclusions drawn from this model should be interpreted with caution.

Differences in participation need

The completion of the PVE or survey resulted in an increase or decrease in the desire to participate across three categories. Those are; the need to receive information (2), the need to think along with the decisionmakers (3) and the need to co-decision with the decisionmakers (4). The difference in this need are shown per type of survey in Figure 32, Figure 33 and Figure 34. It can be seen that the distributions follow fairly similar shape but the survey is slightly more spread out than the PVE.

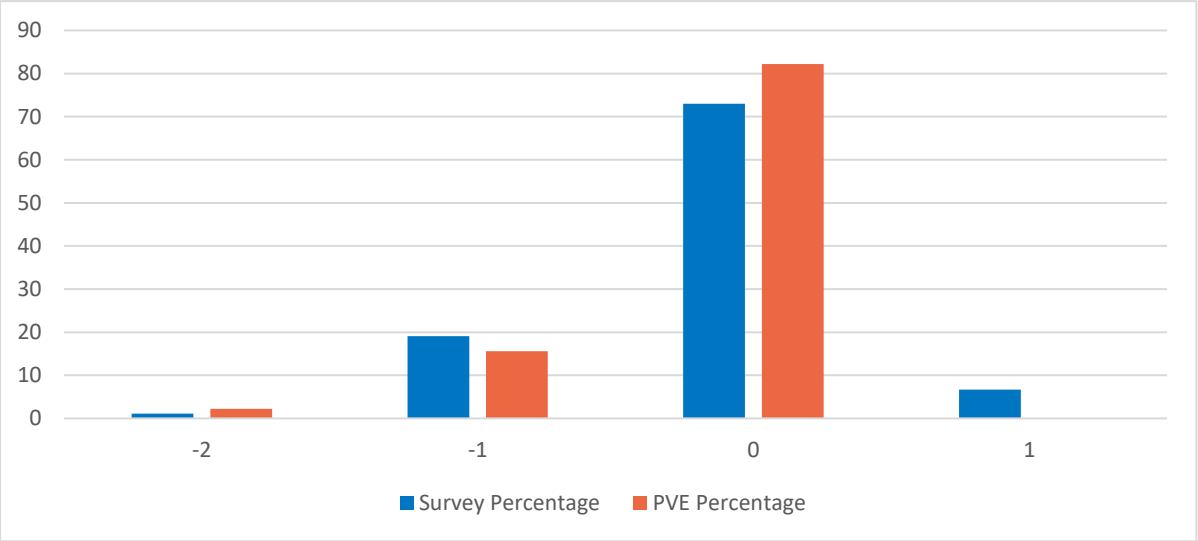

Figure 32 Histogram of difference in need to receive information and type of consultation

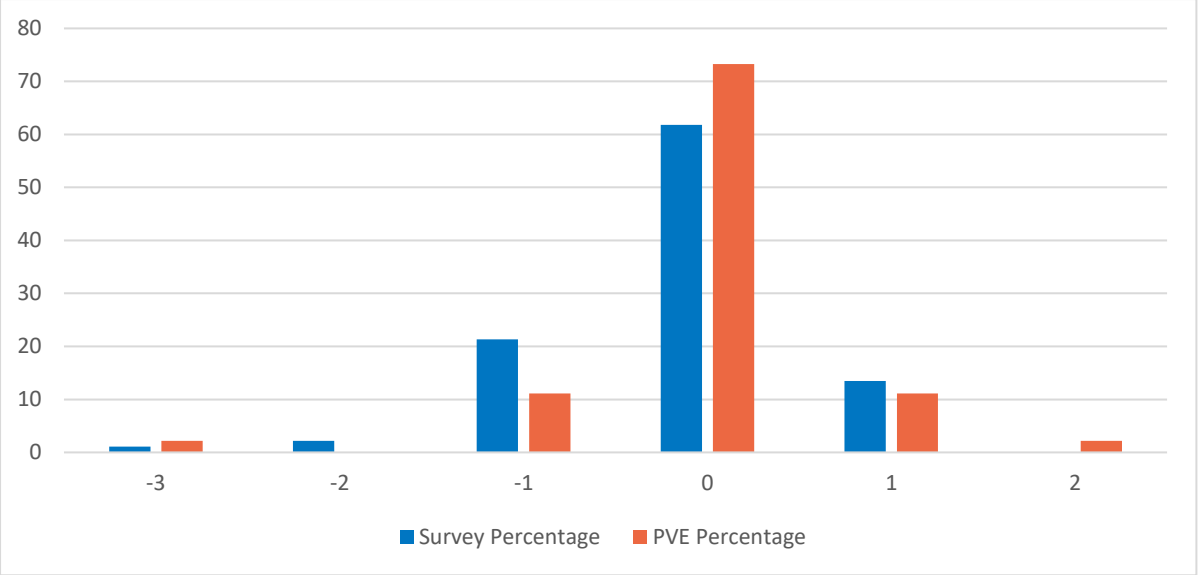

Figure 33 Histogram of difference in need to think along and type of consultation

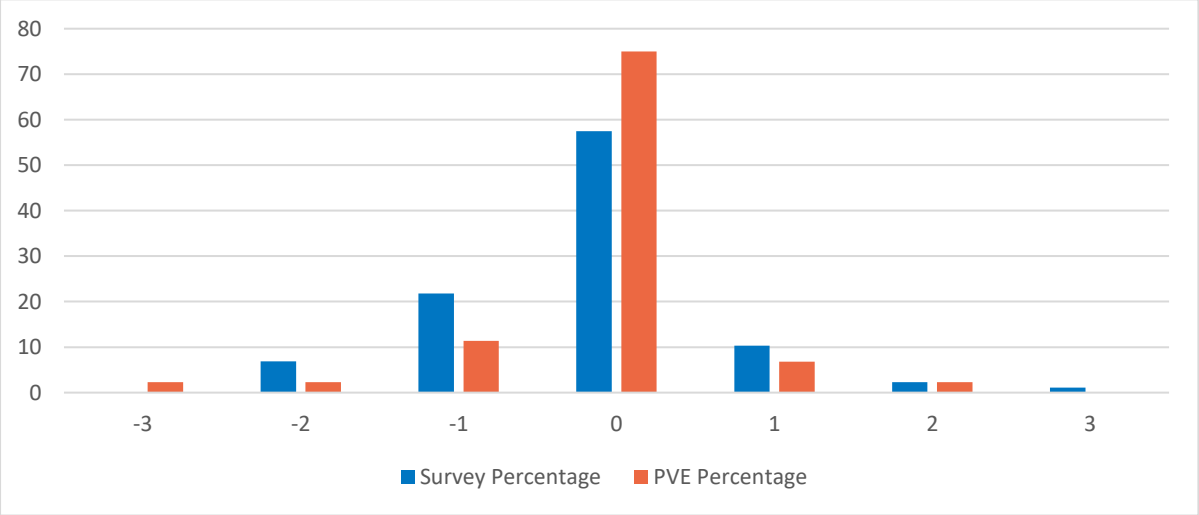

Figure 34 Histogram of difference in need to co-decision and type of consultation

The multiple regression models indicate that the type of consultation cannot explain the changes in participation need for all three categories. This also holds true for all other demographic characteristics, except for one where the coefficient is statistically significant. This significant coefficient is associated with net income and the difference in information need. The coefficient value is -0.147, indicating that for every increase of one category in household net income, the expected difference in information need decreases by 0.147. The categories of net income are defined in increments of 1000 euros.

Difference in willingness to connect to district heating networks

Both in the survey and the PVE, respondents indicate that they are, on average, less motivated to connect to a DHN after completing the consultation. In the PVE, there is a decrease of 0.11, which means that approximately 1 out of 10 respondents indicate a one-level lower preference for connecting to the district heating network. This decrease is bigger in the survey. This means that in this setting the PVE performed better in keeping people motivated to connect to a DHN. The histogram of the type of consultation and the

difference in the need to connect to a DHN is shown in Figure 35. However, the multiple regression model indicates that the type of consultation and the demographic characteristics have no significant influence on the difference in willingness to connect to a district heating network.

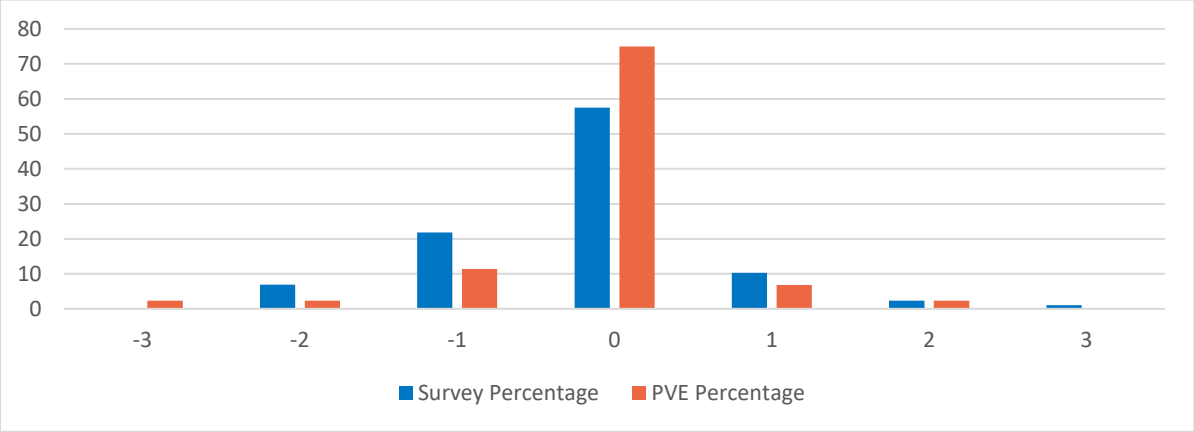

Figure 35 Histogram of difference in willingness to connect to a DHN and type of consultation

6.6. Comparison of the advice given with the PVE and the survey

A PVE and a survey provide different ways of responding and different information on which to base one's answers. This can result in different responses or a different view on the preferences of the consulted public. In this section, these differences in the survey and PVE are compared.

A PVE provides more detailed information, including additional details accessible through information buttons. Respondents can immediately see the effects of their choices. Furthermore, respondents have certain restrictive goals they must achieve, which may make certain options unavailable and necessitate making choices. Additionally, certain combinations of options may be incompatible. All of these factors can influence how individuals fill out the consultation. The differences between the survey and the PVE are presented in Chapter 5.

Type of heat source

A district heating network needs to be connected to a heat source that provides heat to the houses. Sometimes, it's not possible to connect multiple sources to the network, so a choice must be made among the available options. There is an ongoing debate in society about whether it's good or not to use waste heat. In the consultation respondents can express their preferences for the different heat sources.

In the PVE, the respondent cannot choose both heat sources. They have to pick one of the two options. If they choose not to select a source, it makes the district heating network impractical, and the progression through the PVE becomes unattainable. On the other hand, the survey allows the respondent to express their support or opposition for both sources. This way, the PVE encourages people to decide between the two options, so they understand the difficulties faced by the government. Additionally, the PVE provides more information about the choices, helping the respondent make a better-informed decision.

In the survey, 74.2% of the respondents agree that the district heating network should be connected to waste heat, while 93.3% believe it should be connected to renewable sources. It appears that the public has a strong preference for connecting both options. However, if a choice were to be made, respondents would likely have a preference for connecting the district heating network to a renewable source.

Table 9 Preference for the use of different types of heat for the respondents of the survey

Type of heat	Unit	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I'd rather not say/don't know
Waste heat	Number	3	4	12	41	25	4
Waste heat	Percentage	3,4%	4,5%	13,5%	46,1%	28,1%	4,5%
Renewable resources	Number	0	0	4	41	42	2
Renewable resources	Percentage	0%	0%	4,5%	46,1%	47,2%	2,2%

In contrast, among the group of respondents who participated in the Participatory Value Evaluation (PVE), a different outcome is evident. Here, a majority of 55.6% choose the waste heat source. While 44,4% choose the renewable sources option. The difference between the PVE and the survey can possible be explained by two factors. Firstly, respondents in the PVE received more detailed information about the waste heat source. This additional information may alleviate concerns or help them recognise its advantages. The respondents of the PVE, who were not able to select both options, ultimately decided that using heat that is available is more important than using renewable energy. This means that if respondents are forced respondents to make a choice between two things that their preference can be different from what they otherwise would have chosen. This difference is important to consider because it was a significant point for stakeholders to provide input on the choice between waste heat or renewable sources.

Table 10 Preferences for the type of used heat for the respondents of the PVE

Type of heat	Unit	Not selected	Selected
Waste heat	Number	20	25
Waste heat	Percentage	44.4%	55.6%
Renewable sources	Number	25	20
Renewable sources	Percentage	55.6	44.4%

Additional heat sources

When designing a district heating network, it is essential to ensure a match between the heat demand and heat supply. Naturally, the objective is to meet the standard heat

demand. However, a decision must be made regarding the size of additional peak capacity. Additional capacity guarantees an adequate heat supply during cold periods when there is high demand. There is always the option to design the network with more capacity in terms of heat supply the heat supply compared to the heat demand, which entails two main effects. Firstly, it reduces the likelihood of disruptions caused by excessive peak demand. Secondly, a larger heat supply results in higher costs for end-users. The survey offers limited space for communicating these effects. Conversely, the PVE provides an opportunity for providing additional explanations and presenting information about the effects.

In the survey, 62.9% of respondents indicated their approval for connecting the district heating network to additional heat sources. This is shown in Table 11. However, As shown in Table 12, in the PVE, only 37.8% chose to incorporate extra sources. The reasons provided by individuals for not connecting to additional sources are as follows.

"Short failures regarding heat are acceptable to me. Too expensive for too little benefit"

"Cost. We will survive the occasional outage"

"It would be better, but it could not be included due to feasibility"

The observation that fewer individuals choose to connect additional heat sources in the PVE, combined with the reasons provided, indicates that once people are presented with the effects of their choices, their perspective on the decision changes. Moreover, they make different choices in practice.

This implies that a PVE is more effective in communicating the government's dilemmas, as it can make the respondents truly feel the choice dilemma. In this case, they can see the negative effects of connecting additional heat sources to the district heating network. As a result, some respondents decide to recommend not connecting to extra sources.

Table 11 Preference for the use of additional heat sources for the survey respondents

Unit	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I'd rather not say/don't know
Number	0	2	24	46	10	7
Percentage	0%	2.2%	27%	51.7%	11.2%	7.9%

Table 12 Preferences for the use of additional heat sources for the PVE respondents

Unit	Not selected	Selected
Number	17	28
Percentage	62.2%	37.8%

Distribution of costs

In the PVE, three effects are presented: the feasibility of the plans, the costs for taxpayers, and the costs for customers of the district heating network. The feasibility of the plans is partially based on the expenses incurred by the developer during the construction and operation of the network. This means that if the user or taxpayer bears higher costs, the feasibility increases. In the PVE, two options have been added that require customers or taxpayers to contribute more financially.

Among the survey respondents, 20.2% (see Table 13) believe that customers of the district heating network should make additional contributions, while in the PVE, this percentage is 42.2% (see Table 14). This difference can possibly be explained by the fact that PVE respondents are presented with the positive outcomes that can be achieved for the network by paying more as customers.

In the survey, 61.8% of respondents believe that more subsidies should be provided for the establishment of district heating networks, whereas in the PVE, this figure rises to 80%. This can be attributed to the PVE demonstrating that subsidies enhance the feasibility of district heating networks, enabling the construction of a better network.

Table 13 Preference for the distribution of the costs for the district heating network for the survey respondents

Measure	Unit	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I'd rather not say/don't know
Higher customer payment for connection to the DHN	Number	11	20	34	16	2	6
Higher customer payment for connection to the DHN	Percentage	12,4%	22,5%	38,2%	18%	2,2%	6,7%
Higher government subsidy for connection to the DHN	Number	2	4	20	38	17	8
Higher government subsidy for connection to the DHN	Percentage	2,2%	4,5%	22,5%	42,7%	19,1%	9%

Table 14 Preference for the distribution of the costs for the district heating network for the PVE respondents

Measure	Unit	Not selected	Selected
Higher customer payment for connection to the DHN	Number	26	19

Higher customer payment for connection to the DHN	Percentage	57,8%	42,2%
Higher government subsidy for connection to the DHN	Number	9	36
Higher government subsidy for connection to the DHN	Percentage	20%	80%

Nuisance

In the Participatory Value Evaluation (PVE) and the survey, respondents were asked whether they desired the mitigation of three different forms of inconvenience. These three forms pertained to nature, neighbourhood residents, and users of the district heating network. Table 15 reveals that 74.1% of survey respondents indicated agreeing or strongly agreeing with the prevention of inconvenience to nature. For users and neighbourhood residents, these percentages were 51.7% and 59.4%, respectively. From this data, it can be concluded that the group that participated in the survey considers the prevention of inconvenience to nature to be the most important. Inconvenience to neighbourhood residents and users are closely aligned, with respondents showing a slight preference for reducing inconvenience to neighbourhood residents compared to users of the district heating network.

Table 15 Preference for the distribution of the reductions of nuisance for the survey respondents

Measure	Unit	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I'd rather not say/don't know
Reduce environmental disturbances	Number	1	6	12	30	36	4
Reduce environmental impact	Percentage	1,1%	6,7%	13,5%	33,7%	40,4%	4,5%
Reduce nuisance for users	Number	1	7	34	32	14	1
Reduce nuisance for users	Percentage	1,1%	7,9%	38,2%	36%	15,7%	1,1%
Reduce nuisance for the neighbourhood	Number	1	11	24	35	18	0
Reduce nuisance for the neighbourhood	Percentage	1,1%	12,4%	27%	39,3%	20,2%	0%

In the PVE, it is noticeable that there is not the same order of preference for these three options. Table 16 shows that respondents prefer to reduce inconvenience to nature first, followed by reducing inconvenience to neighbourhood residents, and lastly reducing inconvenience to users. Furthermore, it is evident that fewer people indicate that these options should be chosen.

The change in the order of preferences is likely explained by the provision of more information. As individuals gain a better understanding of what each policy option entails and take the time to reflect more deeply, they make a different assessment. This suggests that PVE respondents provide more nuanced advice.

Table 16 Preference for the distribution of the reductions of nuisance for the PVE respondents

Measure	Unit	Not selected	Selected
Reduce environmental disturbances	Number	25	20
Reduce environmental disturbances	Percentage	55,6%	44,4%
Reduce nuisance for users	Number	34	11
Reduce nuisance for users	Percentage	75,6%	24,4%
Reduce nuisance for the neighbourhood	Number	37	8
Reduce nuisance for the neighbourhood	Percentage	82,2%	17,8%

Coercion to switch to a district heating network

The imposition or prohibition of choices is something that is sensitive in the Netherlands as a country that values freedom. However, for the purpose of achieving a new energy system, it can have positive effects. In the PVE, the effects of this choice have been clearly demonstrated through additional information and displayed with corresponding impacts on the right-hand side. Additionally, this option can contribute to the feasibility of the project and help keep costs low for taxpayers or customers of the district heating network. In the survey, no information regarding the effects was provided, allowing respondents to freely express their views on the extent to which mandates should be considered.

Table 17 reveals that in the survey, 42.7% of the respondents agree or strongly agree that there should be the possibility to impose the remaining gas users to switch to a district heating network. In the PVE, 75.6% of respondents opted to allow for this option. This difference highlights the suitability of a PVE in effectively communicating the effects of policy measures and prompting thoughtful consideration.

Table 17 Preference for the ability to coerce citizens to switch to a DHN the survey respondents

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	I'd rather not say/don't know

Number	8	16	20	24	14	7
Percentage	9%	18%	22,5%	27%	15,7%	7,9%

Table 18 Preference for the ability to coerce citizens to switch to a DHN the PVE respondents

	Not selected	Selected
Number	11	34
Percentage	24,4%	75,6%

6.7. Conclusion on results of the Participatory Value Evaluation and survey

Significant differences are found between the PVE and the survey. The drop-off rate is 66.4% for the PVE and 25.2% for the survey. The completion time for the PVE is 22.5 minutes, while the survey respondents take an average of 13.4 minutes. In terms of representativeness, it is found that the PVE is completed by a lower percentage of individuals with a lower education, lower wealth, higher age, and households with children compared to the survey. Regarding the difference in perceived knowledge, participation need, and willingness to connect to a DHN, no influence of the type of consultation on these variables can be found. Additionally, it is found that PVE respondents perceive their consultation as significantly more complex than the survey respondents. However, the PVE participants indicate that they have learned more about government decision-making through the consultation. Furthermore, respondents of the PVE attribute fewer responsibilities to citizens compared to survey respondents. Lastly, it is observed that respondents' choices differ when they receive more information and have restrictive goals.

7. Discussion and Conclusion

In this chapter the results are interpreted and discussed, consequently the conclusions are presented. The limitations of this research are addressed in section 7.1. The sub-questions are answered in section 7.2, leading to the response to the main research question in section 7.3. The scientific contribution of this study is elucidated in section 7.4. Finally, recommendations for further research and for practitioners are provided in section 7.5.

7.1. Limitations

Selection bias

One limitation of this study is the possibility of selection bias due to the voluntary nature of participating in the Participatory Value Evaluation (PVE). People who chose to take part in the PVE may have different views compared to those who decided not to participate. The difference in perspectives may contribute to individuals deciding not to participate in the consultation process. This phenomenon is also present in other forms of public engagement, and it is inherent that a comprehensive representation of all citizens affected by the proposed policy cannot be achieved.

No contact possibilities with respondents who stopped

One limitation of the study is the inability to reach individuals who drop out of the Participatory Value Evaluation (PVE). In the current setup, there is no means to contact or inquire about the reasons for their disengagement. This limitation hinders the researchers' ability to gather data and insights from this group of respondents that drop out. Despite the limitation regarding reaching individuals who drop out, the study still provides valuable findings based on the data collected from respondents who completed the PVE.

Comparing different data of the survey and PVE

Another limitation of the study relates to the design of the Participatory Value Evaluation (PVE), which was customised to accommodate the preferences of stakeholders. This customisation led to the implementation of a pick mode PVE, wherein respondents had the discretion to choose whether to select specific options presented to them. In contrast, the survey employed a Likert scale to measure respondents' agreement or disagreement with multiple statements, thereby avoiding binary responses. Consequently, comparing the substantive findings between the survey and PVE becomes more complex due to the differing response formats.

Small sample size

Another limitation of this study is the constrained time and resources available. As it was conducted as a thesis, there was no budget allocated for remunerating a participant panel. To maintain independence from external timelines, such as those dictated by local governments, respondent recruitment was carried out by the researchers. Consequently, a relatively small sample size (2700 delivered letters, 134 completed surveys) was used, potentially limiting the generalizability of the findings. However, despite this limitation, clear differences between the two methods were identified.

7.2. Answers to the sub questions

Sub question 1:

'What are the goals, perceived strengths and weaknesses of using a Participatory Value Evaluation for the development of district heating according to stakeholders?'

This has been addressed in Chapter 4, where the results of the interviews are presented and analysed. The goals can be categorised into two main types: process goals that describe the outcomes of conducting a PVE, and subject goals that define the topics to be addressed in the PVE.

The process goals for stakeholders involve gathering input and creating awareness and understanding. It should be noted that the reasons for collecting input vary among stakeholders. The first reason is to better align the construction of the district heating network with the needs of the community. Some stakeholders also believe that better aligned plans will ultimately encourage more residents to join the network. The third reason is to make residents feel heard, fostering a more positive attitude toward the plans of the development parties. The first reason is substantive in nature, while the latter two are instrumental.

The subject goals mentioned include division of responsibilities and roles, individual choice versus collective heat supply, thermal insulation, and additional technical aspects. It is worth noting that stakeholders have differing opinions on which topics should be addressed in the PVE.

The challenges identified by stakeholders in using a PVE to gather input from citizens include representativeness, language barriers, digital literacy, general reasons for dropping out of participation, coordination of the PVE process, and the need for a realistic and simple PVE.

According to the interviewed stakeholders, reaching a representative group for the targeted area and public poses a significant challenge. They emphasise the importance of having a simple, realistic, and language wise accessible PVE. However, this desire for simplicity conflicts with the need to explain complex issues and seek advice on difficult matters.

The stakeholders recognise several benefits, including improved understanding and awareness, reaching a broader public, and gathering more valuable input through effective questioning. It is acknowledged that a PVE can engage different groups compared to more traditional forms of public participation processes.

Sub question 2:

'What are relevant questions to ask citizens to advise on in a Participatory Value Evaluation & survey about the development of district heating in their neighbourhood?'

This question is answered in Chapter 5 by with input from the literature review and stakeholder interviews. The relevant questions to be asked to the respondents are

presented in five dilemmas, which aim to collect input while creating awareness and understanding.

The first dilemma is the forced disconnection of gas users. Respondents in the PVE have the option to choose forced disconnection, which involves disconnecting remaining natural gas users from the gas network. This choice can increase feasibility and decrease costs for taxpayers and customers of the district heating network. If respondents don't support forced disconnection, there will be limited opportunities to enhance the attractiveness of the district heating network.

The second dilemma is the distribution of costs. The PVE offers options for different cost distribution among customers, taxpayers, and the heat company. Respondents are made aware that ultimately someone must bear the costs, and additional subsidies for district heating networks are funded by taxpayers.

The third dilemma is balancing inconveniences and costs. Respondents are presented with options to mitigate inconveniences related to heat grid construction for residents, customers, and the natural environment. However, reducing these inconveniences may come at a financial cost, and the PVE aims to provide insight into the trade-off between cost and inconvenience.

The fourth dilemma is about heat source options. The consultations focus on sustainable sources and waste heat as alternatives to fossil fuels for district heating networks. Respondents can choose between connecting to a sustainable source or utilising waste heat, allowing for insights into individual considerations and trade-offs when selecting a preferred heat supply option.

The last dilemma is the downtime risk and costs. The PVE addresses the trade-off between installing additional heat capacity to reduce disruptions during cold days and the associated costs.

Overall, the PVE and the survey seeks to gather public opinions and insights on these different aspects to inform the development and implementation of district heating networks while considering costs, feasibility, inconveniences, heat source options, and reliability.

Sub question 3:

'What is the experience of citizens in the use of the Participatory Value Evaluation and survey in terms of representativeness, completion time and perceived quality?'

Chapter 6 of the thesis examined the experiences of citizens regarding their participation in the Participatory Value Evaluation (PVE) compared to a survey. This comparison was conducted to provide a reference for assessing the PVE experience, as it is challenging to make a comprehensive evaluation without comparative material.

Citizens' experiences of their participation in the Participatory Value Evaluation (PVE) and the survey were examined, considering factors such as, representativeness,

completion time, rating, validity of the consultation and drop-off rates. The analysis revealed the following insights:

Representativeness: It has been found that the PVE is relatively more likely to be completed by individuals with higher incomes, more disposable income at the end of the month, higher educational attainment, children in the household, and younger age compared to the survey. Stakeholders' expectations regarding the reach and potential challenges of the PVE were confirmed. The PVE and survey were completed to a similar extent by participants from different genders, daily life occupations, and levels of neighbourhood connectedness.

Completion Time: It can be concluded that the setup with more available information and respondents needing to balance their choices of measures leads to a longer average duration of the surveys. On average, respondents spent 13.4 minutes completing the survey, while the PVE required an average time of 22.5 minutes. This difference in completion time was found to be statistically significant for the population, indicating that the PVE demanded a longer time commitment from respondents compared to the survey. This finding is not inherently positive or negative, but it is an important factor to consider when formulating the remaining conclusions of this study.

Rating: The conclusion can be drawn that the differences in the two types of consultation did not lead to a significant difference in the rating provided by the respondents. In the sample, respondents provided an average rating of 4.62 for the survey and 4.58 for the PVE on a scale of 1 to 7, where 7 represents the highest rating. These ratings fell between average and above average. This small difference is remarkable given the significant variations between the two consultations. It should be noted that the small difference in ratings between the PVE and survey observed in the sample is not statistically significant for the population.

Validity questions: The comparison between the validity questions of the survey and the PVE leads to the conclusion that the PVE is significantly more difficult to complete than the survey and respondents acquire a greater understanding of the government's choices compared to the survey. After the two different consultations, questions were posed to compare the validity of the consultations. Four questions provided respondents with the opportunity to indicate to which extent the research was directive, trustworthy, important and complex. In the final four questions, respondents were asked to indicate whether citizens should be involved more frequently in the decision-making of District Heating Networks (DHNs), whether this method was suitable for that purpose, whether they had learned about the government's choices and whether the use of the method they had completed increased trust in the government. When comparing the results between the PVE and survey, it emerged that the PVE was significantly more difficult to complete and the PVE respondents had significantly learned more from the government's choices.

Drop-off Rates: The sample data indicated a higher drop-off rate for respondents in the PVE compared to the survey. Specifically, 66.4% of respondents who started the PVE did not complete it, while 25.2% of respondents who started the survey did not complete it. This difference was statistically significant, suggesting that it likely holds true for the larger population as well. The factors contributing to this notably higher drop-off rate can

likely be attributed to two factors. Firstly, one of the explanations lies in the longer completion time required for the PVE compared to the survey. Secondly, it is indicated that the PVE is also significantly more challenging to complete than the PVE.

In conclusion, respondents in the PVE exhibited a higher drop-off rate and spent more time compared to the survey. The respondents indicated that the PVE was more difficult to complete but learnt them more about the governments' choices than the survey. The ratings received for both methods were relatively positive and did not differ significantly.

Sub question 4:

'How do the Participatory Value Evaluation and survey differ in creating meaningful input for the involved stakeholders?'

To assess the achievement of creating meaningful input the responses of the different consultations were compared. Examining the interviews, meaningful input can be regarded as input wherein citizens decide between trade-offs and provide nuanced advice to the government that can be used in policy making or execution. The analysis of the responses was conducted in Chapter 6.

The stakeholders' goal of gathering input was achieved by both methods. However, respondents of the PVE provided more detailed explanations of their priorities, which resulted in richer input in the text fields. What was also noticed was that respondents in the PVE made different choices that showed that the availability of extra information influenced their choices.

The key differences in how respondents decide between trade-offs are evident in the dilemma regarding the distribution of costs among involved parties and the potential coercion of citizens to transition away from gas. The comparison reveals that respondents of the PVE are more willing to accept negative consequences for themselves because they know the community will benefit from it.

The findings of the PVE indicate that respondents are more favourable towards enforcing citizens to transition to green heating methods compared to the survey. Moreover, PVE participants show greater willingness to support the idea of individuals connecting to the system and taxpayers contributing more towards the construction of the heat network, in comparison to survey respondents.

Therefore, it can be concluded that the PVE is more proficient in presenting dilemmas than the survey, enabling citizens to make more nuanced considerations by understanding the benefits of seemingly inconvenient policy measures.

7.3. Answer to the main research question

'To what extent do a Participatory Value Evaluation and a survey differ in incorporating the goals and perceived advantages and disadvantages of the involved stakeholders in the decision-making of district heating networks.'

The research aimed to assess the difference between a PVE and a survey in incorporating the goals and perceived advantages and disadvantages of the involved stakeholders. The study addressed several aspects related to this main research question.

The process goals identified for the stakeholders are gathering input and creating awareness and understanding. The PVE and survey seek to collect input and generate awareness and understanding regarding four dilemmas: the forced disconnection of gas users, the distribution of costs, the balancing of inconveniences and costs, and the available heat source options. Challenges such as representativeness, language barriers, and coordination were also recognised.

It was discovered that the PVE was more difficult to complete, had a higher drop-off rate and took more time to complete than the survey. Respondents of the PVE indicated that they learnt more about the choices of the government than the respondents of the survey. Both methods received relatively positive ratings, that don't differ significantly from each other.

The PVE was able to gather more input and create more awareness per respondent than the survey. Respondents made more informed choices and provided detailed explanations of their priorities. However, the higher drop-off rate in the PVE limited the amount of collected input compared to the survey.

In conclusion, it can be stated that both the PVE and the survey have their advantages and disadvantages. The PVE is perceived as a more difficult consultation to complete, with considerably longer completion times and higher drop-off rates. Furthermore, individuals with lower education and lower wealth struggle more in completing the PVE than the survey. However, the PVE yields more input per participant who completes it and has a greater impact on raising respondent awareness.

7.4. Scientific contribution

This thesis research applies a Participatory Value Evaluation (PVE) and survey in an experimental setting to the decision-making process of District Heating Networks (DHNs). The novel application of the PVE, the comparative setup, and the outcomes contribute to the academic literature.

The PVE is already used for community engagement in the energy transition. Hössinger et al. (2023) enable citizen participation in reducing CO2 emissions from transportation through the application of a PVE. However, the specific application of the PVE in the decision-making process regarding DHN installation represents a new use of the method.

Mouter et al. (2021) applied a PVE to involve citizens in the formation of a Heat Transition Plan. They demonstrate, among other findings, that a PVE enables participation from individuals who typically do not engage in such processes. Our comparative study between the survey and PVE reveals that the complexity of the PVE affects participation rates, suggesting that a simpler form of consultation may be more suitable for reaching larger groups of people. Additionally, the article of Mouter et al. (2021) highlights the

usefulness of PVE outcomes for decision-making. From our research we can add that employing a simpler form of consultation may result in less valuable outcomes. Furthermore, Mouter et al. demonstrate that the PVE raises citizens' awareness of decision-making processes and the implications of the energy transition. Building on this thesis research, it can be added that respondents indicate a greater understanding of the government's decision-making choices in a PVE compared to a survey.

Itten & Mouter (2022) conduct an experiment using a PVE combined with a climate assembly to maximise the benefits of both methods and mitigate their drawbacks. Following our comparative study between the survey and PVE, relative advantages and disadvantages between these two methodologies become evident. Just as the benefits of combining a survey and PVE were explored by Itten & Mouter (2022) earlier, it may also be possible to combine a survey and PVE. The combination of these two approaches is further discussed in the recommendations for practitioners (7.5.2).

Of course, the aforementioned studies are also assessed by the authors in terms of their performance. There are also studies in which the PVE method is tested by other researchers. For example, Juschten & Omann (2023) evaluate the PVE method using the CRELE framework. They note that both citizens and expert's express concerns about the tool's complexity as a potential barrier to participation and inclusivity, particularly for elderly individuals and those with lower levels of education. Our study confirms that these concerns are valid and that a PVE indeed attracts higher proportions of younger, highly educated individuals.

Although the research was conducted on a relatively small sample size, it provides a foundation for future investigations to build upon. Further research in this area can expand upon these findings and explore the effects of different consultation formats on participant engagement, input quality, and awareness generation on a larger scale.

7.5. Recommendations

7.5.1. Recommendations for further research

This study provides valuable insights into the differences between a PVE and survey. To expand on these findings and contribute to the field of public participation practices, several areas of further research are suggested.

Firstly, conducting interviews with both completing and non-completing respondents would offer deeper insights into their perspectives and experiences. By exploring their reasons for completion or dropping out, researchers can gain a better understanding of the factors influencing drop-off rate. Such research would generate insights on the effectiveness of different consultation methods and contribute to the development of more inclusive and impactful engagement strategies.

Secondly, it is recommended to explore the effects of a dynamic consultation approach that allows participants to determine their desired level of detail and duration of involvement. By offering flexible options, such as a simpler or more extensive consultation, researchers can assess the preferences and engagement levels of

participants. This study would provide insights into tailoring consultation processes to meet the needs and preferences of respondents.

Furthermore, improving respondent recruitment methods is crucial to address selection bias in future studies. Researchers should consider implementing strategies such as targeting specific demographic groups or providing incentives to ensure a more representative sample and reduce self-selection bias. By employing these approaches, researchers can enhance the reliability and applicability of their findings, ensuring that the outcomes accurately reflect the perspectives of a wider range of participants.

In conclusion, investigating the differences between consultation methods, exploring dynamic consultation approaches, and improving respondent recruitment methods are recommended for future research. These efforts will contribute to a better understanding of public participation strategies and facilitate the development of inclusive public consultation practices.

7.5.2. Recommendations for practitioners

Following the research, three recommendations can be made to enhance the use of a Participatory Value Evaluation (PVE) in engaging homeowners in the development of district heating networks. These three recommendations focus on professionals that develop PVE's for government organisations and civil servants that want to use a PVE to engage with the community. By considering these recommendations, practitioners can enhance the design and implementation of PVE's, ensuring a more tailored and engaging experience for respondents while facilitating meaningful and sustained contributions to decision-making processes.

Consider the trade-off between complexity and effectiveness

When designing a participatory evaluation, it is crucial to carefully consider whether the benefits of a more complex questionnaire outweigh the potential challenges it may pose. Assess the level of complexity required to gather valuable insights and strike a balance between comprehensiveness and respondent engagement. By finding the right balance, you can enhance the quality of data collected while minimising respondent drop-off.

Foster ongoing engagement and community building:

The PVE should not be viewed solely as a one-time engagement tool. Utilise the PVE as a means to foster ongoing engagement and build a sense of community among respondents. Particularly in local PVEs, consider asking respondents for their consent to be contacted for future involvement in similar activities or discussions. This approach can help maintain a pool of engaged stakeholders who are willing to contribute their perspectives beyond the initial PVE. Additionally, engage respondents in conversations about the PVE results, providing them with feedback on how their input has influenced decision-making processes. By establishing ongoing dialogue and communication channels, a sense of ownership and collaboration can be fostered, strengthening the effectiveness and impact of future participatory evaluations.

Implement a dynamic PVE approach

Where feasible, consider implementing a dynamic Participatory Value Evaluation (PVE) approach. A dynamic PVE approach can be seen as a PVE where respondents are given the choice of which form of consultation they participate in. This approach allows for a distinction between a more comprehensive version and simpler variant. The aim of this approach is to maximise the benefits of both the PVE and the survey while mitigating their drawbacks. By providing flexibility in participation, this approach aims to create a more inclusive consultation process, allowing individuals to fully engage according to their preferences and capabilities.

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Appendix A. Interview questions

Interview guide – PVE voor decision-making of District heating network

Eigen inleiding:

- Studie CME
- Afstuderen bij Populytics op de ontwikkeling van een PWE hoe huiseigenaren betrokken kunnen worden bij warmtenet ontwikkelingen
- Semi gestructureerd interview, vragen voorbereid maar ook mogelijkheid om af te wijken
- Later in het gesprek workshop gedeelte waarin we specifiek over PWE gaan hebben
- Opnemen

Inleidende vragen:

- Bij welke organisatie ben je werkzaam?
- Welke rol heb je bij die organisatie? Wat doe je op dagelijkse basis?
- Welke rol speelt jullie organisatie in de warmtetransitie?

Rol ontwikkeling warmtenetten:

- Hoe zijn jullie betrokken bij de ontwikkeling van warmtenetten?
- Op welke manier worden huiseigenaren betrokken die in een wijk wonen waar een warmtenet ontwikkelt wordt?

Uitleg aan interviewee:

Participatieve Waarde Evaluatie (PWE) is een nieuwe methode om beleidsopties te evalueren en de participatie van grote groepen burgers te faciliteren. De essentie van een PWE is dat burgers op een laagdrempelige manier een advies kunnen geven over een keuzevraagstuk van een overheid. Lelylijn was in het nieuws afgelopen dagen en een raadpleging over het energie systeem van de toekomst. Zij worden als het ware op de stoel van de bestuurder gezet. In een online omgeving zien zij welke keuze de bestuurder moet maken, ze krijgen een overzicht van de concrete voor- en nadelen (of effecten) van de opties waartussen de bestuurder kan kiezen en de beperkingen die er zijn (bijv. beperkt budget of een verplichtend doel). Vervolgens wordt er aan hen gevraagd wat zij de bestuurder zouden adviseren. Ten slotte lichten burgers hun keuzes toe wat een scherp beeld oplevert van hun voorkeuren en overwegingen.

- PWE ontwikkelen woningeigenaren betrekken of benaderd moeten worden voor ontwikkeling warmtenetten.
- Meerdere stakeholders interviewen, hoeverre kunnen er meerdere doelen meegenomen worden.

Input vragen burgers:

- Welke dilemma's spelen er rond het aansluiten van particulieren op warmtenetten?
- Wie ervaart dit dilemma?
- Waar kunnen inwoners inspirerende ideeën leveren?
- Op welke manier kan burgerparticipatie hier bij helpen?

Vragen over doelen PWE:

- Wat zouden voor jullie organisatie doelen kunnen zijn om met een PWE gericht op huiseigenaren die in een wijk wonen waar een warmtenet ontwikkeld gaat worden te realiseren?
- Wat zijn in jullie ogen **voordelen** van het toepassen van een PWE gericht op huiseigenaren die in een wijk wonen waar een warmtenet ontwikkeld gaat worden?
- Wat zijn in jullie ogen **uitdagingen** van het toepassen van een PWE gericht op huiseigenaren die in een wijk wonen waar een warmtenet ontwikkeld gaat worden?
    - Hoe zou je deze uitdagingen zelf tackelen?

Appendix B. Independent sample t tests used in the comparison of the two types of consultations

Group Statistics

	Treatment_number_letop	N	Mean	Std. Deviation	Std. Error Mean
Secondesoutliersverwijderd	0	88	801.9205	573.66489	61.15288
	1	41	1350.3902	643.31306	100.46862

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
						Significance				95% Confidence Interval of the Difference
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Secondesoutliersverwijderd	Equal variances assumed	2.145	.146	-4.863	127	<,001	<,001	-548.46979	112.78646	-771.65384	-325.28574
	Equal variances not assumed			-4.663	70.670	<,001	<,001	-548.46979	117.61641	-783.00925	-313.93033

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
Secondesoutliersverwijderd	Cohen's d	596.47930	-.920	-1.305	-.530
	Hedges' correction	600.03095	-.914	-1.298	-.527
	Glass's delta	643.31306	-.853	-1.263	-.434

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B1 SPSS output of independent sample t test for completion time

Group Statistics

	Group_number	N	Mean	Std. Deviation	Std. Error Mean
Voltooid	0	119	.7479	.43605	.03997
	1	134	.3358	.47405	.04095

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
						Significance				95% Confidence Interval of the Difference
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Voltooid	Equal variances assumed	8.619	.004	7.165	251	<,001	<,001	.41208	.05751	.29881	.52534
	Equal variances not assumed			7.201	250.681	<,001	<,001	.41208	.05723	.29937	.52478

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
Voltooid	Cohen's d	.45658	.903	.643	1.161
	Hedges' correction	.45795	.900	.641	1.157
	Glass's delta	.47405	.869	.600	1.136

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B2 SPSS output of independent sample t-test for drop-off rates

Group Statistics

	Group_number	N	Mean	Std. Deviation	Std. Error Mean
Geslacht	0	89	.51	.503	.053
	1	45	.62	.490	.073

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Geslacht	Equal variances assumed	5.524	.020	-1.278	132	.102	.203	-.117	.091	-.297	.064
	Equal variances not assumed			-1.289	90.445	.100	.201	-.117	.090	-.296	.063

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
Geslacht	Cohen's d	.499	-.234	-.593	.126
	Hedges' correction	.502	-.232	-.590	.126
	Glass's delta	.490	-.238	-.598	.125

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B3 SPSS output of independent sample t test for gender

Group Statistics

	Group_number	N	Mean	Std. Deviation	Std. Error Mean
Leeftijdsgroep	0	91	3.92	1.529	.160
	1	46	3.43	1.440	.212

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Leeftijdsgroep	Equal variances assumed	.030	.862	1.799	135	.037	.074	.488	.271	-.048	1.025
	Equal variances not assumed			1.835	95.428	.035	.070	.488	.266	-.040	1.016

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
Leeftijdsgroep	Cohen's d	1.500	.326	-.032	.682
	Hedges' correction	1.508	.324	-.032	.678
	Glass's delta	1.440	.339	-.024	.699

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B4 SPSS output for independent sample t test for age

Group Statistics

	Group_number	N	Mean	Std. Deviation	Std. Error Mean
Opleiding2	0	89	1.8652	.34348	.03641
	1	46	1.9783	.14744	.02174

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Opleiding2	Equal variances assumed	22.819	<,001	-2.131	133	.017	.035	-.11309	.05307	-.21807	-.00812
	Equal variances not assumed			-2.667	129.695	.004	.009	-.11309	.04240	-.19699	-.02920

Independent Samples Effect Sizes

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
Opleiding2	Cohen's d	.29226	-.387	-.745	-.027
	Hedges' correction	.29392	-.385	-.741	-.027
	Glass's delta	.14744	-.767	-1.153	-.374

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B5 SPSS output for independent sample t test for education

Group Statistics

	Group_number	N	Mean	Std. Deviation	Std. Error Mean
Dummywerk	0	89	.7753	.41976	.04449
	1	45	.8222	.38665	.05764

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Dummywerk	Equal variances assumed	1.670	.198	-.627	132	.266	.531	-.04694	.07482	-.19494	.10105
	Equal variances not assumed			-.645	95.170	.260	.521	-.04694	.07281	-.19149	.09761

Independent Samples Effect Sizes

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
Dummywerk	Cohen's d	.40902	-.115	-.473	.244
	Hedges' correction	.41136	-.114	-.471	.243
	Glass's delta	.38665	-.121	-.480	.239

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B6 SPSS output for independent sample t test for daily life occupations

Group Statistics

	Group_number	N	Mean	Std. Deviation	Std. Error Mean
Hoogteinkomen3	0	69	1.8406	.67787	.08161
	1	41	2.1463	.76030	.11874

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean	Std. Error	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Difference	Difference	Lower	Upper
Hoogteinkomen3	Equal variances assumed	1.176	.281	-2.185	108	.016	.031	-.30576	.13991	-.58308	-.02844
	Equal variances not assumed			-2.122	76.652	.019	.037	-.30576	.14408	-.59268	-.01885

Independent Samples Effect Sizes

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
Hoogteinkomen3	Cohen's d	.70951	-.431	-.821	-.039
	Hedges' correction	.71449	-.428	-.815	-.039
	Glass's delta	.76030	-.402	-.796	-.003

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B7 SPSS output for independent sample t test for household income

Group Statistics

	Group_number	N	Mean	Std. Deviation	Std. Error Mean
Geldover	0	81	3.93	.985	.109
	1	41	4.29	.716	.112

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean	Std. Error	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Difference	Difference	Lower	Upper
Geldover	Equal variances assumed	.283	.596	-2.117	120	.018	.036	-.367	.173	-.710	-.024
	Equal variances not assumed			-2.345	105.117	.010	.021	-.367	.156	-.677	-.057

Independent Samples Effect Sizes

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
Geldover	Cohen's d	.904	-.406	-.784	-.026
	Hedges' correction	.910	-.403	-.779	-.026
	Glass's delta	.716	-.512	-.902	-.118

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B8 SPSS output for indenpendent sample t test for amount of money left at the end of the month

Group Statistics

	Group_number	N	Mean	Std. Deviation	Std. Error Mean
Gezinsvorm2	0	92	.2717	.44729	.04663
	1	45	.1333	.34378	.05125

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean	Std. Error	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Difference	Difference	Lower	Upper
Gezinsvorm2	Equal variances assumed	16.787	<,001	1.827	135	.035	.070	.13841	.07575	-.01140	.28821
	Equal variances not assumed			1.998	110.428	.024	.048	.13841	.06929	.00110	.27571

Independent Samples Effect Sizes

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
Gezinsvorm2	Cohen's d	.41639	.332	-.027	.691
	Hedges' correction	.41872	.331	-.027	.687
	Glass's delta	.34378	.403	.034	.767

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B9 SPSS output independent sample t test for household with children

Group Statistics

	Group_number	N	Mean	Std. Deviation	Std. Error Mean
Verbondenheidbuurt	0	92	3.10	.865	.090
	1	46	3.20	.957	.141

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Verbondenheidbuurt	Equal variances assumed	1.121	.291	-.604	136	.273	.547	-.098	.162	-.418	.222
	Equal variances not assumed			-.584	82.462	.280	.561	-.098	.168	-.431	.235

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
Verbondenheidbuurt	Cohen's d	.897	-.109	-.463	.245
	Hedges' correction	.902	-.108	-.460	.244
	Glass's delta	.957	-.102	-.456	.253

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B10 SPSS output of independent sample t-test for connectivity with the neighbourhood

Group Statistics

	Group_number	N	Mean	Std. Deviation	Std. Error Mean
Waardering	0	89	4.62	1.143	.121
	1	45	4.58	1.196	.178

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Waardering	Equal variances assumed	.001	.970	.189	132	.425	.850	.040	.212	-.380	.460
	Equal variances not assumed			.186	84.953	.426	.853	.040	.216	-.389	.469

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
Waardering	Cohen's d	1.161	.035	-.324	.393
	Hedges' correction	1.168	.034	-.322	.391
	Glass's delta	1.196	.034	-.325	.392

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control group.

Figure B11 SPSS output of independent sample t-test for the rating of the consultation

Appendix C. Cross tabulation between type of consultation and validity question

Question	Type of consultation	Unit	Completely agree	Agree	Neutral	Disagree	Completely disagree	Total
The research steered my choices in a certain direction	Survey	Number	12	31	32	10	2	87
		Percentage	13,79%	35,63%	36,78%	11,49%	2,30%	100,00%
	PVE	Number	5	16	17	5	2	45
		Percentage	11,11%	35,56%	37,78%	11,11%	4,44%	100,00%
I trust this research is fair	Survey	Number	0	3	14	51	20	88
		Percentage	0%	3,41%	15,91%	57,95%	22,73%	100,00%
	PVE	Number	0	1	10	18	16	45
		Percentage	0%	2,22%	22,22%	40,00%	35,56%	100,00%
This was an important topic to give my opinion on	Survey	Number	1	2	14	49	23	89
		Percentage	1,12%	2,25%	15,73%	55,06%	25,84%	100,00%
	PVE	Number	0	2	8	20	15	45
		Percentage	0,00%	4,44%	17,78%	44,44%	33,33%	100,00%
I found this research hard to understand	Survey	Number	33	36	16	3	1	89
		Percentage	37,08%	40,45%	17,98%	3,37%	1,12%	100,00%
	PVE	Number	7	16	13	8	1	45
		Percentage	15,56%	35,56%	28,89%	17,78%	2,22%	100,00%
Residents should be more involved in the development of DHN's	Survey	Number	2	1	17	45	19	84
		Percentage	2,38%	1,19%	20,24%	53,57%	22,62%	100,00%
	PVE	Number	1	1	14	20	8	44
		Percentage	2,27%	2,27%	31,82%	45,45%	18,18%	100,00%
This method is suitable for involving residents in the development of DHN's	Survey	Number	3	10	30	38	5	86
		Percentage	3,49%	11,63%	34,88%	44,19%	5,81%	100,00%
	PVE	Number	1	6	15	19	3	44
		Percentage	2,27%	13,64%	34,09%	43,18%	6,82%	100,00%
Because I am participating in this research, I have learnt about the choices the government has to make on this issue	Survey	Number	11	14	35	24	2	86
		Percentage	12,79%	16,28%	40,70%	27,91%	2,33%	100,00%
	PVE	Number	3	8	12	19	3	45
		Percentage	6,67%	17,78%	26,67%	42,22%	6,67%	100,00%
If the government allows residents to participate in these kinds of choices in this way, I will have more	Survey	Number	8	10	22	38	8	86
		Percentage	9,30%	11,63%	25,58%	44,19%	9,30%	100,00%
	PVE	Number	1	6	14	19	4	44
		Percentage	2,27%	13,64%	31,82%	43,18%	9,09%	100,00%

Appendix D. Frequencies of responsibilities

Group Statistics

	Treatment_number_letop	N	Mean	Std. Deviation	Std. Error Mean
Bewonerscombi	0	89	9,00	2,804	,297
	1	45	8,29	2,555	,381
Gemeentecombi	0	89	12,43	2,163	,229
	1	45	12,53	2,341	,349
Warmtenetbeheerdercombi	0	89	11,28	2,693	,285
	1	45	11,82	2,026	,302
Warmteleveranciercombi	0	89	7,29	2,590	,275
	1	45	7,36	2,186	,326

Descriptive Statistics

Treatment_number_letop		N	Minimum	Maximum	Mean	Std. Deviation
0	Bewonersvraag1	89	1	4	2,80	1,068
	Gemeentevraag1	89	1	4	3,19	,890
	Warmtenetbeheerdervraag1	89	1	4	2,39	,925
	Warmteleveranciervraag1	89	1	4	1,62	,948
	Valid N (listwise)	89				
1	Bewonersvraag1	45	1	4	2,64	1,069
	Gemeentevraag1	45	1	4	3,20	,968
	Warmtenetbeheerdervraag1	45	1	4	2,51	,944
	Warmteleveranciervraag1	45	1	4	1,64	,933
	Valid N (listwise)	45				

Descriptive Statistics

Treatment_number_letop		N	Minimum	Maximum	Mean	Std. Deviation
0	Bewonersvraag2	89	1	4	1,76	,917
	Gemeentevraag2	89	1	4	2,56	,865
	Warmtenetbeheerdervraag2	89	1	4	3,37	,981
	Warmteleveranciervraag2	89	1	4	2,30	1,070
	Valid N (listwise)	89				
1	Bewonersvraag2	45	1	4	1,56	,813
	Gemeentevraag2	45	1	4	2,58	,941
	Warmtenetbeheerdervraag2	45	2	4	3,53	,694
	Warmteleveranciervraag2	45	1	4	2,33	1,022
	Valid N (listwise)	45				

Descriptive Statistics

Treatment_number_letop		N	Minimum	Maximum	Mean	Std. Deviation
0	Bewonersvraag3	89	1	4	2,13	1,013
	Gemeentevraag3	89	1	4	3,21	,994
	Warmtenetbeheerdervraag 3	89	1	4	2,79	1,039
	warmteleveranciervraag3	89	1	4	1,87	,907
	Valid N (listwise)	89				
1	Bewonersvraag3	45	1	4	1,98	,941
	Gemeentevraag3	45	1	4	3,29	,991
	Warmtenetbeheerdervraag 3	45	2	4	2,96	,796
	warmteleveranciervraag3	45	1	4	1,78	,974
	Valid N (listwise)	45				

Descriptive Statistics

Treatment_number_letop		N	Minimum	Maximum	Mean	Std. Deviation
0	Bewonersvraag4	89	1	4	2,30	,897
	Gemeentevraag4	89	1	4	3,46	,840
	Warmtenetbeheerdervraag 4	89	1	4	2,73	,926
	Warmteleveranciervraag4	89	1	4	1,51	,814
	Valid N (listwise)	89				
1	Bewonersvraag4	45	1	4	2,11	,959
	Gemeentevraag4	45	2	4	3,47	,786
	Warmtenetbeheerdervraag 4	45	1	4	2,82	,886
	Warmteleveranciervraag4	45	1	4	1,60	,863
	Valid N (listwise)	45				