Julius Schutte - 4489039

Energy transition in underprivileged neighbourhoods

Analysing governance arrangements to support just energy transition in the Bospolder-Tussendijken case

TU Delft

[This page is left blank intentionally]
Front page images (Verbeek, 2014; Stuiver, 2021)

Energy transition in underprivileged neighbourhoods

Analysing governance arrangements to support just energy transition in the Bospolder-Tussendijken case

By

Julius Schutte
4489039

in partial fulfilment of the requirements for the degree of

Master of Science in Complex Systems Engineering and Management
at the Delft University of Technology,
to be defended publicly on Thursday December 7, 2023, at 16:00.

Supervisors: Dr. Thomas Hoppe, (Chair)
Dr. Aad Correljé (Second Supervisor)
Diletta Ricci MSc (Advisor)

[This page is left blank intentionally]

Preface

This thesis concludes my Master of Science in Complex Systems Engineering and Management at the Faculty of Technology, Policy and Management at Delft University of Technology. This research was conducted as part of the NWO JUST PREPARE project. Because of this project, I knew where to start with my thesis.

First, I would like to thank my supervisors, Thomas Hoppe and Aad Correljé, for their to-the-point and very useful feedback. Even more, I would like to thank them for their understanding and support during the most challenging period of my thesis. Next, I thank Diletta Ricci for her help during this thesis. Finally, I would also like to thank all the interviewees who participated in my research.

I would also like to thank some people close to me. First and foremost, my parents, younger brother, and other family members for their support not only during this thesis but since I can remember. I would like to thank my roommates for their patience and help during the more frustrating and busy moments. Finally, I would like to thank all my friends who have supported me, including by occasionally not letting me think about my thesis.

Julius Schutte
Rotterdam, November 2023

Executive summary

Climate change is happening, and the consequences of it are becoming increasingly visible. Climate goals have been set in the Paris Agreement to stop and potentially reverse climate change. This agreement has been implemented in both EU and Dutch climate laws. The goal in the Netherlands is to reduce emissions in 2030 by 55% and achieve net zero by 2050. An essential element in achieving these goals is the energy transition, moving away from fossil-based energy production and consumption systems. This is a transition in many parts of society, and energy transition for heating and cooking in existing houses is an essential element to achieve the climate goals. These goals can only be achieved if everybody contributes to this energy transition of existing houses in all parts of society. This also means that underprivileged neighbourhoods will have to participate, for which this might not be the immediate highest priority.

Extensive research has been performed on the energy transition in the existing housing sector in urban areas so far, including underprivileged neighbourhoods. Several research projects have been performed on governance, but few or none have focused on governance issues concerning energy transition in underprivileged neighbourhoods so far. Therefore, a knowledge gap exists in the literature regarding the governance arrangements in the energy transition in underprivileged neighbourhoods.
To address this knowledge gap, two main questions are formulated:

1. *What governance arrangements are currently influencing decision-making with regard to having a just energy transition in the neighbourhood "Bospolder-Tussendijken"?*
2. *How to design governance arrangements to improve decision-making in underprivileged neighbourhoods in the future?*

The exploratory approach was chosen for this research. A case study was performed in the neighbourhood Bospolder-Tussendijken. This research had both an empirical and a design component. Data has been gathered in this research by performing a desk study and conducting thirteen interviews. Interviews were held with directly involved stakeholders in the energy transition in Bospolder-Tussendijken and with experts researching the field of energy transition in existing houses in urban neighbourhoods to get a broader perspective. The data gathered have been used to analyse the decision-making process using the IAD framework, the four-layer model, and the energy justice decision-making principles. Furthermore, the seven basic elements of governance arrangements have been addressed to design the governance arrangement.

In the neighbourhood of Bospolder-Tussendijken, the energy transition is focused on the disconnection of natural gas and towards the connection of a district heating grid. On the neighbourhood level, three major players are present, the municipality of Rotterdam, the housing association Havensteder and the heating company Eneco, who came to an area agreement after an intensive negotiation. This impacted the decision-making since the method, high-temperature district heating, and the project area were decided. The area agreement also instructed how to come to decisions per building, where still for every house or building a connection agreement needs to be closed with the people living there. The decision-making between these parties is influenced in several ways. One way was the Climate Agreement that ordered municipalities to provide a transition vision heat. The

national government has also provided subsidies to help the energy transition. Another way was that the municipality, Havensteder and Eneco entered into a collaboration agreement with energy-related stakeholders in the neighbourhood. This influenced the decision-making because although no clear goals were set in the agreement and no formal decision was made, it provided a platform to keep talking about the energy transition.

However, this did not result in a completely just energy transition. The influence of neighbourhood residents on the decision-making process was negligible, and the information provision towards residents was mainly project-focused. Everyone who lived within the project area could connect to the district heating grid. Although it tried to keep it affordable, the coupling between gas and heat prices is troubling, even more because Eneco asks for the maximum tariff the ACM allows. This affects the affordability, especially in this poor neighbourhood. Next to this, the project costs were much higher than expected, which came forward out of the fact that everything was new. District heating can be considered more sustainable than natural gas. Compared with alternative solutions, it does not cover the cooling needs during summer, however, possibly resulting in more emissions by residents to cool their homes.

To perform a more just energy transition, a governance arrangement is proposed with changes made on the national, municipal, and neighbourhood levels.
The higher levels of government could take more decisive and consistent positions. The EU could do this by naming natural gas fossil instead of green. The national government is advised to anchor in legislation how many houses should be disconnected from natural gas every five years. Next, it should approve the Collective Heat Act and Wgiw and bring the decoupling of natural gas and heat forward. Finally, the subsidies for connecting to high-temperature district heating could be used for incentives for insulation, and only subsidies for connections to at least mid-temperature district heating should be provided.
On the municipal level, municipalities are advised to revise their transition visions heat, so that first difficult neighbourhoods and easier neighbourhoods are being made natural gas-free simultaneously, but not underprivileged neighbourhoods. Only after these first neighbourhoods have been evaluated should making underprivileged neighbourhoods natural gas-free start. This also allows for insulating in underprivileged neighbourhoods before disconnecting from natural gas. In these transition visions heat, yearly intermediate goals should also be set for the number of houses to be disconnected.
On the neighbourhood level, it is advised to involve residents of underprivileged neighbourhoods more. First, it is important to involve residents as soon as possible and let them clarify their position. Secondly, they can get involved by educating about, and with this, enthusing them for the energy transition. Finally, the active citizens of initiatives and the neighbourhood council should get a seat at the actual decision-making table.

The research has addressed the existing knowledge gap by researching the current governance arrangements influencing decision-making regarding the energy transition in an underprivileged neighbourhood and proposing a new governance arrangement for the energy transition in underprivileged neighbourhoods. With this proposed governance arrangement, a more just and efficient energy transition could be performed in underprivileged neighbourhoods. It provides multiple additions to the current debate about a just energy transition. Furthermore, it provides some opportunities for future research.

Table of Contents

List of Figures

List of Tables

Glossary

In Table 1, the definitions of the core concepts in this research are presented.

Table 1: Glossary

Concept	Definition
Energy justice	Everyone should have access to affordable, safe, and sustainable energy and that everyone should be able to take part in the energy decision-making processes (Carley & Konisky, 2022).
Energy transition	A well-used term, but its meaning is much broader than sometimes assumed. Next to producing energy sustainably it includes the challenge of reducing energy usage, for example by making houses more sustainable, by improving insulation, the installation of a heat pump, and many other options (Tambach et al., 2010).
Governance arrangement	"A governance arrangement is the ensemble of rules, processes, and instruments that structure the interactions between public and/or private entities to realize collective goals for a specific domain or issue" (Termeer et al., 2011, p. 161).
Underprivileged neighbourhoods	Neighbourhoods with a lower level of welfare and education (Universiteit van Amsterdam, 2022).

1. Introduction

In this chapter, the research will be introduced. First, the problem will be introduced. After this, a knowledge gap will be identified based on a literature review. To address this knowledge gap, the research goal, objectives, and questions will be introduced. After this, the link to the Complex Systems Engineering and Management study program and societal relevance will be explained. Finally, the outline of the research will be presented.

1.1 Problem Introduction

Climate change is a highly topical issue. Newspapers and news broadcasts report on it almost every day, primarily because of disasters happening because of climate change, such as the floods in Pakistan in August 2022 (Zhong, 2022). To stop climate change, the world needs to reduce its carbon emissions. Therefore, the energy transition is necessary to replace fossil sources with renewable energy sources (TNO, 2022).

To guide the energy transition in the Netherlands, the Dutch government presented the Climate Agreement as a part of the climate policy. In this agreement, the government, civil society organisations, and businesses agreed on measures for the next ten years (Rijksoverheid, 2019). A problem in the current energy transition governance is that it is less effective in underprivileged neighbourhoods.

In these underprivileged neighbourhoods, the issues are “mismatches between retrofit of poorly isolated houses and residents’ energy practices, and between residents and those actors planning and implementing solutions” (Universiteit van Amsterdam, 2022). This has two main consequences: energy injustice and ineffectiveness of the energy transition.

The injustice has two elements: a disproportional burden and a lack of access. People in underprivileged neighbourhoods are confronted with a disproportionate burden because the negative external effects of renewable energy are often in their neighbourhoods, like the noise of windmills. Furthermore, they lack access because they cannot pay for renewable energy technologies and renovations and are less involved in decision-making (Carley & Konisky, 2022).

The ineffectiveness is because the resistance in these underprivileged neighbourhoods can be significant because of the injustice and because people often do not agree with governments, as mentioned before (Universiteit van Amsterdam, 2022). Another reason is a lack of knowledge of benefits and burdens, which results in the choice that sticking with what is familiar is usually considered the best option (Hoppe, 2012). This will harm the effectiveness of the energy transition because an uphill battle has to be fought.

The problem that underprivileged neighbourhoods do not comply with the energy transition policies constitutes a threat to reaching the energy transition goals in general. Although the Netherlands is a developed country, it still has a lot of underprivileged neighbourhoods. To achieve the climate goals set for 2030 and 2050, these neighbourhoods also need to participate in the energy transition. Therefore, to stop climate change as much as possible, governance for a just energy transition in underprivileged neighbourhoods is required.

1.2 Literature Review

Available research is investigated to assess a possible knowledge gap, and areas not yet covered are identified. An overview of the literature used, and the selection process of the literature for this review can be found in Appendix B.

Broers et al. (2019) found that every homeowner goes through several steps before deciding to (not) take energy renovation measures and that many factors influence the decision. The policy should be more specified in the different stages to make it more effective. Bertoldi et al. (2021) found that one-stop shops can help make progress in house renovation because it lowers the step to go through several bureaucratic steps. Homeowners can just come by with their questions without all bureaucratic steps.

Hoppe (2012) found a deep-seated distrust of governmental authorities and housing associations among tenants. Also, a lack of knowledge was found, which troubled the tenants' opportunity to see the net benefit, but only the short-term costs. The fact that tenants were not or very late included in the decision-making process could also have had a role. Breukers et al. (2017) presented in their findings the first step out of an institutional lock-in, which is present in several underprivileged neighbourhoods. However, this is only the starting point, and more is needed to get real participation in these neighbourhoods. Broers et al. (2022) show that the multidimensional justice perspective can be applied to implement a broader, more pluralistic perspective on justice principles. This can be a starting point for achieving a more just energy renovation process in social housing. However, the recommendations are based on a limited sample, meaning the method may not work everywhere.

Murphy et al. (2012) found that policy instruments such as incentives and taxes fail to make the transition more structured. This is because they do not get fully integrated but are used for a short term and later replaced by another option instead of being used as a combined strategy. More research is needed into the effect on end users. Tambach et al. (2010) found that long-term policy instruments should be added to the Dutch policy instruments to ensure the current renovation regime changes. Ebrahimigharehbaghi et al. (2019) found that homeowners think the decision-making process for home renovations is too complex and that information barriers exist. Reducing the time needed to get subsidies, simplifying the process, and providing easier access to information could solve this.

Hoppe et al. (2011) found that the collaboration of local authorities and local actors mostly is at ‘favourable’ locations, with a lot to improve, resulting in projects that are not very ambitious to achieve the goals set. This is called “a strategy of plucking the low-hanging fruit”. To achieve something, less willing neighbourhoods should also be talked to. A future case study should research this. Guerra-Santin et al. (2017) found that the different typologies of houses make a big difference in the energy consumption and preferences of tenants for renovation. The needs and concerns differed as well, but this was not related to the typology of the houses. It is crucial to create participation to motivate the tenants to renovate their homes because otherwise, these projects might not be accepted anymore in the long term.

Taking together the information obtained from the papers described above, a knowledge gap can be identified. Several studies have been done on the energy transition in the existing housing sector in urban areas so far, including underprivileged neighbourhoods. Of the large volume of research performed on governance, little to none has been focused on governance issues concerning energy transition in underprivileged neighbourhoods. Therefore, a knowledge gap exists in the literature regarding the governance arrangements in the energy transition in underprivileged neighbourhoods.

1.3 Research Goal & Objectives

First and foremost, the goal of this research is to contribute to the energy transition and, more specifically, to the energy transition in underprivileged neighbourhoods. To achieve this goal, this research has a few objectives:

- Understand how the decision-making process with regard to the energy transition in a selected underprivileged neighbourhood works.
- Understand what governance arrangements are.
- Understand how governance arrangements influence the decision-making process in a selected underprivileged neighbourhood.
- Understand the barriers in the current decision-making process in a selected underprivileged neighbourhood.
- Deliver new or modified governance arrangements to improve the decision-making process in the future.

1.4 Research Questions

Taking together the problem, the knowledge gap, and the research objectives, the research questions can be formulated. Two main research questions are identified to address both an empirical component and a design component.

The research questions are:

1. *What governance arrangements are currently influencing decision-making with regard to having a just energy transition in a selected underprivileged neighbourhood?*
2. *How to design governance arrangements to improve decision-making in underprivileged neighbourhoods in the future?*

To be able to answer these research questions, several matters need to be clarified. First, it is essential to know what governance arrangements are and how they relate to decision-making. Secondly, creating or using a framework that explains energy justice and local governance is necessary. Furthermore, it is important to know how decision-making takes place to realise a just energy transition and who the stakeholders are that make the decisions. Next to that, it is important to understand what the barriers are in current decision-making. Finally, knowing what new governance arrangements should look like is essential. Therefore, the following sub-questions are drawn up.

Sub-questions:

1. *What are governance arrangements and what does it mean in relation to decision-making with regard to planning a just energy transition in neighbourhood renovation?*

2. *Which theoretical framework can be used to get a better insight into the governance arrangements influencing the decision-making with regard to planning and implementation of a just energy transition?*
3. *What does decision-making look like in a selected underprivileged neighbourhood and how is it influenced by governance arrangements with regard to planning a just energy transition in neighbourhood renovation?*
4. *What are the key barriers that hamper the current decision-making and how could governance arrangements solve these?*
5. *How should the governance arrangements be designed to improve complex decision-making in neighbourhoods in the future?*

1.5 Societal Relevance

As mentioned before, the Dutch government set climate goals for 2030 and 2050. To achieve these goals, everyone will have to comply with the energy transition. The existing houses are an essential part of this transition. Only capturing the easy neighbourhoods would result in falling short of the targets. Complying with the energy transition will, however, impact the lives of residents. This can be in a positive way, for example by achieving long-term savings, but in a negative way as well, for example by the need for substantial investments.

Since residents of underprivileged neighbourhoods often lack the opportunity to make investments to comply with the energy transition, they also miss out on the long-term advantages. Therefore, it is crucial to research governance arrangements that help these people join the energy transition as well. This research also investigates energy justice to make the energy transition as painless as possible for people in underprivileged neighbourhoods. If a just energy transition is performed, this could result in some inconvenience. Still, the residents of underprivileged neighbourhoods will profit from it long-term because they can also participate in the energy transition. Next, society will benefit as it helps achieve the climate goals.

1.6 Relevance to CoSEM

This research is the end of the Master's program in Complex Systems Engineering and Management. In this Master's program, innovations in socio-technical environments are explored because technical solutions also have to fit into the existing social and institutional environment (TU Delft, n.d). Therefore, multiple reasons are present why this can be considered a CoSEM research.

First, it is a socio-technical problem because it contains a technical component, renewable energy technologies, and a socio-component because social participation in underprivileged neighbourhoods is needed. Secondly, both the private and public domain are present. The private domain is represented by people in underprivileged neighbourhoods and companies that are part of the energy transition in the neighbourhood. The multiple levels of government represent the public domain. Lastly, it links directly to the courses SEN 113 Institutional Economics for Designing in Socio-technical Systems and SEN 114 Managing Multi-actor Decision-making.

1.7 Outline of the Research

After introducing the problem in this chapter, the next chapter will present the theoretical groundwork for this research. Chapter 3 will explain the methodology, how the data for this research is gathered, and how it will be analysed. In Chapter 4, some background on the case, a stakeholder, and an institutional analysis will be presented. In Chapter 5, the decision-making process and its barriers will be discussed, and the energy justice in the case will be discussed. In Chapter 6, the findings of the interviews with experts will be presented. In chapter 7, the design of new governance arrangements will be presented. In Chapter 8, the research questions will be answered, the discussion will be presented, and recommendations will be made for further research and policy.

2. Theoretical Frameworks

In this chapter, the theoretical foundation for this thesis will be laid. First, energy justice and how to incorporate it in decision-making will be further explained. When this framework of principles has been presented, two theoretical frameworks will be introduced: the IAD Framework of Ostrom (Ostrom, 2011) and the four-layer model of Williamson (Williamson, 1998). Finally, governance and governance arrangements will be defined, and it will be explained how to design governance arrangements.

2.1 Energy Justice

An important term in this research is energy justice since this research investigates the decision-making regarding having a just energy transition. According to Carley & Konisky (2022), energy justice means that everyone should have access to affordable, safe, and sustainable energy and should be able to participate in the energy decision-making processes. Energy justice has three main tenets: distributional justice, procedural justice, and recognition justice.

The first tenet, distributional justice, asks for the equal distribution of burdens and benefits. The second tenet, procedural justice, wants access to the energy decision-making process for all stakeholders. The third and last tenet, recognition justice, asks for the fair representation of all individuals. (Jenkins et al., 2016)

According to Mulder et al. (2023, p.1), a just energy transition can be defined as a situation where "(i) everyone has access to affordable, reliable and clean energy services, (ii) everyone can participate in decision-making processes regarding changes in the energy system, and (iii) there is recognition of problems arising from energy poverty and unequal opportunities in the transition."

Sovacool & Dworkin (2015) argue that eight energy justice decision-making principles should be considered:

- Availability: This is the most fundamental aspect since it asks for the assurance of energy availability when needed. This, therefore, asks for the possibility of everyone accessing it and the reliability and security of supply. This means that even with a disruption, a backup source should be in place that can replace the primary source when it is disrupted.
- Affordability: The second aspect asks not simply for bottom prices but for continuity in pricing, so no huge differences every year. Affordability also implies the ability for everyone to pay for their energy without it being an unreasonable part of their monthly income.
- Due process: This principle asks for all stakeholders to be heard during policymaking, especially if the decisions may directly affect them. They should also be able to make their complaints clear to an independent arbitrator.
- Good governance: This principle asks that everyone should be able to get high-quality information if they want to, both about energy and the environment. Next to this, the decision-making process should be transparent.
- Sustainability: This principle asks for using sustainable resources, or at least not using natural resources too fast. Furthermore, it asks not to harm the environment irreversibly.
- Intragenerational equity: This principle asks that everyone in this generation should be able to access energy services for the basic enjoyment of welfare.

- Intergenerational equity: This principle asks for the same as the previous one, but in this case, for future generations. It asks to use energy so that the next generation will not be disturbed by the effects this generation creates.
- Responsibility: This principle asks that everyone is responsible for ensuring the environment will not be harmed more than necessary so that the chance of environmental threats will be minimised.

The first step should be to achieve the first principles, availability and affordability, before focusing on the latter. The further down the list, the more complex the principle is to achieve.
In this research, the energy justice decision-making principles of availability, affordability, due process, good governance, and sustainability will be considered since for these principles, it is possible to examine these within the scope of the research. The analysis will not discuss the principles of intergenerational equity, intragenerational equity, and responsibility since these go beyond the scope of this research.

2.2 The IAD Framework

The Institutional Analysis and Development (IAD) framework, which Elinor Ostrom and her fellow researchers developed, can be used to get insights into the decision-making process. According to Lammers & Hoppe (2019), the IAD framework used to be applied only to the research of common pool resource management, but over the last few years, it has also shown value in researching energy transitions. As mentioned before, this research looks into a socio-technical system, which the IAD framework helps decompose (Iychettira et al., 2017).

"The IAD framework is intended to contain the most general set of variables that an institutional analyst may want to use to examine a diversity of institutional settings." (Ostrom, 2010, p. 646). According to Hess & Ostrom (2007), the IAD framework exhibits considerable adaptability and can effectively address various research questions concerning human decision-making. The IAD framework can be used as a coat rack to analyse cases because it organises all factors and variables in a case into different categories and puts these categories in the framework with clear relationships, basically breaking it down into several building blocks (McGinnis, 2011).

The IAD framework is shown in Figure 1. It can be divided into three parts. The external variables, the action situation and after the action situation. The external variables and the elements after the action situation will be defined first:

- Biophysical/Material Conditions: This is the physical environment influencing possible actions taken in action situations (Milchram et al., 2019). According to Ostrom (2010), this can also be simplified into one of the four types of goods: common-pool resources, public goods, private goods, or toll goods.
- Attributes of Community: This element is about the characteristics of the community of the project, which can mean knowledge, financial status, or effects of earlier projects (Ostrom, 2010).
- Rules-in-use: these are the formal laws and regulations that enable and constrain the behaviour of participants (Milchram et al., 2019). These rules may evolve over time because the involved actors change, for example (Ostrom, 2010).

- Interactions: Procedural aspects, i.e., interaction among participants in an action situation (Milchram et al., 2019).
- Outcomes: Results of interactions, which may be institutions, knowledge, or operational outcomes, such as the implementation of new policies or technologies, realised by the actors together (Milchram et al., 2019).
- Evaluative criteria: These are used to evaluate both the results, the outcomes, and the process that led to these outcomes (Ostrom, 2011).

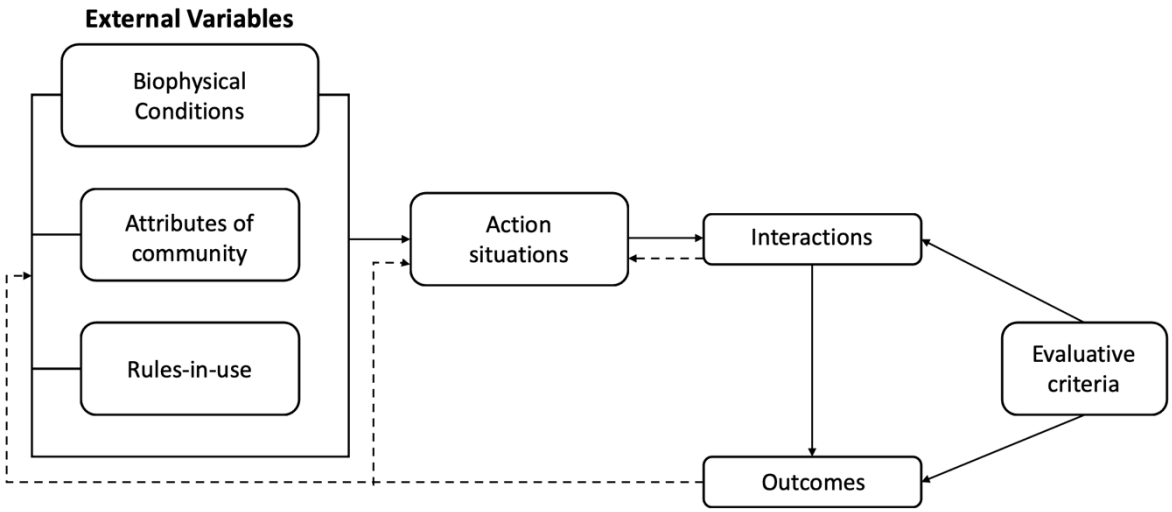

Figure 1: The IAD Framework (Adapted from Ostrom, 2011, p.10)

According to McGinnis (2011, p. 173), the action situation is "the core component of the IAD Framework, in which individuals (acting on their own or as agents of organizations) observe information, select actions, engage in patterns of interaction, and realize outcomes from their interaction." The action situation is shown in more detail in Figure 2. As can be seen, the action situation consists of seven elements, which all play an important role in the decision-making process. These seven elements are described by Ostrom (2011) and will be used in this research. The elements themselves are indicated by an *italicised font:*

- Characteristics of the *actors* involved.
- *Positions* the actors hold in the process.
- Set of *actions* that actors can take at specific moments.
- The amount of *information* available at specific moments in the process.
- *Outcomes* of the process.
- The *control* the actors have over their own choices and other actors' choices.
- The outcomes will have associated *costs and benefits* of the actions taken.

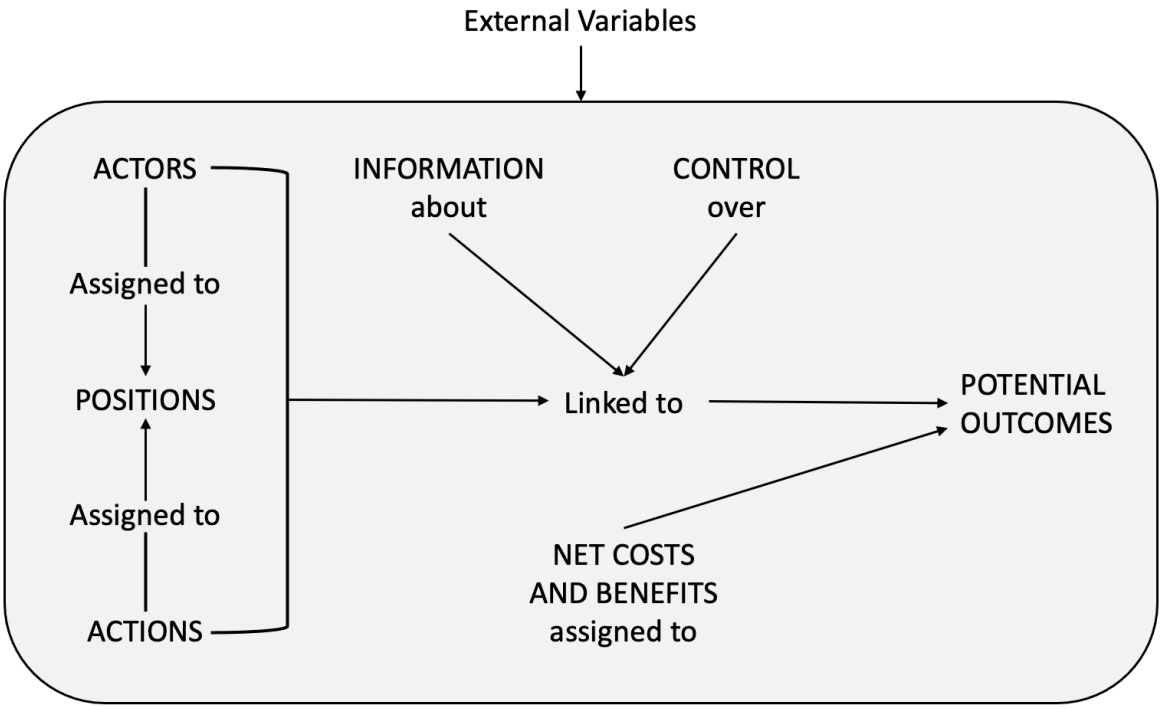

Figure 2: The action situation (Adapted from Ostrom, 2011, p.10)

As shown in Figure 3, all these components in the action situation are affected by external variables. McGinnis (2011) mentions that the values of all these seven elements, which play an important role in the decision-making process, are specified by external rules. The seven rules are:

- Boundary rules: Specify how actors were chosen, the number of actors participating in the local energy planning project, and how actors enter or leave the decision-making process (Lammers & Hoppe, 2019; Ostrom, 2010).
- Position rules: Specify the set of positions that actors hold and how many actors hold a position in the local energy planning decision-making process (Lammers & Hoppe, 2019; Ostrom, 2010).
- Choice rules: Specify the sets of actions that can (could have), may or must not (have) been taken and to which actor in what position they are assigned at specific points in time (Lammers & Hoppe, 2019; Ostrom, 2010).
- Information rules: Specify the amount and type of information available to participants and the communication channels between participants (Lammers & Hoppe, 2019; Ostrom, 2010).
- Aggregation rules: Specify how decisions are made and have to be mapped, e.g., by an individual actor or in collaboration with others, to arrive at the outcomes (Lammers & Hoppe, 2019; Ostrom, 2010).
- Payoff rules: Specify the net costs and benefits that derive from particular actions and outcomes and how these are divided between actors (Lammers & Hoppe, 2019; Ostrom, 2010).
- Scope rules: Specify the set of potential outcomes, as well as the jurisdiction and state of outcomes, e.g., if they could be affected or whether they are final or not (Lammers & Hoppe, 2019; Ostrom, 2010).

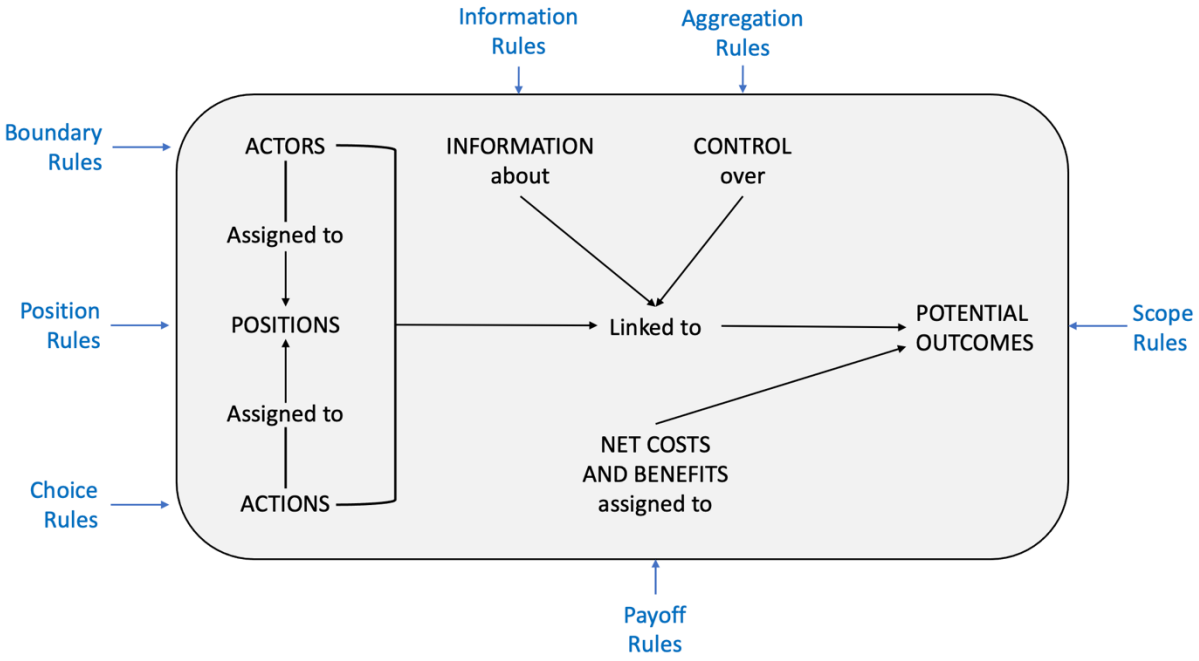

Figure 3: Rules affecting elements in the action situation (Adapted from Ostrom, 2011, p.20)

2.3 The Four-layer Model

Institutions are defined in this research as "the humanly devised constraints that structure political, economic and social interaction" (North, 1991, p.97). Institutions are important in this research because they can structure the energy transition decision-making process.

Oliver Williamson created his four-layer model, shown in Figure 4, and the institutions are ordered into different categories with the four levels. The four levels are connected; the solid arrows show that higher levels impose constraints or help facilitate the level below, and the dashed arrows indicate the feedback from lower levels to higher levels, where efforts are made to change institutions so that they are more up to date (Williamson, 1998; Broekhans & Correljé, 2008). It can therefore be used to analyse the institutions and their interactions. This creates a better overview of the institutional environment. According to Van Es (2017), the four-layer model of Williamson and the IAD framework can be used together since Williamson's model can deliver input to the IAD framework.

The first and highest level is the social embeddedness level. This is the level where the informal institutions, norms, values, and often religions are located, and this does not change very often; it usually takes 100 to 1000 years to change these in a society. Because they change so slowly, they can be taken as given; therefore, this level may have some comparisons with the element attributes of the community in the IAD framework. This level strongly influences the other levels since the values located here also strongly influence laws and the day-to-day rules in society (Williamson, 1998).

The second level is the institutional environment. This level is where formal arrangements like laws and European treaties are located; they provide the rules of the game and could also land in the rules-in-use element of the IAD framework. These regularly take 10 to 100 years to change, but, usually during crises, windows of opportunity exist to implement significant changes (Williamson, 1998).

The third level is where the institutions of governance are located. Here is the play of the game, contracts, and agreements, situated and more informal agreements based on trust, that are shaped within the rules of the game established in the level above (Williamson, 1998). These agreements could land in the IAD framework's rules-in-use element and usually take one to ten years to change.

The fourth and lowest level is resource allocation and employment level. Here, the day-to-day decision-making is located, the actions taken, the cost and benefits of these actions and the outcomes of these decisions. These change continuously, and therefore this is the fastest-changing level. (Williamson, 1998).

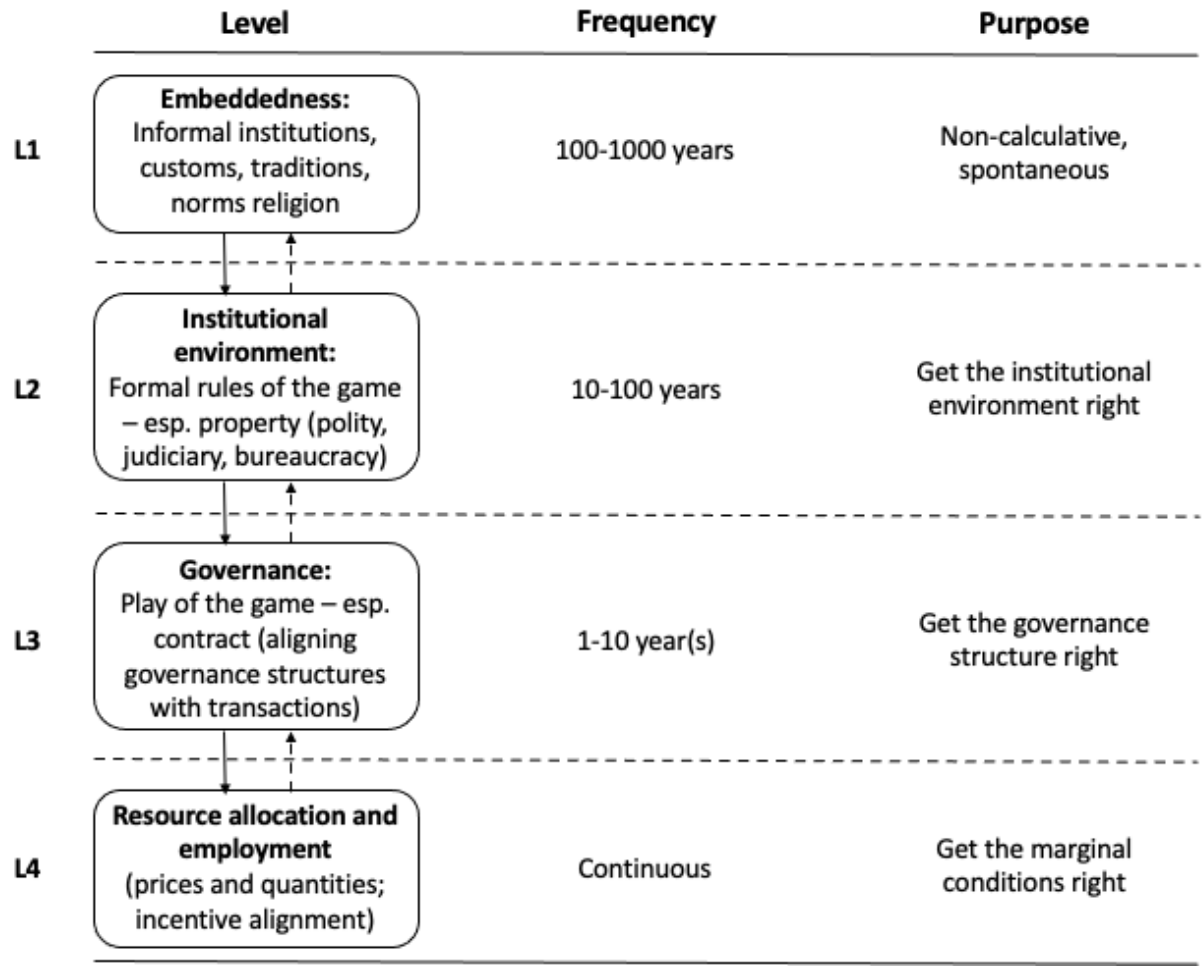

Figure 4: The four-layer model (Adapted from Williamson, 1998, p.26)

2.4 Governance Arrangements

Before focussing on governance arrangements, it is important to specify what governance is. It has been defined in multiple ways because it can differ what it means per research section. This research is focused on the energy transition in a neighbourhood in a city, which can be referred to as urban energy governance (Lammers & Hoppe, 2019). According to Rutherford and Jaglin (2015, p. 174), the term urban energy governance is “used broadly to capture the multitude of ways in which urban actors engage with energy systems, flows and infrastructures in order to meet particular collective goals and needs, as framed or

expressed in policymaking processes, but also in debates, contestations and conflicts over policy orientations, resources and outcomes." Now that urban energy governance is defined, governance arrangements can be investigated.

Governance arrangements usually consist of various organisations, where governmental, market, and non-profit organisations come together (Bevir, 2012). The definition used for a governance arrangement in this research is: "A governance arrangement is the ensemble of rules, processes, and instruments that structure the interactions between public and/or private entities to realize collective goals for a specific domain or issue" (Termeer et al., 2011, p. 161). Governance arrangements are therefore crucial for the decision-making process since they are the framework within which the decisions are made and where the policy is shaped (Vink & Dewulf, 2015). Governance arrangements can include various stakeholders, which can influence decision-making massively since the inclusion or exclusion of stakeholders will change the dynamics of decision-making (Valkenburg & Cotella, 2016). The role of non-governmental actors has grown over the last few years, and this can be very important in climate change-related problems since they have a role in lots of work (Aylett, 2014). The rules included in governance arrangements can both help and hamper the decision-making process since they can contradict or support policies in other layers of government (Leonhardt et al., 2022). The rules also include, next to regulation, the norms and values of actors and a neighbourhood (Arts & Leroy, 2006).

The design of governance arrangements is also an essential part of this research. Termeer et al. (2017) have defined seven basic elements to address while designing governance arrangements. These will be described in the following paragraphs.

The first element is to frame the problem. Governance arrangements are made to resolve a problem, so it is important to first make sure everyone knows which problem will be addressed. In every problem, multiple stakeholders are involved, which can result in multiple frames of the problem. These may differ fundamentally because the stakeholders have different views and backgrounds and usually frame problems in ways that best suit their interests. Termeer et al. (2017) explain that while framing the problem, it is important to both investigate storylines and solutions on the one hand and to choose which frames are the most appropriate for the problem on the other hand. Establishing the right frame is important because it can ensure the attention and participation of all the important stakeholders. If a problem is framed as too big, it might scare stakeholders, who will then quit or be less willing to cooperate to solve the problem. Overall, according to Termeer et al. (2017), governance arrangements that facilitate reflexivity are more capable of handling diverse frames, and they are also less likely to fall into the traps of narrow focus and enduring conflicts between influential stakeholders. Making the frame not too rigid is also advisable because that may exclude some stakeholders. Nonetheless, the problem should not be framed too abstractly because that could result in everyone thinking someone else will step in, resulting in no action being taken.

The second element is the levels of action. This means that a decision needs to be made regarding which level of government is the most appropriate to take action to address this problem. When a level is chosen, it is important to ensure different levels of government still work together. Termeer et al. (2017) argue that for most energy transition-related problems,

the local government is best placed to take a leading role. Still, most current big problems also require national or international involvement. The level of government chosen to take the lead in the action impacts the opportunity for stakeholders to be involved or excluded since local stakeholders will be involved earlier when the municipality gets the lead than when the ministry leads. Therefore, the right level of government has to be chosen for the scale of the problem.
Therefore, multilevel governance could be an option, especially when it is unclear at what specific level a problem should be governed (Termeer et al., 2017). This can result in challenges for the cooperation between higher and lower levels of government. It is important that there is communication between the different levels and that their instruments are modified in such a way that they will support each other. Boundary actors play a vital role in this process.

The third element is the timing of policies. This does not only mean when to take action but also in what order the actions have to be taken. Although many problems are related to climate change and the energy transition, and the uncertainties are still significant, the decisions about how to act on these problems need to be taken or at least planned as soon as possible. Termeer et al. (2017) argue that it is crucial to decide if action has to be taken now or if it is better to wait for more knowledge.
To deal with this, an option could be to take robust and flexible measures. Robust measures are actions that can deliver for the purpose they are designed for in multiple scenarios. Measures are flexible if they can be increased or decreased, meaning they can deal with different scenarios and developments over time. With robust and flexible measures, it is possible to make decisions now for the long term (Termeer et al., 2017).
When climate change-related disasters happen, the energy transition is at the top of everyone's mind. This may lead to more opportunities to act, but when the number of disasters decreases, the support for actions will also decrease (Termeer et al., 2017). During more stable periods, it is tempting for politicians to defer challenging or costly decisions that will not have results immediately but will bring results in the coming decades.

The fourth element is the alignment across sectoral boundaries. This means that energy transition-related problems not only ask for public or energy transition-minded entities but also sectors with less interest in the energy transition need to be involved. Termeer et al. (2017) argue that there are two possibilities to deal with this: measures could be incorporated within current policy domains, or a new policy domain could be created specially dedicated to energy transition issues. Both strategies have advantages because incorporation can be useful during decision-making, implementation, and enforcement of policies, while creating a new domain can be beneficial for getting awareness and finding more backing.
Policy integration is not a static process with already-known results. Termeer et al. (2017) argue that the degree of integration can vary based on several factors, like how broad the problem is, the number of policy sectors present, the intensity of interactions across boundaries, and the consistency of policy goals. It is essential to recognise the value of lower levels of integration, as they may be more practical and suitable for addressing complex challenges. Policymakers should avoid attempting to link all problems to each other. Besides spanning boundaries, maintaining clear boundaries regarding responsibility and

accountability is crucial. Well-defined boundaries can bring order because otherwise, the wrong sectors will handle the wrong situations.

The fifth element is the selection of policy instruments. With this, the actions of individuals and companies can be shaped in a specific direction to get them involved in the energy transition. Multiple policy instrument packages are possible: hierarchical governance, enforcing a set of norms through regulatory means; market-based governance, which spreads norms through economic tools; and network-based methods, where communication and trust-based incentives play a significant role (Termeer et al., 2017).
Typically, a custom combination of policy tools matched to the unique context of a specific challenge is the most suitable approach. Termeer et al. (2017) argue that different governance types are needed during various stages of an issue. The most common option is to start with hierarchical measures, and the market or network governance takes over when it comes to the implementation. The different forms of governance can also strengthen each other by, for example, legislating some requirements but, on the other hand, giving out subsidies to achieve the requirements.
Termeer et al. (2017) further argue that alternative instruments, like contracts, exist. In contracts, stakeholders are not forced to comply, but once they are committed, they are obligated to adhere to the agreed-upon rules.

The sixth element is the organisation of the science-policy interface. According to Termeer et al. (2017), a lot of knowledge is required for decision-making regarding the energy transition. The opposition against climate change science is growing, however. Opponents strengthen their points by using uncertainties in the scientific literature and disagreements. The relationship between policymakers and climate scientists will be crucial to execute the energy transition successfully.
However, it gets increasingly clear that the relationship between science and policy is far more complicated than initially thought. Policymakers do not always take the word of scientists for granted like they used to. To let scientific advice be as helpful as possible, it is important that the main actors identify the knowledge as credible, salient, and legitimate. According to Termeer et al. (2017), boundary organisations, joint fact-finding, and co-production are crucial in bridging the gap between science and policy. Boundary organisations operate at the intersection of politics and science, with clear lines of responsibility to both realms.
Effective partnerships between policymakers and scientists can bring these two sectors closer to each other but also carry risks, such as collusion, which can stifle critical thinking and foster non-confrontational environments, particularly during transformative periods (Termeer et al., 2017). Transparency is crucial, as failing to disclose advocacy can undermine the credibility and legitimacy of scientists and their expertise.

The seventh and final element is the appropriate forms of leadership. Termeer et al. (2017) argue that all stakeholders involved in the energy transition must try to improve the coordination and cooperation of all the earlier-mentioned elements. Multiple forms of leadership exist, but because most energy transition problems are highly fragmented, just one actor cannot be the only leader. Therefore, a traditional leadership role should not have the preference. This situation requires all stakeholders to take some leadership, which can lead to the accommodation of multiple values, interests, and motives.

More recent leadership theories identify four purposes of leadership that are needed for adaption governance: administrative, adaptive, connective, and enabling (Termeer et al., 2017). Administrative leadership targets getting more organisation in an entity, adaptive leadership is about creating new strategies, connective leadership tries to build bridges between different levels and sectors, and enabling leadership tries to make innovation possible.
According to Termeer et al. (2017), it is not necessary to have specific leaders per leadership form; one person can fulfil parts of multiple leadership forms, and researchers may also be part of the leadership.

These seven elements could be brought together into a governance arrangement, according to Termeer (2017).

2.5 Conclusion

This chapter discusses the relevant theory for answering the research questions.
The definition used for a governance arrangement in this research is: "A governance arrangement is the ensemble of rules, processes, and instruments that structure the interactions between public and/or private entities to realize collective goals for a specific domain or issue" (Termeer et al., 2011, p. 161). Governance arrangements can impact decision-making processes by including or excluding specific stakeholders and rules. To design a governance arrangement, the seven design elements for governance arrangements of Termeer need to be addressed. These seven elements are framing the problem, levels of actions, timing of policies, alignment across sectoral boundaries, policy instruments, organisation of the science-policy interface, and leadership.

To get a better insight into the governance arrangements influencing the decision-making with regard to planning and implementation of a just energy transition, three frameworks are used.
The four-layer model divides institutions into four categories, presenting the agreements, financial instruments, and formal rules. These are all part of governance arrangements and are influencing the decision-making process. Furthermore, the three highest levels of the model are input for the IAD framework, as rules in use and biophysical conditions.
The decision-making process can be analysed with the IAD framework because it breaks down the process into separate blocks. By using the external rules, it can be seen how the action situation is influenced.
However, the IAD framework and the four-layer model do not cover energy justice. Five of the energy justice decision-making principles, affordability, availability, due process, good governance and sustainability, will be used to investigate whether it is a just energy transition.

3. Methods

This chapter will explain and explore the methods used in this research. First, the research approach will be introduced, after which the case selection will be explained. After this, the methods of data collection will be presented and underpinned, and the ways of analysing the data will be presented. Finally, the design methods for governance arrangements will be presented.

3.1 Research Approach

The approach chosen for this research is the exploratory approach. A case study will be performed, a stakeholder analysis will be performed, experts and stakeholders will be interviewed, and literature and policy documents will be studied. The study will therefore have both an empirical and a design component. The empirical component is linked to the first main research question, with direct observations and experiences. The design component is linked to the second main research question, the analysis of what can be done better in the current system and how to change it.

The exploratory research has been chosen because some governance arrangements are in place already, but the improvement of these governance arrangements to have a more just energy transition has not been researched very widely. Exploratory research can be used to explore the problem and find an answer that will not be conclusive because it "tends to tackle new problems on which little or no previous research has been done" (Brown, 2006, p. 43). According to Dudovskiy (2013), the advantages of the exploratory approach are the amount of flexibility and the low cost of research, while a disadvantage is that exploratory study "generate qualitative information and interpretation of such type of information is subject to bias". According to Chaudhari (2022), another disadvantage of the exploratory approach is that the research results have a chance of being unrepresentative for other cases because of the often small size of the case. The advantage Chaudhari names is that exploratory research can give an excellent starting position for future researchers, who can use the research for other cases around the same issue, and that exploratory research uncovers facts and brings a lot of new issues to light.

3.2 Case-study Selection

As mentioned before, including underprivileged neighbourhoods in the energy transition will be crucial for achieving the goals set in multiple agreements.
Underprivileged neighbourhoods are under-researched in the energy transition literature. Because it is essential that these neighbourhoods comply with the energy transition, a case study will be performed in an underprivileged neighbourhood where the energy transition is being performed.
In Rotterdam, the neighbourhood Bospolder-Tussendijken is located. Bospolder-Tussendijken is one of the poorest neighbourhoods of the Netherlands, and the overall quality of life is the lowest in Rotterdam (König, 2020). In this neighbourhood, the energy transition is being performed by becoming natural gas-free and connecting to the district heating grid.
Next to this, Bospolder-Tussendijken is a part of 'Programma Aardgasvrije Wijken (PAW)' a program that helps municipalities to become natural gas-free and uses these neighbourhoods as living labs to learn how to make the Netherlands natural-gas free entirely (Programma Aardgasvrije Wijken, n.d.-b).

Therefore, it is important to evaluate the governance arrangements influencing the decision-making with regard to having a just energy transition in this neighbourhood. All this combined makes Bospolder-Tussendijken the underprivileged neighbourhood that is selected as the subject of the case study in this research.
Because the choice has been made to perform both an empirical and a design component, the choice has been made to perform a single case study so that the case can be studied in more detail (Gustafsson, 2017).
Because the rules and relevant actors have not changed significantly since the start of the project to the point when this case study is being performed, the choice is made to investigate the case as one action situation. The decision-making process concerning making Bospolder-Tussendijken natural gas-free is the focus of this research, and this can be seen as one situation during the project so far.

3.3 Collection of Data

In this section, the different methods used for the collection of data will be presented. This collected data will be used as input for the IAD Framework, the five energy justice decision-making principles, and the four-layer model to help answer the first four sub-questions and the first main research question. It will furthermore be the preparation for the seven design elements of governance arrangements.

3.3.1 Desk Study

The first part of this involves desk research, consisting of a literature study and a policy documents study.
A literature study will be performed in this research. This has multiple functions in the research. First, it is used to get an overview of the knowledge obtained from previous research and with this, the knowledge gap is identified (Snyder, 2019). Secondly, the literature study was also used to set up the theoretical framework presented in the previous chapter. Finally, literature will be used in the results section to support or refute certain claims made.
Next to this, a policy documents study will be performed. Here, the plans made by the municipality, province, or ministries can be found, as well as updates on how these plans are evolving. This is also very useful information, augmented with the information gathered from the interviews. The policy documents study will also cover, to some extent, the current governance arrangements.

3.3.2 Semi-structured Interviews

To get more information on the case, semi-structured interviews will be used. Although much information can be found in policy documents and literature, a valuable complementary insight can be gained from interviews. Adams (2015) found that, although semi-structured interviews are very time-consuming, they are helpful when evaluating key stakeholders. The semi-structured interview questions will be prepared with the help of the desk study and mainly by the external rules of the IAD framework, the energy justice principles, and the elements of governance arrangements. Questions will be prepared before the interviews are held, but there will also be the possibility of picking up on interesting aspects during the interviews. Semi-structured interviews will be conducted with both case stakeholders and experts on the topic; these interviews are therefore an essential part of the data collection of this research.

3.3.2.1 Case Stakeholder Interviews

Seven key stakeholders will be interviewed about the case. Six interviews will be held with stakeholders of Havensteder, Eneco and the municipality, and one interview will be held with a neighbourhood stakeholder. The interviews will be divided into three parts: the rules in use and the barriers, energy justice, and a part that can be used during the design of governance arrangements. In Appendix D, the questions prepared for the case interviews can be found. The interviews were meant to take 45 minutes, but some interviews ran out of time by five to ten minutes longer interviews.

One case stakeholder did not want to participate in an interview but did share an extensive written response. Parts of this response will be used in the description of the case.

3.3.2.2 Expert interviews

After the case interviews are completed, four expert interviews will be held. The interviews will be held with a person who worked at multiple municipalities regarding neighbourhood renovations and researched it, two persons researching neighbourhood renovations from universities and one who worked in numerous neighbourhood renovations.

Using these four expert interviews, insight into the problem will be gained from people researching the broader field and not directly involved in the case, and the focus will be mainly on the barriers, energy justice principles and the elements for the design of governance arrangements. The choice is made to perform expert interviews next to case stakeholder interviews because expert interviews are a very common method, usually used to explore a specific topic and gather knowledge (Döringer, 2021). According to Van Soest (2023), expert interviews are vital in analysing complex decision-making processes and are well-suited for this research. In Appendix E, the questions prepared for the interviews can be found. The interviews took about 55 minutes per interview.

When these governance arrangements are designed, two more interviews will be held with experts, both researchers at universities, to validate these designed governance arrangements. According to Buchbinder (2011), in a validation interview, a researcher and interviewee have a conversation to improve, rectify or confirm the research results.

3.3.2.3 Ethical Considerations

The transcripts of the interviews are saved on a protected SurfDrive provided by the TU Delft to ensure the privacy of all interviewees. All the interviewees are being anonymised, but in Appendix C, the interviewees can be found with a brief description of their roles. To reference them in this research, all interviewees got a number. All the interviewees were sent an informed consent form that they signed, making sure no problems would occur after or during the interviews because the conditions during and after the interview had been made clear. In Appendix C, the consent forms all interviewees signed can be found.

3.3.3 Supportive Tools

The interviews will, with consent, be recorded in Microsoft Teams, which also has the function to automatically transcribe the recordings, which is very useful for the analysis of the interviews. Furthermore, the AI software ChatGPT and Grammarly were used for this research to rewrite some sentences that were too complexly formulated or incorrect.

3.4 Analysis of Data

Here, the methods for the analysis of the data are presented. With Atlas.ti and a stakeholder analysis, the data will be prepared to be put into the IAD framework, the energy justice decision-making principles, the four-layer model and the governance arrangement design elements.

3.4.1 Atlas.ti

The interviews will provide large bodies of text. This will be analysed in Atlas.ti because, according to Hwang (2008), this is very useful software because it works like your research assistant and is mainly useful with large bodies of text. Here, a deductive analysis will be performed with a predefined set of codes based on the theoretical frameworks presented in Chapter 2. The coding scheme can be found in Appendix A. The coding was usually straightforward because the interview questions were based on the theoretical framework presented in Chapter 2. Therefore, this will be theoretically driven, where the interesting parts are analysed in detail, and the less interesting parts will be covered in less detail (Friese et al., 2018).

3.4.2 Stakeholder Analysis

Next to the analysis performed in Atlas.ti, a stakeholder analysis will be performed. According to Bryson (2004), the first step in identifying potential stakeholders is a brainstorming session. The list will be extended with information from the literature and policy documents study. These steps will result in a preliminary list of stakeholders since finding stakeholders is an iterative process (Reed et al., 2009). As finding stakeholders is an iterative process, one or more may be missed in the first iteration because they do not show up in documents. Still, these could also be augmented with the information gathered in interviews, where interviewees will be asked about the most relevant stakeholders in the case. The answers will be compared with the list made before the interviews.

The stakeholders will be analysed and placed in one of the four categories of the power versus interest grid (PI grid), which is shown in Figure 5. With this PI grid, a difference can be made in how important stakeholders are based on their power and interest in the case. The PI grid has four quadrants: player, subject, context setter, and crowd (Ackermann & Eden, 2011):

- The players, stakeholders with high power and high interest, are the significant stakeholders and the stakeholders of whom it will be most critical that they participate and need to be managed closely.
- The context setters, stakeholders with power but low interest, need to be kept satisfied, and this can be done by attracting their attention only when it is crucial but otherwise not.
- The subject, stakeholders with high interest but low power, need to be kept informed to keep them quiet.
- The crowd, actors with low power and low interest, can be seen as potential stakeholders rather than real stakeholders and only have to be monitored.

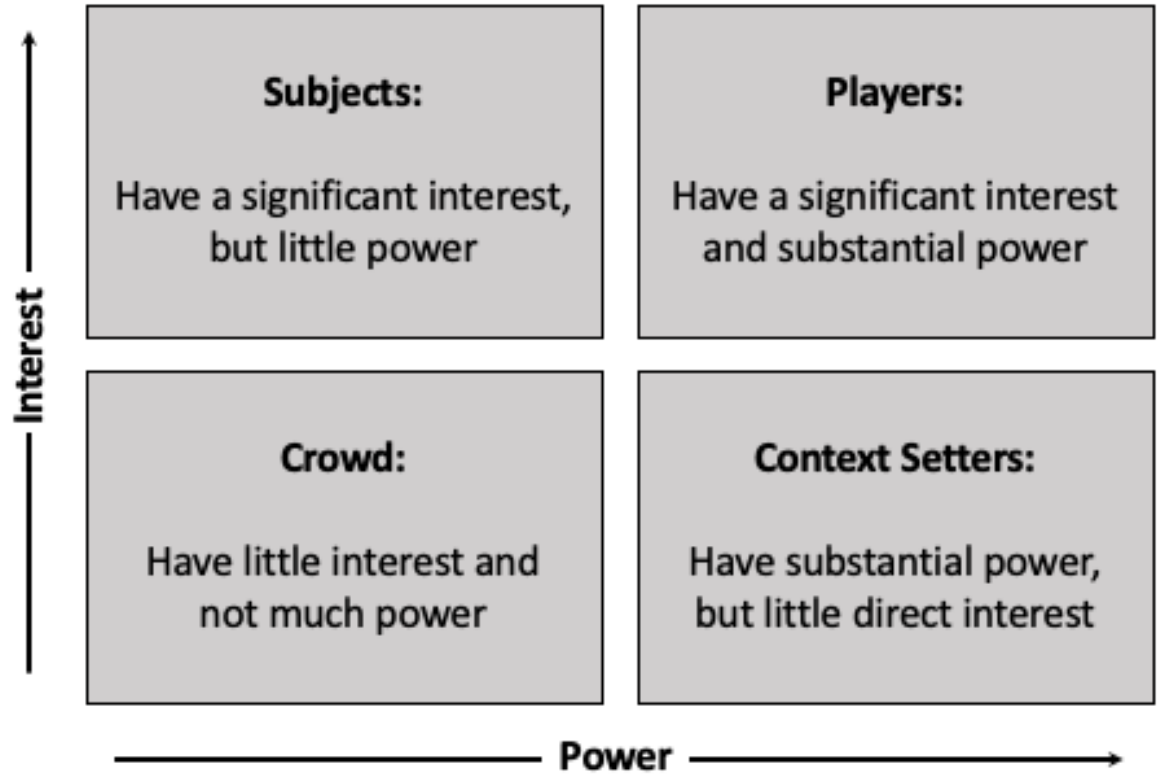

Figure 5: The power interest grid (Adapted from Eden & Ackermann, 1998, p.122)

A limitation of the PI-grid is that it only tells how important stakeholders are, but it does not give any information on the position of the stakeholders if they are in support or opposition to the objectives. Therefore, the stakeholders will also be placed in an overview table for the classification of interdependencies. This gives a clear overview of whether the stakeholders support or oppose the objectives, how dedicated they are, and whether they are critical in achieving the goals (Hermans et al., 2010). With the combination of the power interest grid and the table for the classification of interdependencies, a clear overview of the stakeholders and their positions can be provided.

3.5 Design

Finally, new governance arrangements will be designed. This will be done based on the analysis executed with the IAD framework, the energy justice decision-making principles, the four-layer model, the barriers identified, and the questions in interviews concerning elements of the governance arrangement that are made with the input of the literature, policy documents, and interviews and following the guidelines of Termeer et al. (2017) presented in the previous chapter. First, the seven elements will be discussed separately, whereafter the elements will be brought together, resulting in a proposed governance arrangement that will be validated by two interviews with experts, as mentioned before. The second main research question and the fifth sub-question can be answered with this.

3.6 Conclusion

This research looks into the governance arrangements influencing the decision-making process regarding having a just energy transition and how to improve this. The exploratory approach is most suitable for this research since little to no research has been performed on this subject. The research will have both an empirical and a design component to cover both aspects of the research. The research will perform a single case study, and the neighbourhood Bospolder-Tussendijken is selected for this case study.

The data in this research is gathered in two ways. First, the desk study. With a literature review, the knowledge gap was found in Chapter 1. With a literature study, the theoretical framework was set up in Chapter 2 and in the following chapters, it will be used to support or refute claims made. Next to the literature, policy documents will be studied to get an insight into the current situation.
Next to the desk study, semi-structured interviews will be held. Seven interviewees are direct stakeholders in the Bospolder-Tussendijken case, so they can provide very useful information concerning the current decision-making process. One case stakeholder did not want to participate in an interview but did share an extensive written response.
Four experts are interviewed with a bit broader look on the subject to get more general insights, instead of only from one case. Finally, two experts are interviewed to validate the designed proposed governance arrangement.

The data collected in the interviews will be analysed with Atlas.ti. Next, a stakeholder analysis will be performed with the PI grid and the classification of interdependences table. Microsoft Teams will be used to record and transcribe the interviews. Finally, all interviewees signed an informed consent form.

The information obtained from interviews and desk study will be the input for the analysis with the theoretical frameworks. The institutions will be ordered with the four-layer model, the decision-making process will be analysed with the IAD framework, and the justice of the transition will be examined with the energy justice principles. Finally, bringing together all the information obtained, a governance arrangement will be designed using the design elements of Termeer.

4. The Case Bospolder-Tussendijken

This chapter will explore the case of making Bospolder-Tussendijken natural gas-free. This chapter starts with background information about the neighbourhood, and the plans based on policy documents will be presented. After this, a stakeholder analysis will be presented, and finally, an institutional analysis will be presented. A lot of the information obtained in this chapter comes from the interviews with case stakeholders. For readability, the choice has been made not to include every quote with (Interviewee #x) and in Appendix F, the analysis of the interviews can be found.

4.1 Background

This section will provide background information on the case. First, about the neighbourhood Bospolder-Tussendijken, and then an analysis of the policy documents to sketch an image of the case so far.

4.1.1 Context

The case study will be performed in the neighbourhood of Bospolder-Tussendijken, also called BoTu. This neighbourhood consists of two twin neighbourhoods, Bospolder and Tussendijken, as can be seen in Figure 6. The neighbourhood is located in the western part of Rotterdam in the district of Delfshaven. The neighbourhood has over 14,000 inhabitants in almost 7,000 households, of whom approximately 80% of the population is made up of immigrants, and nearly 70% is of non-Western background (Gemeente Rotterdam, 2018b). In Bospolder-Tussendijken, the unemployment figures and debts are high, the quality of housing is low, and an above-average number of residents do not have a diploma or do not have the proper diploma, and the quality of life is classified as below average (Veldacademie, 2021; Minkman et al., 2020). Both postcodes of Bospolder and Tussendijken are among the poorest 20 postcodes in the Netherlands (SCP, 2019), and almost 75% of the households belong to low incomes (Gemeente Rotterdam, 2018b).

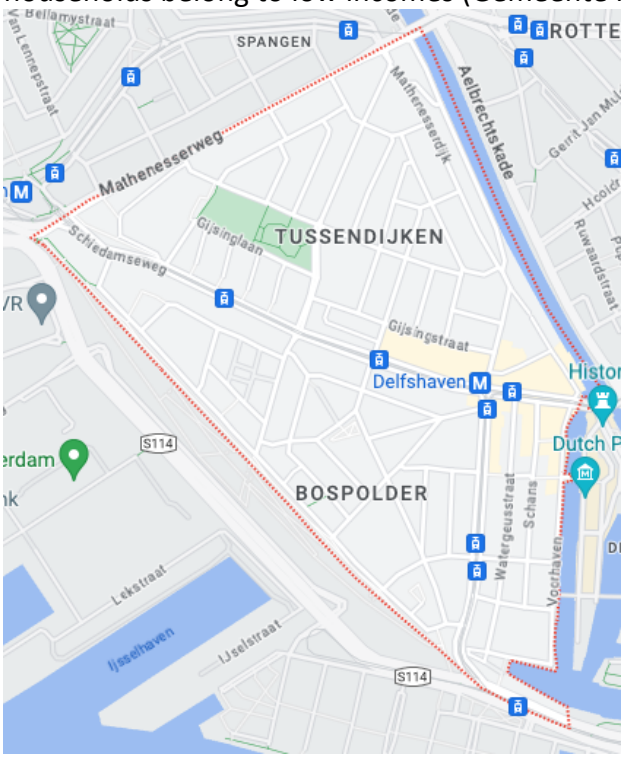

Figure 6: Bospolder-Tussendijken (Google maps, n.d.)

However, at the edges of the neighbourhood, more privileged residents are moving in. The city centre's relative proximity, public transport, and nearby arterial roads make BoTu attractive for higher-educated and wealthier residents. Despite this, the residential areas in the inner of the neighbourhood are still very vulnerable (Gemeente Rotterdam, 2018b). Therefore, the neighbourhood Bospolder-Tussendijken can be called an underprivileged neighbourhood and will be the subject of the case study in this research.

4.1.2 Policy Documents

Several things stand out when looking into policy documents regarding the energy transition. First, the coalition of political parties that formed the city council of 2018-2022 presented in their coalition agreement that Rotterdam had to become more sustainable, and more energy efficient, and the city should have proper air quality (Gemeente Rotterdam, 2018a). To achieve this, the ambition of a CO_2 reduction of 440-640 kilotons per year for 2022 was presented, while CO_2 emissions in 2018 were about 30,000 kilotons of CO_2 per year. In 2021, the municipality presented its transition vision heat, including the ambition to disconnect all 263,000 natural gas connections in Rotterdam (Gemeente Rotterdam, 2021). In this transition vision heat, district heating was considered the optimal alternative to disconnect most of the neighbourhoods in Rotterdam from natural gas for heating. District heating means residual heat from big companies, in Rotterdam mainly in the port of Rotterdam, which will be used to convert water into hot water, which will be used to heat houses.

The available heat supply in the Rotterdam region is nearly double the anticipated future heat demand, with a significant surplus of residual heat. Specifically, within the port area, a substantial excess of residual heat exceeds the city's current utilisation (Gemeente Rotterdam, 2021).
In the transition vision heat (Gemeente Rotterdam, 2021), it was also stated that district heating would be the cheapest alternative. This was because a district heating grid was already in place in Rotterdam. Because the heat sources for the system could be changed for more sustainable ones in the future, such as geothermal, the investment was called a no-regret investment. This is an investment that, no matter what the future brings, is always worth it, and although it might not be the best option anymore in five or ten years, it will still be sufficient.
In a policy document where the roadmap for natural gas-free neighbourhoods was presented, it turned out that Bospolder-Tussendijken was one of the first five neighbourhoods that would be disconnected from natural gas (Energietransitieteam Rotterdam, 2018). This was because buildings were suitable for the step towards district heating, the housing association owned a large part of the buildings, other construction work was already planned, and it turned out that a collective alternative for natural gas was the socially cheapest option for the neighbourhood.

The municipality also presented a guideline for working methods for area approaches (Gemeente Rotterdam, 2019). This guideline presented the long-term perspective and the working methods for area approaches. For the long-term perspective, ten goals were set:

1. Provide a clean, safe, and reliable energy supply for all residents of Rotterdam.
2. The ambition is to make the district heating system fuelled by more sustainable sources, such as geothermal heat. This would mean a shift to a low-temperature district heating system, and buildings should be better insulated for this shift.

3. To provide users more choices in the future, in the type of source, tariff, form of organisation, for example, a heat corporation, and/or delivering back to the district heating grid.
4. Maximum CO_2 reduction at a minimum social cost.
5. Socially cheapest based on the lowest total cost over a 30-year period. Key factors underpinning the attractive low total costs are the high availability of the system and a surplus of residual heat. Alternative solutions based on clean energy would be challenging due to a shortage of clean energy. Furthermore, building more wind turbines in Rotterdam is technically and socially challenging.
6. Prevent energy poverty. Energy poverty occurs when people spend more than 10% of their spendable income on energy bills. Energy transition should be kept affordable for everyone.
7. Although energy consumption is everyone's responsibility, energy coaches can help residents reduce their energy consumption.
8. The municipality does not supply subsidies for the energy transition. Financial arrangements are in place for insulation or disconnection from natural gas. Everyone can access these arrangements.
9. A logical, transparent, and proportional allocation of the construction costs of the basic infrastructure between all property owners in an area. Next, the municipality is in talks with the state to see if state funds will be available, just like for other energy infrastructure.
10. There should be a single tariff for fixed charges and gigajoules for everyone in Rotterdam.

Working methods in area approaches were set based on eleven points (Gemeente Rotterdam, 2019):

1. Area agreements must be integral. This means that area approaches focus on all properties in a selected area and that there has to be an alternative for natural gas for everyone within the area for all the functions where natural gas is used. Furthermore, it should try to couple the project with other projects in an area.
2. Every area approach involves a process with two tracks: a social/societal track and a technical/economic track. The steps within the tracks are area-specific, however. These steps can be adjusted based on regulations and the experiences in the first neighbourhoods.
3. Based on the research in both the social and the technical track, a plan for phasing the approach will be made. Based on this, the geographical scope of the area will be determined.
4. The starting point for every area approach is to involve residents and property owners in the area approach. This should be determined within the neighbourhood how to do so in the best possible way.
5. The communication has to be honest and transparent. Relevant developments are communicated in time and clearly, and it should also be communicated if things are not clear yet. Residents have to be well informed.
6. The area business case is the starting point for trying to be as efficient as possible and reduce costs. The area business case will be used to transparently spread the costs of the basic infrastructure needed for the project, with every actor taking a proportional part.

7. Area approaches choose the socially cheapest alternative to natural gas in every area. In most areas, the selected socially cheapest alternatives are far cheaper than the next-best alternative. Most property owners are expected to choose the selected alternative because of this, but every property owner is allowed to make their own choices.
8. Since the first of July 2018, it has been mandatory for all new buildings to be natural gas-free. If it is not possible to connect to the district heating grid because it is too far away, but there will be a grid in the place within ten years, there is the possibility to choose a temporary heating solution.
9. The area approaches need to add value to an area. This can be done by involving other tasks, such as creating employment or improving the outdoor space within areas.
10. In each area approach, the main stakeholders have to form a joint project organisation with a municipality representative as a project leader, landlords communicate with tenants, and all stakeholders provide a budget for research.
11. At the start of an area approach, a letter of intent or cooperation agreement has to be drawn up. In it, parties agree to start an area approach and outline what they will do. The results of the process land in an area agreement. In it, parties lay down how the transition will occur, who does what and under what conditions.

As mentioned before, Bospolder-Tussendijken was one of the first five neighbourhoods in Rotterdam appointed to become natural gas-free. In 2020, the municipality of Rotterdam therefore applied to join the "Programma Aardgasvrije Wijken" (PAW) (Ministerie van Binnenlandse Zaken en Koninkrijkrelaties, 2022). The national government set this program up. Municipalities could choose how they wanted to become natural gas-free in this program. The neighbourhoods that participated are used as living labs to learn how municipalities nationwide can best start making neighbourhoods natural gas-free. In return, the participating municipalities received subsidies from the national government (Rijksoverheid, 2023). The municipality of Rotterdam received 4.9 million euros from this program to disconnect 1645 buildings from natural gas and connect them to high-temperature district heating (Programma Aardgasvrije Wijken, n.d.-a).

This program matched well with a program that had already started in Bospolder-Tussendijken. In 2019, the program 'Veerkrachtig BoTu 2028' was launched. This program aims to make Bospolder-Tussendijken in ten years the first resilient neighbourhood in Rotterdam (Resilient Rotterdam, n.d.). The program involves collaboration between the municipality of Rotterdam, residents, local organisations, and partners. Next to trying to improve the social index, which is very low in Bospolder-Tussendijken compared to the average in Rotterdam, the energy transition has also been an important part of the program since the start (Interviewee #7).

4.2 Stakeholders

To get a more precise overview of the case, it is crucial to know who was involved and how these stakeholders were involved. Therefore, a stakeholder analysis will be presented here, with the stakeholders placed in both the PI grid and the classification of interdependencies table. This also covers the position and boundary rules of the IAD framework.

4.2.1 Players

In this case, the first and most obvious stakeholder was the municipality of Rotterdam. As mentioned above, the municipality wants to disconnect all 263,000 natural gas connections. Therefore, the municipality decided on the best alternative for natural gas per neighbourhood. The municipality is the local government and therefore an important stakeholder in almost everything that happens in Rotterdam.

Next to this is Havensteder. Havensteder is the housing association which owns a high percentage of the buildings in Bospolder-Tussendijken (Havensteder, 2021). Therefore, Havensteder was a crucial stakeholder in this case because many homes were needed to connect a neighbourhood to the district heating grid; it was impossible with just a few houses (Interviewee #2).

Next to this is Eneco. According to the transition vision heat the municipality presented, district heating was considered the optimal alternative to disconnect most of Rotterdam's neighbourhoods from natural gas for heating, as earlier mentioned. Eneco is an energy company with a district heating grid next to the neighbourhood Bospolder-Tussendijken (Eneco, n.d.). Eneco was therefore the appointed party to build and exploit the district heating grid in Bospolder-Tussendijken and was consequently a crucial stakeholder in this case.

These three stakeholders were the three stakeholders with both high influence and high interest. The municipality as the government, Havensteder as the housing association, and Eneco as the heating company (Interviewee #5) are therefore placed in the PI-grid's player quadrant, as can be seen in Figure 7.

4.2.2 Context Setters

As mentioned before, the municipality is the local government. Higher levels of government also had a role in this case.
The European Union wants to reduce CO_2 emissions in the entire European Union to achieve the goals set and to mitigate the consequences of climate change. To do so, they give subsidies to sustainable projects. They also supplied subsidies to this project.

The Dutch government, specifically the Ministry of Economic Affairs and Climate Policy, also aims to reach the climate goals set and is also a supplier of subsidies to sustainable projects. They also supplied subsidies to this project.

The province of South Holland was also involved. They did not give subsidies to this project but helped to get some European subsidies for Bospolder-Tussendijken in combination with a couple of other municipalities (Interviewee #2).

Stedin is the grid operator in Rotterdam, meaning they deliver natural gas and electricity (Stedin, n.d.). Stedin can, therefore, also be considered a context setter because they had to decouple natural gas connections and replace some of their cables and were therefore very important and could be considered to have high power, but the case was not very interesting for them.

The 'Autoriteit Consument & Markt' (ACM) is an independent supervisor committed to ensuring well-functioning markets for people and businesses, now and in the future. To that end, the ACM supervises competition in several specific sectors, including heating. The ACM is the organisation in the Netherlands that calculates the maximum tariff a heat supplier may charge every year (ACM, 2023b).

All these parties could, with their choices, determine which direction the municipality, Eneco, or Havensteder could and should take and, therefore, had much power. However, they were less interested in this case; they looked at the bigger picture. Consequently, they are context setters.

4.2.3 Subjects

Next to this, many local stakeholders are highly interested in this case in Bospolder-Tussendijken because it directly influences them.
First, the neighbourhood council (Dutch: Wijkraad). The neighbourhood council of Bospolder-Tussendijken also includes Spangen, an adjacent neighbourhood, so it is called the neighbourhood council Bospolder-Spangen-Tussendijken. The function of the neighbourhood council is to represent the neighbourhood. Through the neighbourhood council, residents, organisations, and entrepreneurs can draw the attention of the municipality to things they consider important in the neighbourhood. The neighbourhood council advised the municipality on everything that matters to the neighbourhood, solicited and unsolicited (Bospolder-Tussendijken, 2023).

Another organisation here was the Delfshaven Energy Cooperation. This organisation focuses on sustainability and wants to contribute to a cleaner environment. They operate collective solar roofs in which residents can participate. Part of the benefits go back to the residents, and a part goes into a neighbourhood fund to finance future projects (Delfshaven Energie Cooperatie, 2023).

Another organisation interested in this case was the Tenants Council West (Dutch: Huurdersraad West). As a tenants' organisation, it aimed to represent the interests of tenants living in houses in Bospolder-Tussendijken and elsewhere owned by Havensteder. The Tenants' Council West consists of several active tenants of Havensteder. In principle, all Havensteder tenants in these neighbourhoods are automatically members of Tenants Council West (Huurdersraad West, n.d.). Furthermore, the Tenants Council West has a legal advice right, which can be used more extensively when Havensteder changes its policy substantially (Huurdersraad West, 2020).

These three organisations all had much interest in the case but did not have much power other than making their concerns clear. Therefore, they can all be considered subjects, as shown in Figure 7.

4.2.4 Crowd

No stakeholders were identified with low power and low interest. Therefore, the crowd quadrant in Figure 7 is left empty.

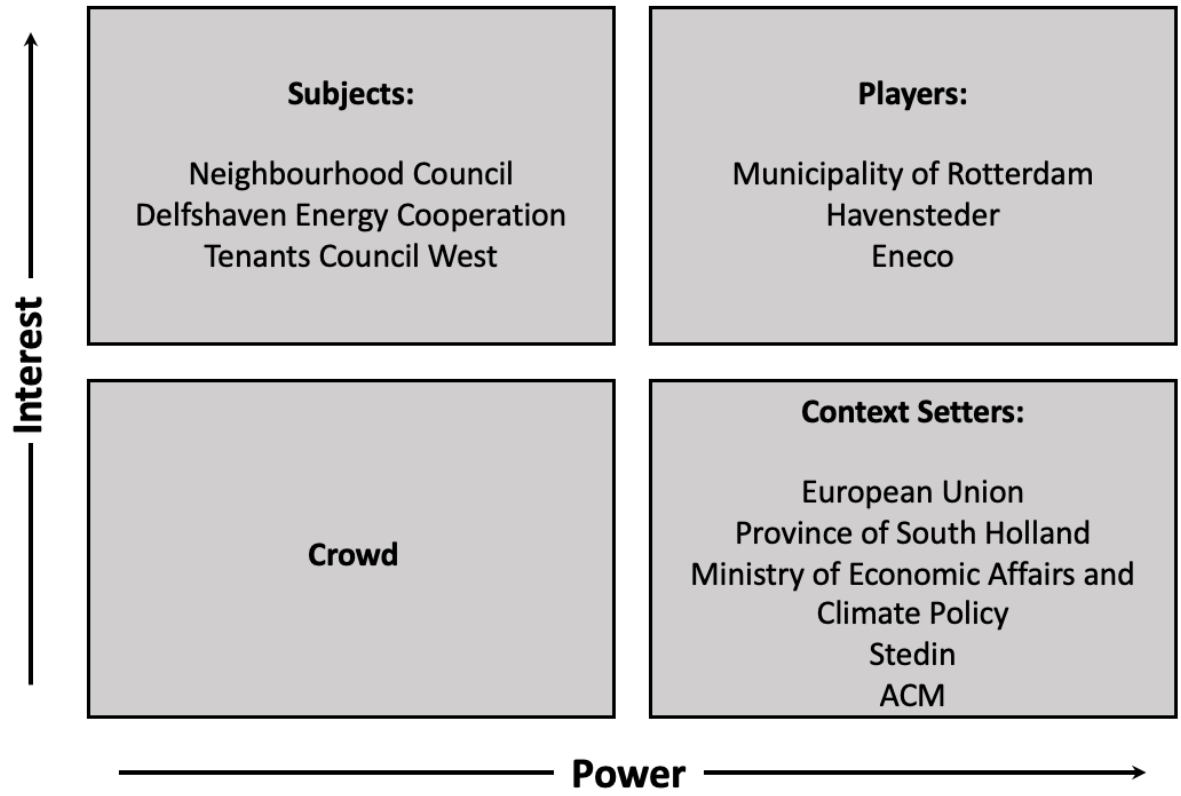

Figure 7: Power interest grid case

4.2.5 Classification of Interdependencies

Although the PI grid provides a clear overview of the power and interest of stakeholders in this case, it does not show in any way if the stakeholders are supportive or have conflicts with the case. Table 2 presents the table of interdependencies, which also gives an overview of which stakeholders had supportive and which had conflicting objectives.

The three actors that were dedicated, critical, and supportive were Eneco, Havensteder, and the municipality. The municipality because this would help them achieve the goals set for becoming natural gas free, Eneco because they could expand their district heating grid and Havensteder because their property would be made future proof. In this case, these stakeholders were the driving forces and could be strong allies.
The neighbourhood council, Delfshaven Energy Cooperation, and the Tenants' Council West were also dedicated but had deviating objectives and were less critical in achieving the goals set since they were not explicitly needed to achieve the goals. They would prefer to consider other options than the district heating grid, like collective solar roofs or more insulation. They were critics of the decisions made and the alternatives chosen and could be described as barking dogs, according to Hermans et al. (2010).

The European Union, Ministry of Economic Affairs and Climate Policy, Province of South Holland, and ACM were all critical stakeholders who supported the case but were not that dedicated because they looked at the bigger picture.

Stedin was a stakeholder that was not that dedicated but was critical and had different objectives because it had to replace some of its cables and disconnect natural gas connections, which did not go very fast, according to a municipal councillor (Dagblad010, 2022).

Since no stakeholders were in the crowd quadrant in the PI grid, no stakeholders are placed stakeholders in the non-dedicated and non-critical actors column in the classification of interdependencies table.

Table 2: Classification of Interdependencies

	Dedicated Actors		**Non-dedicated actors**	
	Critical	Non-critical	Critical	Non-critical
Similar/supportive interests and objectives	Municipality of Rotterdam Havensteder Eneco		European Union Ministry of Economic Affairs and Climate Policy Province of South Holland ACM	
Conflicting interests and objectives		Neighbourhood council Delfshaven Energy Cooperation Tenants' Council West	Stedin	

4.3 Institutions

The institutions were another critical aspect of the case in Bospolder-Tussendijken; a few influenced this case. These will be presented in the four levels of the model of Williamson: embeddedness, institutional environment, governance, and resource allocation and employment. In Table 3, the situation is summarised by presenting the four-layer model.

4.3.1 Embeddedness

As mentioned above, the neighbourhood Bospolder-Tussendijken is underprivileged. The unemployment figures are high, and Bospolder and Tussendijken are two of the poorest postcodes in the Netherlands, with many families below the poverty line (Gemeente Rotterdam, 2018b). Furthermore, the education level is low, and the distrust of the government is high.

4.3.2 Institutional Environment

The Paris Agreement was the basis to which many of the earlier-mentioned policy documents referred. The Paris Agreement is a legally binding international treaty on climate change adopted by 196 Parties at the UN Climate Change Conference in 2015 (UNFCCC,

n.d.). In this treaty, the goal was set to limit global warming to a maximum of 1.5 °C by the end of the 21st century.

In July 2021, the European Union came up with its climate law. The law enshrined the previously established objectives of achieving climate neutrality for Europe's economy and society by 2050, and it also introduced an interim milestone in 2030. This milestone entailed a minimum reduction of greenhouse gas emissions by 55% compared to the reference year 1990. All EU Institutions and Member States are required to take all possible actions at a European and national level to meet the goals (European Commission, n.d.).

In the Netherlands, a climate law was already in place in 2019. This was primarily based on the Paris Agreement and contained some goals, including a greenhouse gas emissions reduction of 49% in 2030 compared to 1990 and a reduction of 95% by 2050 compared to 1990 (Raad van State, n.d.). After implementing the European climate law, the goals for greenhouse gas emissions reduction in the Dutch climate law were aligned with the goals of the European climate law: a reduction of 55% in 2030 and climate neutrality in 2050 (Tweede Kamer, 2023).

Another important law in this case was the Heat Act (Dutch: Warmtewet). This act regulated maximum tariffs for heat. The maximum tariff ensured that someone with a district heat connection did not pay more than someone with a gas-fired central heating boiler because the heat and gas prices were linked. This is called the 'Niet Meer Dan Anders' (NMDA) principle. Because of the Heat Act, more supervision was in place of district heating and block heating suppliers. The Consumer and Market Authority (ACM) checked whether district heating suppliers complied with these rules. (Ministerie van Economische Zaken en Klimaat, n.d.)

Another interesting aspect of this neighbourhood renovation was that the landlord required the tenant's permission to remodel the property. This requirement was loosened when the tenant lived in a building with at least ten flats. In that case, the landlord needed the permission of at least 70% of the tenants in the building (Ministerie van Binnenlandse Zaken en Koninkrijkrelaties, 2023). When more than 70% of the tenants of a building agreed, the remaining tenants could go to court within eight weeks after they are notified that 70% agreed. However, the chance of winning such a dispute was low since the verdict would probably be that the proposal was reasonable (Interviewees #2 and #4).

4.3.3 Governance

This level will be split into two categories: agreements and financial instruments.

4.3.3.1 Agreements

First, the Climate Agreement. To guide the energy transition in the Netherlands, the Dutch government presented the Climate Agreement as a part of the broader climate policy. In this agreement, the government, civil society organisations, and businesses agreed on measures for the next ten years (Rijksoverheid, 2019). It also stated that municipalities had to produce a policy document called "transition vision heat", which the municipality of Rotterdam did, as earlier mentioned.

Secondly, based on the plans presented earlier in this chapter, a document called “area agreement” (Dutch: Gebiedsovereenkomst (GOK)) have been prepared. This agreement was between three parties: the municipality, the local government, Havensteder, the housing association and owners of a majority of the homes in the neighbourhood, and Eneco, the heating company. In this, it was agreed that the municipality and Havensteder would connect their property within the project area to the district heating grid that Eneco would construct. Furthermore, Eneco guaranteed the delivery of heat, Havensteder would make its best effort to get the agreement of at least 70% of the tenants per building, and the municipality would take the leading role in trying to persuade as many private owners as possible with an offer (Gebiedsovereenkomst, 2021). The municipality would help Havensteder and Eneco with permits. Furthermore, they intended to sign a collaboration agreement.

Finally, a document called “collaboration agreement” (Dutch: Samenwerkingsovereenkomst (SOK)) was signed a month after the area agreement. This was an agreement between the municipality, Havensteder and Eneco, all kinds of local energy initiatives, business owners, and active citizens (De Participatiecoalitie, 2021). This collaboration agreement agreed upon how to work together to perform the energy transition.
The goals set in the agreement were to work towards a more sustainable neighbourhood with an affordable and reliable energy supply and, if possible, combine this with other projects to improve the neighbourhood. The municipality, Eneco and Havensteder needed to include residents and neighbourhood organisations. Finally, everyone should be able to give their opinions on decisions made about the transition (Bospolder-Tussendijken, 2021).
These goals should be achieved by collaborating. All involved parties should keep talking to each other. If a disagreement exists about decisions, collaboration is still needed. It should be an inclusive collaboration; everyone who wants to join must be able to do so (Bospolder-Tussendijken, 2021). Everyone who wants to and endorses it can still sign the collaboration agreement.

4.3.3.2. Financial Instruments

Some financial instruments played a crucial role in this case, mainly subsidies. The most important ones will be described here.

First, the incentive scheme for natural gas-free rental homes (Dutch: stimuleringsregeling aardgasvrije huurwoningen, (SAH)), offered by the national government, is a subsidy that covers the indoor housing costs and the connection costs, up to € 5,000 per home (RvO, n.d.). Although this would only cover part of the costs, it was beneficial to the recipients (Interviewee #3).

Secondly, the national government also allocated a subsidy to the municipality of Rotterdam for the ‘Programma Aardgasvrije Wijken’ program. The municipality received a subsidy of 4.9 million euros for the Bospolder-Tussendijken natural gas-free project (Gemeente Rotterdam, 2020). The funding would be used to finance owner-occupiers for the transition to the district heating.
Finally, another important financial instrument was the SOFIE fund. This fund, set up by the municipality of Rotterdam and facilitated by European funds to support connecting neighbourhoods to district heating, provided a loan of up to 425,000 euros to Eneco (Eneco,

2019). With this money, the over-dimensioning of the pipes was made possible (Interviewee #1).

4.3.4 Resource allocation and employment

Here, the actual events are displayed. Some interesting events have already occurred as a result of this case. Houses have been disconnected from natural gas and connected to the district heating network, where the owners of the property signed connection agreements with Eneco per building. Some financial issues have emerged because of not just estimations and rising prices.

Table 3: Four-layer model case

Level	
Embeddedness	Energy justice, distrust of government, education low, affordability
Institutional environment	Paris agreement, European climate law, Dutch climate law, Heat Act, 70% tenants have to agree
Governance	Climate Agreement, area agreement, collaboration agreement, subsidies
Resource allocation and employment	Disconnecting natural gas connections and connect the district heating, financial issues because higher prices, connections agreements signed

4.4 Conclusion

In this chapter, the background of the case was described. It revealed that the twin neighbourhoods Bospolder-Tussendijken are both among the poorest 20 postcodes in the Netherlands. Next to this, the quality of life, income, and education is low in Bospolder-Tussendijken. Therefore, this can be considered an underprivileged neighbourhood.

Furthermore, in the policy documents analysis, an explanation was found that natural gas is being disconnected to achieve the climate goals set and that the municipality of Rotterdam appointed district heating as the socially cheapest alternative for natural gas. One of the first five neighbourhoods to start this transition was Bospolder-Tussendijken.

Next, the stakeholder analysis, in which the boundary and position rules of the IAD framework came up, revealed that the most critical stakeholders in this case are the municipality of Rotterdam, Eneco, and Havensteder. These stakeholders have the power to make decisions and have a direct interest in the case. The parties that are the most significant opposition in the case are neighbourhood stakeholders, Tenants Council West, the neighbourhood council, and the Delfshaven Energy Cooperation, who have the same goals as the most critical stakeholders but different ways to achieve the goals. They do not have the power to change the decisions of the municipality, Eneco and Havensteder since they can only make their standings clear by giving advice. As facilitators, the higher levels of government also play a role in this case, as do Stedin and the ACM. These parties have power but not the interest in micromanaging this case.

The result of this division of roles is that the decision-making power is mainly for the governmental bodies and companies, while (representatives of) neighbourhood residents do not have any real decision-making power.

Finally, the institutions were analysed and presented in the four-layer model of Williamson. The culture of the neighbourhood is a distrust of government, low or the wrong education and the need for affordable energy. It turns out that the climate laws, the Heat Act, and the fact that 70% of the tenants have to agree in a building with more than ten houses to allow a landlord to renovate are the most important formal institutions. Furthermore, the climate agreement, area agreement, collaboration agreement, and the SAH, PAW and Sofie fund subsidies are the most important governance in this case.
Because of this, tenants can impact the decision to renovate their homes. However, this does not let them influence the decision-making concerning the plans for the neighbourhood, but just for their own homes.

The fact that governmental bodies and companies mainly possess the decision-making power and that residents have a say in the disconnection of their own homes but not in the decision-making process in a broader perspective could lead to an unjust energy transition. This will be further investigated in the next chapter.

5. Decision-making Process

In the previous chapter, the boundary and position rules were already discussed within the stakeholder's analysis, and the rules-in-use during the institutional analysis, as are the attributes of the community in the embeddedness level and the neighbourhood overview. This chapter will analyse the decision-making process concerning becoming natural gas-free by implementing a district heating grid in Bospolder-Tussendijken. The other five external rules of the IAD framework are described, the energy justice part of the decision-making part will be presented, and the barriers in this decision-making process will be presented and discussed. A significant part of the information obtained in this chapter comes from the interviews with case stakeholders. For readability, the choice has been made not to include every quote with (Interviewee #x) and in Appendix F, the analysis of the interviews can be found.

5.1 IAD Framework

In this section, the action situation, the biophysical conditions, and the remaining rules of the IAD framework will be presented, as well as the interactions and evaluative criteria. Next, the entire IAD framework for the case will be presented, including the boundary and position rules discussed in the previous chapter.

5.1.1 Action Situation

In this case study, the action situation consists of the decision-making process around the disconnection from the natural gas grid and the provision of replacement connections to the district heating grid of homes in the underprivileged neighbourhood Bospolder-Tussendijken.

5.1.2 Biophysical Conditions

The neighbourhood of Bospolder-Tussendijken is an old neighbourhood, with often outdated houses that suffer from overdue maintenance. The houses are usually not well insulated. The neighbourhood contains many narrow streets with many cables in the ground already, and the neighbourhood is densely built with a lot of stacked housing. To be able to place the pipes for the district heating, some cables have to be shifted. When looking at the four types of goods, the district heating grid can be described as a public good.

5.1.3 Choice Rules

The municipality of Rotterdam granted Eneco a concession in 2010 to build the infrastructure for distribution to end users in certain parts of Rotterdam, including the neighbourhood Bospolder-Tussendijken, from 2013, the first delivery, to 2044. This made Eneco a monopolist in these parts of Rotterdam (Rekenkamer Rotterdam, 2019).
The municipality decided in 2018 that Bospolder-Tussendijken would be one of the first five neighbourhoods to be disconnected from natural gas and probably would be connected to the district heating grid (Energietransitieteam Rotterdam, 2018). This was also because a subsidy from the national government (SAH) was available to switch towards district heating, which could be seen as steering by the different levels of government (Huurdersraad West, 2020).
Eneco, the municipality, and Havensteder decided internally whether they would join this project at the end of 2018.

The choice was also made by Havensteder to first look for a replacement for natural gas instead of improvements to insulation (Huurdersraad West, 2020). This choice was made because Havensteder could spend their money only once and could not afford to connect to district heating and simultaneously insulate all their property in the neighbourhood (Interviewee #3).
In 2019, it was decided by the municipality to start with the ten-year program of "Veerkrachtig BoTu 2028".
Bospolder-Tussendijken was selected as one of the national example neighbourhoods in the 'Programma Aardgasvrije Wijken' in 2020.

In January 2021, the municipality, Havensteder and Eneco reached the area agreement, which many of the interviewed case stakeholders mentioned as the most important decision.
Quickly thereafter, in February 2021, the decision was made to sign the collaboration agreement with the stakeholders of the area agreement and the important energy-concerned stakeholders in the neighbourhood, like Delfshaven Energy Cooperation and actors and initiatives involved in the Veerkrachtig Botu 2028 energy program.
Interviewee #5 stated that the decision was made not to include private owners in the area agreement. This was because including them in an area agreement is more complex than a housing association. After all, they are less organised therefore this decision was delayed. Next, private owners are a minority since a majority of the buildings are property of Havensteder (Programma aardgasvrije wijken, n.d.-a).
The decision to offer residents to switch to district heating was taken when all the financial agreements were made in the summer of 2021.

In Figure 8, the timeline is presented. Here, the most important decisions in the decision-making process are outlined.

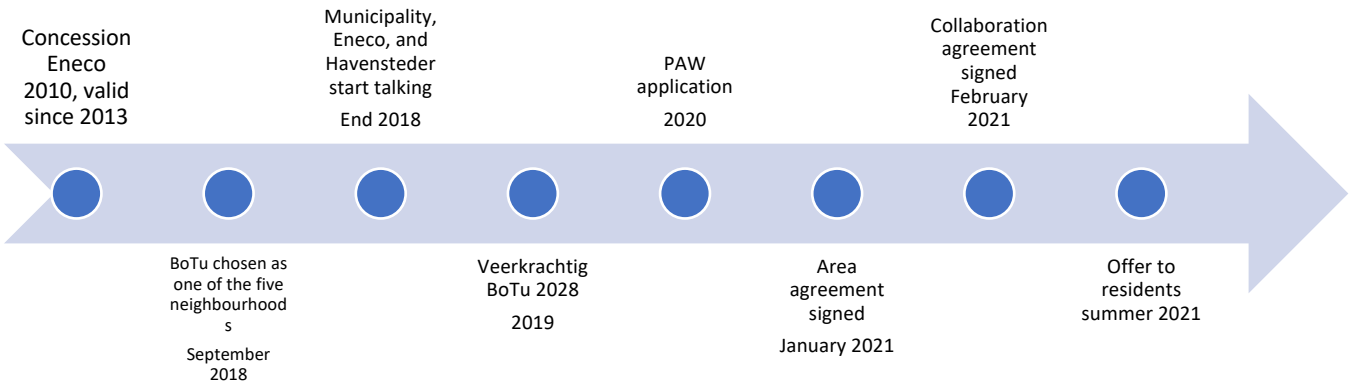

Figure 8: Timeline

5.1.4 Information Rules

Eneco, the municipality, and Havensteder had open books when negotiating the area agreement; they shared almost everything, at least all that was relevant to the case in the beginning. Eneco even shared the business case, which they were not used to before this negotiation (Interviewee #5). This openness helped to build trust between the parties. By

sharing this business case, the municipality and Havensteder could see what happened when different buttons were turned.

The information sharing was initially not very transparent to the active neighbourhood residents who signed the collaboration agreement. After some time passed, this improved, and the information from the municipality, Eneco, and Havensteder towards the neighbourhood stakeholders improved. Nevertheless, transparency remained suboptimal because the area agreement was signed around the same time, resulting in two separate discussions. The area agreement was surrounded by secrecy, resulting in the feeling that not all information was shared with the neighbourhood (Interviewee #7).

The information sharing with the neighbourhood council was not very transparent, or at least not complete to their expectations, since a member of the neighbourhood council spoke during a municipal council ((Dutch: gemeenteraad)) meeting and asked what the role of the residents in the living lab is, when the living lab is a success, and what criteria are used (Gemeenteraad van Rotterdam, 2022).

The information sharing with the residents in the neighbourhood mainly was project-focused, without much education on the entire energy transition.
The information sharing of Eneco, the municipality, and Havensteder to the residents went through joint newsletters. In these newsletters, it was communicated for a long time that they were looking into it, and then suddenly: we are starting this project. (Interviewees #1, #2, #4, #5)

5.1.5 Aggregation Rules

The decision to grant Eneco the concession was made by the municipality alone.
The decision to join this project was first made within the organisations of Eneco, Havensteder, and the municipality internally before taking any other decisions that impacted this case.
The decision to sign the area agreement in 2021 was made together by Eneco, the municipality, and Havensteder. This happened after months of negotiations with three parties with different interests and ideals. They came a long way with the idea that they were committed to doing this, and therefore, all took the risks that were most to their credit. However, this was easier in the first subjects because it was quite logical who took what risks; in the end, with the more sensitive topics, it became more challenging to take on risks and the difficult points were exchanged. Representatives of the three parties indicated in interviews that they operated as equals also because they were dependent on each other. However, as legally determined, the municipality was the leading entity.
Almost at the same moment as the signing of the area agreement, Eneco, the municipality, and Havensteder signed the collaboration agreement with the neighbourhood stakeholders. The process towards the signing went smoothly because no specific goals were set, and because of this, there was not much to complain about. Therefore, it was indicated in an interview that the process towards the collaboration agreement provided a basis for further collaboration, more than the agreement itself.

5.1.6 Pay-off Rules

When looking at the pay-off rules, it is important to clarify that costs and benefits are not only about money, although it is an important aspect in this case, it can also be seen in other elements.

The first one is, of course, the area agreement, which had the benefit that a framework was already in place within which the decision-making could take place, which made sure the parties did not have to negotiate that part for every separate street of the project area in the neighbourhood (Interviewee #6).
For Eneco, this is straightforward. The costs were the investment costs in the district heating grid in Bospolder-Tussendijken, which were a high upfront cost, and the benefits are an expected income, potentially for a very long time, resulting eventually in profit for Eneco. Next to this, Eneco has the ambition to be climate neutral by 2035, not only in its activities but also in the energy Eneco delivers to customers, so this was a contribution to achieving that goal as well.

For the municipality, this project contained a few benefits and some costs. First, a benefit was that many homes would become natural gas-free, which helped achieve the goal of becoming completely natural gas-free. Another benefit for the municipality was that all distribution stations were located indoors, mostly in buildings of Havensteder, so not in the streets, because of which not a single tree had to be felled. Next to this, the social track was important because it helped the neighbourhood by developing other projects and trying to tackle energy poverty. The costs for the municipality were primarily financial, although some expenses were covered by higher levels of government (Interviewees #1, #2).

For Havensteder, the benefit was also that their property would become natural gas-free, which they had to do because of regulation. With this project, they did not have to do this alone but in collaboration with the municipality and Eneco. They also got the chance to have a lot of insight into their tenants, which could help them solve deeper problems. The costs for Havensteder were primarily financial, but also the fact that because they had to spend money on the connection to the district heating grid, they could not spend this money on, for example, insulation.

This project resulted in quite some concerns for residents. They had only one supplier of heat left, Eneco. This excluded the possibility of free competition, which could lead to better options by switching from suppliers now and then (Huurdersraad West, 2020). Furthermore, cooling might be more important than heating in the future. District heating does not provide cooling, so only the tenants that received better insulation next to district heating benefited (Huurdersraad West, 2020).

5.1.7 Scope Rules

The project area is much smaller than the initial search area. The entire neighbourhood was an option when starting the project, as shown in Chapter 4 Figure 6. Based on the interests of all stakeholders combined, where the municipality moved a bit towards Havensteder, it was brought back to this project area of three blocks in Tussendijken. This project area is shown in Figure 9. The possibility of expanding the project area to Bospolder did not make it because of conflicting interests between Eneco and Havensteder (Interviewee #3, #4, #5).

Havensteder wanted the guarantee that the district heating grid would be high temperature there as well because their property was not ready for lower temperatures with the current state of insulation. Eneco did not want to guarantee this as they wanted to move to more environmentally friendly lower temperature heating, and therefore, expanding the project area did not make it. This also showed that relations become more complex when working together for a more extended period in such close cooperation, specifically when the stakeholders have deviating interests.

The energy crisis significantly affected this case because the idea when starting this project was that it would also be cheaper for residents. However, because the Heat Act connected heat and natural gas prices, the price of heat was also driven up massively during the energy crisis when gas was getting more and more expensive.
Also, the indoor costs were much higher than expected, which made the project more expensive and could have stopped the project. The connection costs to the district heating grid were 50% higher than expected for Havensteder, eventually leading to Eneco finding other, cheaper connection methods (Interviewee #3).

Figure 9: Project area (Duurzaam010, 2021)

5.1.8 Interactions

The first interaction was between the municipality and the national government, resulting in Bospolder-Tussendijken being selected for the 'Programma Aardgasvrije Wijken'. The next significant interaction was between Eneco, Havensteder, and the municipality, resulting in the area agreement.

Another important interaction was between the stakeholders of the area agreement and the neighbourhood stakeholders to come to the collaboration agreement.
The municipality was also granted a European subsidy by collaborating with other municipalities and the province of Zuid Holland.

The interaction between Eneco and Havensteder for the connection agreements for every building was also very important. Finally, the interaction between residents and/or tenants and Havensteder and/or Eneco was critical to making sure the district heating grid could be connected to homes, where tenants or owner-occupiers in individual houses had to agree or in larger buildings with many apartments, at least 70% of the tenants had to agree. District heating will not be connected to these homes or buildings without agreement.

Tenants Council West and Havensteder also interacted since Tenants Council West advises Havensteder, so in this case also on the decision to connect to district hating instead of natural gas. Havensteder also reacted to this advice but did not always follow it. Sometimes, they discussed matters further or took them together to the municipality or Eneco (Huurdersraad West, 2020).

The final interaction was between the neighbourhood council and the municipality. The neighbourhood council advised the municipality on everything that mattered to the neighbourhood, solicited and unsolicited.

5.1.9 Evaluative Criteria

Multiple interviewees mentioned that eventually, the most important result should be that the residents of Bospolder-Tussendijken were content and did not have too many problems from the district heating grid construction or the fact that they cannot choose their supplier anymore because the only supplier of heat for the neighbourhood is Eneco. Building on this, the hope was that the transition would deliver value to the neighbourhood and the residents by creating employment or tackling energy poverty and that it might lead to a bigger energy community because people might become more invested in the energy transition, to work on a more sustainable neighbourhood (Interviewees #2, #7).

Another mentioned criterion is time. Some subsidies are time-limited, and therefore, the project must be finished within the project time because if not, the subsidies will stop, which will badly affect the parties financially. This is already a critical element due to the project costs exceeding their initial expectations when starting the project (Interviewees #1, #6).

The third element that was mentioned a lot by almost all stakeholders was the costs. As mentioned, the costs were higher than expected when starting with the project, but the goal is overall to be as close as possible to the estimated costs.

For the municipality, Eneco and Havensteder, it was an evaluative criterion that the residents were content with the project, or at least did not have too much trouble from it. For the neighbourhood residents, the most important criteria were the costs, whether it would be affordable and whether the heating price would increase or become more expensive than the previous gas price they paid. Furthermore, the comfort of the transition was important since the neighbourhood residents already have enough other problems without getting an extra issue, and the transition should actually help them (Huurdersraad West, 2020).

5.1.10 Overview

In Figure 10, the IAD framework for this case is shown, and in Figure 11 is focussed on the action situation of the IAD framework in this case.

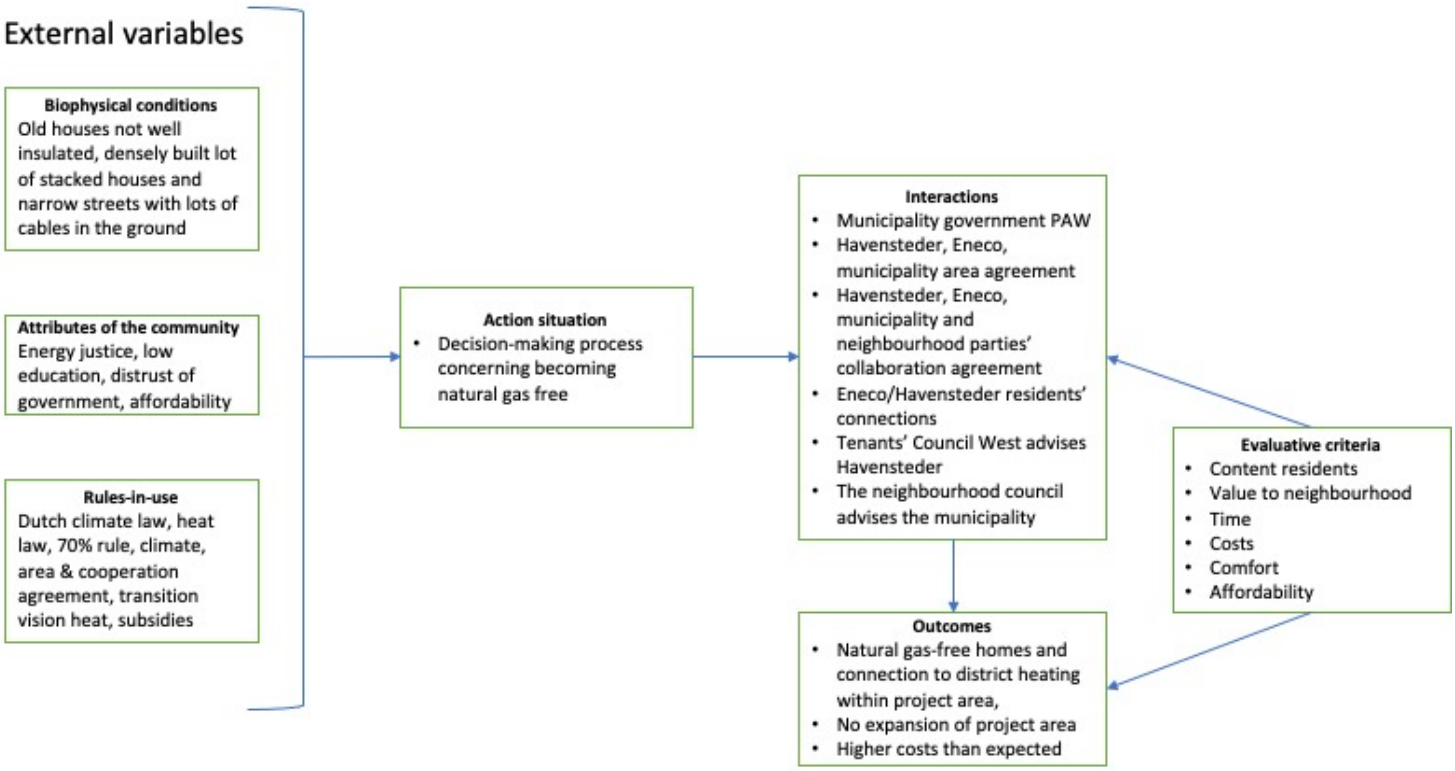

Figure 10: IAD Framework case

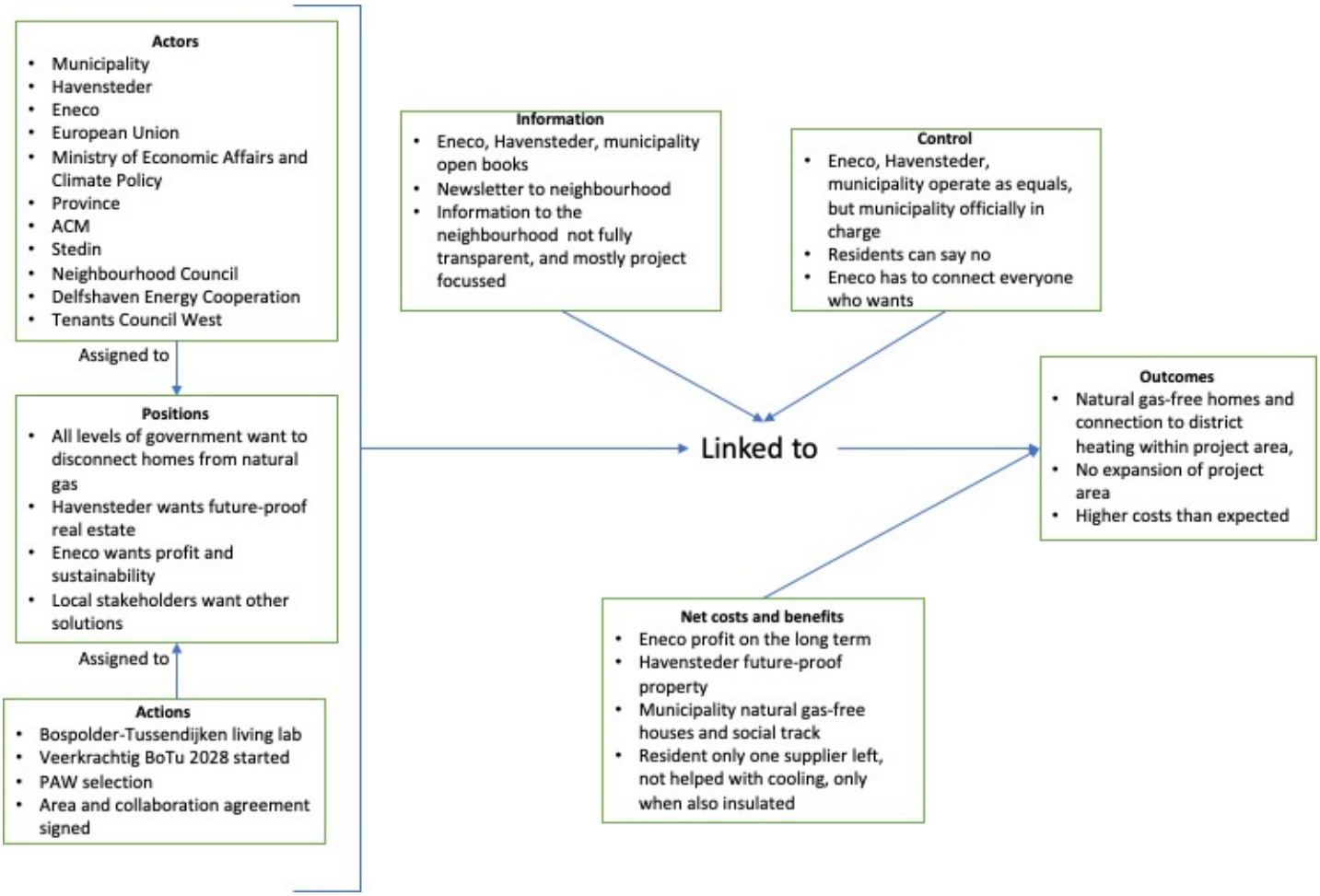

Figure 11: Action situation case

5.2 Energy Justice

In this part, energy justice in this case will be discussed based on five of the eight energy justice decision-making principles by Sovacool & Dworkin (2015) previously mentioned. The principles that will be discussed are availability, affordability, due process, good governance, and sustainability.

5.2.1 Availability

This availability principle asks for the possibility for everyone to access energy when needed and the reliability of delivery.

Within the geographical scope, everyone could be connected to the district heating grid; all the real estate had to get the chance to get connected to the district heating, as agreed on in the area agreement (Gebiedsovereenkomst, 2021). When someone wanted to be connected, Eneco had a connection obligation. Still, some exceptions have been made for complex buildings not owned by Havensteder, where a minimum percentage of 50% of the houses in the building that wanted to connect was needed before they started connecting homes to the district heating grid. This was, however, only a part of Tussendijken and not in Bospolder because no area agreement was signed there because the parties could not reach one.

The availability of energy, also known as the security of supply, is ensured by peak boilers deployed on cold days, for example, when residual heat is insufficient, so that part should be covered. However, it has been questioned what will happen if the primary heat sources drop out while the alternative replacement sources are not ready yet because of technological development (Huurdersraad West, 2020)

5.2.2 Affordability

This principle asks for everyone to be able to afford energy and ensure the prices are stable. The price for connection to the district heating grid will increase with a kind of inflation correction yearly. All groups paid the same, but only within a group, so owners paid a different price than tenants and landlords, but this is because this was differently arranged with subsidies and other agreements (Interviewee #5).

The subsidies allowed owner-occupiers to switch to district heating for 1,500 euros, about 10% of the actual costs. If they could not afford this, they could take out an interest-free loan (Interviewees #1, #2). These conditions are only valid during the project time until January 1, 2026. After this, the subsidies expire, and so do the conditions. After this deadline, connecting to the district heating grid is still an option, but in that case, the conditions will be far less attractive.

A problem here, however, was that some people had fixed gas contracts, which meant that although the current price of heat is not higher than the price of gas, the price of heat could still be higher than the price of gas in the fixed contract, which could seriously increase people's energy bills (Gemeenteraad van Rotterdam, 2022). Natural gas is being made unappealing, which should make alternatives more attractive. However, because of the coupling between gas and heat prices, the affordability did not improve, leading to problems for the financially weakest in the neighbourhood (Huurdersraad West, 2020).

Also, the ACM sets a maximum price for heat yearly. However, when the switch to district heating was made, residents had no choice anymore in the suppliers since Eneco had a monopoly position through the concession given by the municipality. Eneco asked for the maximum tariff set by the ACM for heat in 2023, which could lead to affordability for the poorest residents falling into question (NOS, 2023).

5.2.3 Due Process

This principle asks for the right for all stakeholders to be heard and to be able to make their complaints clear to a neutral arbitrator.
Some local stakeholders were involved in the process, for example, the stakeholders of the Veerkrachtig Botu program (Interviewees #1, #7). They could talk with the municipality, but the municipality had an incentive since it had set goals to disconnect all 263,000 natural gas connections and could therefore not be called a neutral arbitrator. Next, the decision to go for the district heating was already made, and the possibility of changing this decision was unavailable for residents.

Owner-occupiers and tenants only got the question when the district heating would be connected if they wanted to be connected or not. They could say yes or no, and no other alternatives were offered (Huurdersraad West, 2020). It is not the case that owner-occupiers

or tenants had any other say in the decision-making process; only the earlier-mentioned stakeholders could provide their remarks.

5.2.4 Good Governance

This principle requires everyone to get high-quality information and a transparent decision-making process.
The residents of Bospolder-Tussendijken were informed quite late. Eneco, Havensteder, and the municipality decided they wanted to ensure they had all financial agreements ready before officially informing all residents. When all these were in place, they soon informed the residents. The process of these agreements was not fully transparent to the neighbourhood stakeholders involved in the information sharing and even less to the neighbourhood residents (Interviewee #7).
For a long time, the residents only heard through newsletters that Eneco, the municipality, and Havensteder were working on it until they had an agreement. Then, they communicated all at once that they reached an agreement, and the project would start.
Information evenings and workshops were set up to inform residents, but the question is if and how much residents became aware of this.
The residents should also have been informed about the broader energy transition, not only project-focused information (Huurdersraad West, 2020).

5.2.5 Sustainability

This principle asks for using sustainable resources and not harming the environment irreversibly.
Currently, the district heating is not very sustainable because the residual heat used for the high-temperature district heating grid causes a lot of emissions. After all, it is heat released from waste incineration. High-temperature district heating means the temperature is between 70 and 90 degrees Celsius, and the primary sources are heat plants fired with natural gas or biomass, or residual heat, as in this case (Wahi et al., 2023).
In this case, the heat was produced anyway, whether it was used for the district heating grid or not, and it still had less emissions than the use of natural gas. The intention is to go to lower temperatures, making this more sustainable. This is still a long-term plan; no concrete plans have been made yet. At least the possibility to preserve is there, which is not the case when keeping natural gas (Interviewees #2, #5, #6).

As mentioned before, peak boilers are used for the security of supply. This gave a strange image to residents because they had to get disconnected from natural gas, but natural gas was still used. Although it was needed to guarantee the security of supply, it could be better for the project to look into a more sustainable backup as well.
Because the choice was made for only heating instead of another technique that could provide cooling, like heat pumps or better insulation, residents could use more unsustainable sources to cool during summer (Huurdersraad West, 2020).

5.3 Barriers

The first notion is that although some barriers are identified, the interviewees from Havensteder, Eneco, and the municipality were mostly very positive about the project and the decision-making process and mentioned only a few barriers in the decision-making process. Nevertheless, these barriers can become big problems. Therefore, they will be

described and discussed here. In Table 4, these barriers are also presented. The barriers are presented in a random order; the number has no meaning in terms of importance.

The first barrier was that at the beginning of the decision-making process for making the neighbourhood natural gas-free, very short lines of communication existed within the organisations of Eneco, Havensteder, and the municipality. However, this slackened after the area agreement was signed (Interviewees #1, #5). Therefore, the decisions not included in the original area agreement caused a lot of frustration and delay, leading to strained relationships. Building on this, during the implementation phase, the decision-making became more difficult because it was looked at within some organisations as just project work. In contrast, the organisations worked completely differently in the phase before the area agreement was signed. Because of this worsening attention, the decision-making was hampered.

A second barrier was the reason behind the lack of an area agreement for Bospolder. Eneco wanted to connect to a lower-temperature district heating grid there because then they could use more sustainable sources to feed the district heating grid. This was impossible with the status of the real estate of Havensteder because Havensteder did not have the financial resources to disconnect all the houses from natural gas and insulate all their properties better, which was needed to connect to a lower temperature district heating grid. Therefore, Havensteder wanted to get a guarantee that the connection would be to a high-temperature district heating grid there as well because only then could they guarantee their tenants that they would have a warm house in the colder months. Eneco could not agree with this; therefore, the area agreement for Bospolder did not make it (Interviewees #3, #4, #5). As shown here, this was an essential point in the decision-making process and, therefore, a possible dealbreaker.

A third barrier was the Heat Act, in two ways. First, because of the principle that heat cannot be more expensive than gas, and therefore, these prices are coupled, the price of heat also rose enormously during the energy crisis when the gas prices rose, which made it way less attractive to switch to district heating. With this, the NMDA principle, meant to protect customers from unreasonable heat prices, was now the source of very high heat prices and, therefore, was not fulfilling its purpose.
Secondly, Minister Jetten of Climate announced in the plans for the new Heat Act, the Collective Heat Act, that the district heating grids should be at least 51% publicly owned. This new proposal came up after almost seven years of a lot of uncertainty, which is still present, which, of course, massively impacts the business case of Eneco (Interviewee #5).

A fourth barrier was the lack of ambition in the national government. In 2018, plans were presented to go completely natural gas-free, but this has been weakened in the last few years, with many intermediate steps. This slowed down the energy transition, and because the higher levels of government did not entirely follow through, the decision-making in the local energy transition was hampered (Interviewee #3).

The fifth barrier was the lack of possibilities for residents to join the decision-making process. This left an enormous potential untapped in terms of commitment, passion and

knowledge. When these could be set in a climate council, this would anchor decisions about basic services much better in a neighbourhood (Interviewee #7).

A sixth barrier mentioned was the fact that heat delivery would be monopolised. This meant that no other suppliers were allowed and would block the opportunities for innovative alternatives and competition, which could result in lower prices for the next decades. The district heating does not provide cooling, which could be more necessary than heating in the future (Huurdersraad West, 2020).

Table 4: Barriers in the decision-making process case

Barrier	Description
1	Short lines of communication within and between organisations faded
2	Disagreement about the type of temperature of district heating
3	Price coupling in the current Heat Act and proposed new Heat Act
4	Lack of ambition national government
5	Lack of possibilities residents to participate
6	Monopolised alternative without cooling

5.4 Conclusion

In this chapter, the decision-making process of the case Bospolder-Tussendijken was analysed with the IAD framework and the energy justice decision-making principles.

First, the action situation was presented: the decision-making process around the disconnection of natural gas from homes in Bospolder-Tussendijken and the connection to the district heating grid. The infrastructure is old and narrow. The most critical decisions made in the process are the concession given to Eneco, BoTu chosen as one of five neighbourhoods to disconnect from natural gas, the PAW application, and the signing of the area and collaboration agreement. The information shared between Eneco, Havensteder and the municipality was very transparent, but the information supplied towards the neighbourhood was less transparent and mainly project-focused.

Eneco invested a lot of money now and expects to profit in the long term. The municipality got closer to achieving its goal of becoming natural gas-free. Havensteder got future-proof property as a result of the project. For the municipality and Havensteder, the costs were also mainly money. The residents will be left with only one supplier of heat, Eneco, which excluded the possibility of free competition. Furthermore, cooling might be more important than heating in the future, so only the tenants that got better insulation next to district heating benefited. The opportunity of insulating all property parallel to the disconnection from gas was not chosen, predominantly for cost reasons.

The project area, three blocks in Tussendijken, was much smaller than the initial search area, which was the entire neighbourhood Bospolder-Tussendijken. Expanding the project area to Bospolder did not make it because Havensteder and Eneco disagreed about the temperature of district heating. The project costs also were much higher than expected.
The evaluative criteria of this case are content resident, adding value to the neighbourhood, time, costs, and comfort.

The case has also been investigated while looking into energy justice. Concerning the availability, everyone living within the project area could connect to the district heating grid. Peak boilers secured the security of supply, but concerns are raised about what happens when the primary source fails. With subsidies, affordability was tried to be ensured. The coupling between gas and heat prices was troubling here, especially with the extremely high gas prices and the fact that Eneco asked for the maximum tariff the ACM allowed. Because of this, affordability was not fully ensured, especially in this poor neighbourhood. Next to this, the project costs were much higher than expected, which came forward out of the fact that everything was new. Concerning due process, the municipality, Eneco and Havensteder heard the more active citizens and came to a collaboration agreement. However, this was done separately from the decision-making process to move to district heating. Therefore, the process towards the collaboration agreement was more important than the agreement itself since the process provided handles to keep collaborating. Concerning good governance, the neighbourhood was informed through newsletters, but this was not fully transparent. The information was mainly project-focused and not too much on the entire energy transition. Therefore, this could be improved to involve residents even more in the energy transition to let them understand it better. District heating could be considered more sustainable than natural gas when looking into sustainability. With high temperature, it is still much less emitting than natural gas. It does not cover the cooling needs during summer, however, possibly resulting in more emissions by residents to cool their homes, compared with alternative solutions.

Taking together these insights, the case has shown aspects of a just energy transition and an unjust energy transition. The just aspects were that everyone could access the energy, it was more sustainable, and the affordability was tried to be ensured. The unjust aspects were that the residents did not have decision-making power, the affordability was not fully ensured, and the information provision could have been better.

In the decision-making in Bospolder-Tussendijken, six main barriers were identified. The fact that the interest in the case decreased at the top of the different organisations after the area agreement was signed, the disagreement about the type of temperature for the district heating when looking to expand the project area, the uncertainty regarding the (new) Heat Act and the lack of ambition of the national government in general, the lack of possibilities for residents of the neighbourhood to join the decision-making process as mentioned above, and the fact that the heat delivery was monopolised, and the transition does not provide possibilities for cooling, and insulation has been pushed forward.

6. Expert Findings

To look more broadly into the problem, four experts were interviewed, working in or researching the fields beside the case in Bospolder-Tussendijken. The interviews were held with a person who worked at multiple municipalities regarding neighbourhood renovations and researched it, two persons researching neighbourhood renovations at universities and one who worked in multiple neighbourhood renovations. Additional information can be found in Appendix C.

In this chapter, the results of these interviews will be presented. For readability, the decision was made to not include every quote with (Interviewee #x) and in Appendix G, the analysis of the interviews can be found. In these interviews, the main focus was on the choice and information rules, barriers in the decision-making process, the five energy justice decision-making principles, and the governance arrangements elements. However, these elements will not be presented in this chapter but in the next chapter. Finally, the experts were also asked to reflect on the current situation and what they see as the most important governance conditions for a just energy transition in an existing neighbourhood.
Because the experts were selected separately from the case study, no reconstruction was done, but instead asked for their opinions on all the points above. This will also be taken to the design of the governance arrangement in the next chapter.

6.1 Choice Rules

First, deciding where to start with the disconnection of natural gas homes is essential. One way is to investigate in which neighbourhoods, for example, maintenance work is already planned or where the need for home renovations already exists. This provides valuable input into decision-making based on practical considerations of costs and efficiency. Another way to choose is to investigate which neighbourhood needs an uplift because it is, for example, underprivileged, and this can be improved by making the neighbourhood more sustainable.

When this is decided, building trust between the organisations is crucial since private and public parties usually have some natural distrust (Interviewee #13). This can be done by being as transparent as possible.
When starting a project, making sure the juridical steering elements have been established by the municipal council (Dutch: gemeenteraad) or legal provisions is essential. Otherwise, the project will always be undermined by someone. Furthermore, the financial side of the project needs to be clear. It has to be decided who makes which investments, and the risks and liabilities have to be divided between stakeholders (Interviewee #10).

Furthermore, it is important to make sure that every possibility has been considered before choosing a particular solution for the heat transition since residents will ask questions about other alternatives, so it is beneficial to start with a broad view and then funnel the focus.

6.2 Information Rules

According to Interviewee #10, it would be best for stakeholders concerned with the energy transition to inform the residents of a neighbourhood at least two, maybe even four times a year, about the progress of the negotiations. This can be done by either information evenings or newsletters. When reporting, things that did not go as planned should not be concealed unless the very specific case it concerns company secrets. According to

Interviewee #13, this is important because the distrust of professional parties has increased over the last few years in society, especially in underprivileged neighbourhoods. However, choosing the right tone of voice is also crucial so that residents do not get the wrong ideas about their positions.

It is also important to address why specific alternatives are not an option for the neighbourhood and potential collaborating stakeholders. While doing this, it is also essential to ensure that the information is presented comprehensibly because the residents may not have all the capabilities to understand all technical conditions set for alternatives (Interviewee #12).
Furthermore, the decision-making stakeholders should share information to ensure that in such complex systems, every opportunity to couple multiple tasks can be used.

6.3 Availability

The aim has to be to let everyone connect to district heating. Therefore, it is vital that the district heating is available for everyone. However, whether an opportunity exists to connect to district heating is not the only issue; the distrust of governmental bodies, which is very common in underprivileged neighbourhoods, needs to be resolved, and not by someone from the government, but, if possible, by someone living in the neighbourhood or someone specialised in these matters (Interviewee #12).
Next, it could be a primary condition that tenants' houses are insulated to a certain energy label. This would require less heat to warm the houses, increasing the availability of heat to warm houses.

6.4 Affordability

One way to keep the heat affordable is to get higher connection figures. Every house that does not connect in an area where the pipes get laid harms the business case of the project, making it more expensive for the houses that do connect.

Another critical issue concerning affordability is the exploitation of the district heating grids. These are now usually exploited by private parties, usually energy companies, with an important interest in making a profit. Governmental bodies are the only stakeholders within the complex field interested in the public values as the promise of the constitutional state. In the case of neighbourhood renovations, this is the municipality as the local government (Interviewee #11).

Finally, the price of heat could be more subsided, or at least be uncoupled from the gas price, resulting in more, at least relatively, affordable heat. This could be done since heat is less gas-dependent than it used to be. Also, when the exploitation stays within private hands, the returns of private parties could be an interesting point of discussion if the percentages of profit could be lowered.

6.5 Due Process

Especially in an existing neighbourhood, it is essential to include the residents of the neighbourhood. This means that it should not be the case that a finished plan is presented. Instead, at the start of the project, for example, three scenarios could be presented, where every resident can let their thoughts be known, and a vote could be held on the scenarios. In

this way, the thoughts of the neighbourhood are clear, and they have at least been consulted this way, although the vote does not have to be binding (Interviewee #10).

It is crucial to clarify the boundaries within the solutions possible. Limitations exist in the techniques and options suitable for a neighbourhood. If this is not done correctly, the wrong expectations of the neighbourhood may be raised, resulting in possible uproar in the neighbourhood and less willing citizens to comply with the project. If these boundaries are made clear, it is also important to get as high a percentage of the neighbourhood as possible to these evenings to ensure everyone affected by the new policy who wants their opinion to be heard has the chance to do so (Interviewee #11).

These different options would probably not differ very much in terms of the solution, but for example, a district heating connection with some extra insulation and higher rent or without insulation and lower rent or stay with the current gas connection. This keeps it understandable for everyone as well. Next, it could also be an option to discuss these scenarios without voting after the discussion since some people might not want to vote in public or for another reason. However, this could also be solved by adding an option of voting blank.

6.6 Good Governance

Letting everyone in a neighbourhood know how the process works is important because this transparency can take away many suspicions. If communication about decision-making is absent, the possibility arises that individuals may interpret things independently, leading to considerable uproar and uncertainty.
However, an even worse scenario is possible when deals are being made without anyone knowing, while the message to the outside world is that the investigation into the suitable sources of heat is still fully ongoing and that they will update everyone as much as possible. When the information that the deal has already been made leaks, this completely disrupts the entire process, once again making clear that transparency is key (Interviewee #11).

When being transparent, it is crucial to ensure the information provision is approachable since most people will not understand all the technical details of these projects, especially in undereducated neighbourhoods.
Furthermore, citizens should be informed about climate change and the energy transition in a broader way than just the fact that the transition away from natural gas is needed and the details of the project to achieve this. If residents are better educated, they will understand things better and may be more willing to participate in the transition in a more active role (Interviewee #12).

6.7 Sustainability

District heating can be seen as the best alternative to natural gas for collective heat supply, even with only high-temperature heating grids. Although high temperature is not ideal, many options exist to improve this. Because of the electrification of the world, heating with electricity is not an option, according to Interviewee #10.
According to Interviewee #11, an ongoing transition almost guarantees that solutions are suboptimal. This is part of the fact that technology still has to be further developed and that

the perfect solutions may be there already but are not qualified as such yet or still have to be developed.
However, the fact that high-temperature district heating with waste incineration as the heat source is used does not necessarily promote sustainability. A case could be made that less sustainable sources are encouraged or at least legitimised.

6.8 Barriers

In the expert interviews, some more general barriers in the decision-making process concerning becoming natural gas-free were found. In Table 5, all the identified barriers are presented. The barriers are presented in a random order; the number has no meaning in terms of importance.

According to Interviewee #10, uncertainty is a barrier to the decision-making process. If the responsibilities are not made clear, such as with the new Heat Act or within coalitions, or the communication to everyone outside the coalition is unclear, the decision-making process will get hampered.

A second barrier to the decision-making process is the fact that most of the time, only the easy parts of neighbourhoods or cities in the Netherlands get connected to the district heating grid, which makes the decision-making in the short-term easier but more difficult in the longer term since then all at once the problematic parts will have to get connected (Interviewee #10).

Another barrier in the decision-making process is affordability, both for the stakeholders performing the transition and for the neighbourhood residents. First, such a project needs to complete a business case because if that is not possible, most private parties will not participate in the project because they are simply not in business to lose money. Therefore, this can also be a barrier to the affordability of citizens since when the focus is mainly on limiting financial costs for companies, this can be at the expense of residents (Interviewee #11).

Interviewee #11 states that the fact that the decision-making process for planning a heat transition is very context-dependent is also a barrier. Therefore, it is hard to take learnings from one neighbourhood and implement them without further ado in another neighbourhood, with a completely different context, which Hoppe & van Bueren (2015) also describe. This makes it hard to take universal lessons because that can only be done to a certain extent, which makes the decision-making process in every neighbourhood or city a new challenge.

According to Interviewee #12, a barrier in the decision-making process is the fact that support within the neighbourhood has to be created. This makes the decision-making more difficult since enough support is needed. Otherwise, the affordability of the parties building the grid will become critical. On the other hand, residents have to agree before the planning is complete, so one must almost sign a blank cheque, which is challenging to persuade residents to do.

Another barrier is the lack of knowledge by citizens, or at least the mixed signals people get. For example, the European Union gave natural gas the label 'green' because of political pressure from Germany. This results in many people challenging the need to disconnect from natural gas because Germany is moving towards natural gas, and the EU says it is green (Interviewee #12).

In Table 5, all the identified barriers are presented.

Table 5: Barriers in the decision-making process experts

Barrier	Description
1	Uncertainty
2	Mostly only easy parts connected to district heating
3	Affordability of the transition
4	Context-dependency of planning a heat transition
5	Creating sufficient support
6	Natural gas labelled green

6.9 Governance Conditions

The interviewed experts were also asked to reflect on the current situation and what they see as the most important governance conditions for a just energy transition in an existing neighbourhood.

One of the things mentioned is the tax system. In the current tax system, a lot of money enters the treasury of the Netherlands from taxes on fossil fuels like natural gas. Taxes are an important source of funds to build and maintain the infrastructure for district heating networks (Interviewee #10).

Another mention of conditions is the subsidies. The idea is that it should only be possible to get subsidies for connecting to the district heating grid when the house is insulated sufficiently to connect to at least the medium-temperature district heating grid, not the high-temperature grid. This is because the heat energy that is not needed does not have to be supplied. Furthermore, housing associations and other landlords need to ensure that their houses have at least an energy label D or higher in 2030 (NOS, 2022). This could be sharpened to a higher energy label, energy label B or higher in 2030.

What stands out with different governance arrangements is that it is now highly fragmented between different municipalities, making it almost worth moving to another city because the heat transition arrangements are more favourable there. The condition here should be to make sure there is a national standard for the heat transition, with a priority for neighbourhoods with fewer means since there the residents usually cannot insulate their houses well, put solar panels on their roofs, or drive electric cars (Interviewee #11).

Next, a condition should be that the energy supply should be owned 51% by the local environment, as already presented in the Climate Agreement (Interviewee #11). The plans for the new Heat Act say that it should be 51% publicly owned, but it should be added that this should also be locally owned. This has the advantage that the revenues stay at the local level.

6.10 Conclusion

In this chapter, the advice of experts is presented, and here, the most critical insights of this advice will be concluded.

According to the interviewed experts, it is crucial to create trust between the different parties by being transparent since a natural distrust exists between public and private parties. Next to this, the interviewed experts emphasise the importance of considering all alternatives before presenting the chosen alternative. It is also essential to be transparent concerning the decision-making process by updating residents four times yearly. To ensure availability, the experts mention it is essential to connect as many houses as possible and also to insulate. This is also useful for affordability, but affordability could be improved by getting a public interest in district heating and decoupling the price of heat from natural gas. To involve residents in the policy-making process, an advisory, non-binding vote on one of three scenarios could be introduced, according to the interviewed experts. The interviewed experts mention that the decision-making process should be transparent to remove suspicions, but education concerning climate change in general would be crucial. District heating can be seen as the best alternative to natural gas for collective heat supply. However, the fact that high-temperature district heating with waste incineration as the heat source is used does not necessarily promote sustainability. A case could be made that less sustainable sources are encouraged or at least legitimised, according to the interviewed experts.

The barriers resulting from the more general view of experts are the uncertainty, only plucking low-hanging fruit, the affordability, the context dependency, and the mixed signals like the EU naming natural gas green.

Finally, the governance conditions led to the advice of the experts. One change could be to make it only possible to get subsidies for connecting to the district heating grid when the house is sufficiently insulated to connect to the at least medium-temperature district heating grid. Furthermore, because the current approach is highly fragmented, assuring a national standard for the heat transition is essential, with a priority for neighbourhoods with fewer means since the residents of these neighbourhoods do not have the possibility for solar panels on their roofs or drive electric cars, or insulate their houses well.

7. Design of the Governance Arrangement

In this chapter, a proposed governance arrangement will be designed based on the elements Termeer et al. (2017) described. This governance arrangement will address the barriers presented in chapters 5 and 6. The elements will be discussed based on the analysis of case stakeholders and expert interviews, on some points augmented with literature. Finally, the governance arrangement will be presented, which was validated by two interviews. Much of the information obtained in this chapter comes from the interviews with case stakeholders and experts. For readability, it has been chosen not to include every quote with (Interviewee #x), and in Appendix F and G, the analysis of the interviews can be found.

7.1 Framing

Multiple frames are possible for this problem. What is mentioned in almost every interview is that many homes have to be made natural gas-free. What is mentioned as well, is that it is very hard to do so in already existing buildings (Interviewee #1). The problem is also framed much more extensively, that a better environment needs to be ensured. It is also framed smaller, that the homes of tenants of Havensteder are not future-proof, meaning the houses have to be updated, and district heating is the appropriate alternative (Interviewee #3). The problem is described as both a local problem, a global one, and everything in between.

A few important aspects need to be kept in mind. On the one hand, the earth is warming, and emissions from natural gas used to heat homes contribute to this. On the other hand, an example that many people might find more relatable is the earthquakes in Groningen, and the fact that natural gas winning has been stopped there (Interviewee #10).
Furthermore, it could be addressed that the disconnection of natural gas also has financial advantages in the long term, with reference to the energy crisis. Moreover, it could relieve stress because the homes will be made future-proof. However, what frame is most efficient is still context-dependent. An efficient frame in one neighbourhood might backfire in another neighbourhood and the other way around because the interests of residents differ per city and neighbourhood (Interviewee #11).
Another argument could be to not be dependent on geopolitical conflicts determining the price of heating anymore because it is produced nearby instead of somewhere far away, so fewer factors are influencing.

7.2 Levels of Action

To choose at which level action is needed, it is first important to know the chosen alternative. In the case of Bospolder-Tussendijken, the action for the district heating grid is for the local government, the municipality. Nevertheless, action is also needed from higher levels of government because they should provide general conditions and incentives. In practice, this happens, although not always as fast and in the direction that every stakeholder wants. This resulted in dissatisfaction with the choices made and the speed achieved by the government within multiple sectors (Interviewees #1, #3, #5, #6).

The national government needs to decide on a more standardised approach for all municipalities instead of the current situation in which every municipality can choose its own way (Interviewee #11). Furthermore, the national government can take away much uncertainty by simply excluding specific options for heating existing buildings. For example, if the national government does not consider hydrogen an alternative, it could help to simply

exclude it as an option. Next, the national government could set priorities for different classes of neighbourhoods or cities based on welfare. Another essential task for the national government is to provide the municipalities with the funds to make such transitions happen. The European Union needs to take action to ensure consistent messaging. The European Union declared natural gas, a fossil fuel, as a green or sustainable energy source. To perform an efficient energy transition, this should be revised by naming natural gas a fossil fuel (Interviewee #12).

7.3 Timing

The alternative of district heating is chosen because it is no-regret. Therefore, the timing does not matter usually, but the external variables changed significantly during the last few years. The price of heat increased substantially because the price of gas did. Therefore, the timing can be both explained as brilliant and dreadful. The choice can also be made to wait until more knowledge is gained, but the reaction of many interviewees was that more is learned by doing than by waiting until a way better option appears in a few years. The learnings must be widely spread to provide other cities and neighbourhoods with as much information as possible.

Next to this, it is crucial to use momentum. Because of the energy crisis, gas prices are still high worldwide. The price of heat can be lowered, and then the momentum for many people to switch to district heating might be very tempting. However, the timing is also a location-based phenomenon. The neighbourhood Bospolder-Tussendijken is very densely built, close to an industrial harbour with much residual heat, making district heating a logical choice for this neighbourhood. Therefore, this can also be very neighbourhood-specific. It is also an option to wait for linkage opportunities to other renovations to reduce the inconvenience and save some money, as Bospolder-Tussendijken did with the sewer work. This should only be done when it fits very well in the planning; it should not be a reason to postpone the project for years (Interviewee #11).

However, it could be discussed whether it is best to start these living labs in underprivileged neighbourhoods (Interviewee #12). This is, of course, two-sided. If the best solution is chosen, the residents of an underprivileged neighbourhood will directly benefit. If, however, the project faces teething problems, as often happens with new approaches, then underprivileged neighbourhoods are often less able to absorb setbacks since they already face other challenges.

7.4 Alignment

Arguments can be made in favour and against incorporating measures in existing sectors and creating a new domain. Incorporating might be a good idea since moving all experts needed towards a new domain could be difficult. If this does not work out, it would create a new barrier, making decision-making and implementation harder.
However, multiple reasons exist to create a new domain. One is to generate more attention, but it does not seem the problem now, considering that existing sectors are already developing plans to disconnect from natural gas. Another reason is that if different aldermen (Dutch: wethouders) of different political parties are responsible for the project, the process may be frustrated. This is because they both want to push their agenda, resulting in possibly

no decisions. Creating a specific policy portfolio for the disconnection of natural gas with only one alderman could help the decision-making process (Interviewees #12, #13).

A different aspect is the alignment between stakeholders. As mentioned before, some stakeholders consider it a barrier that, although very short lines of communication existed between the organisations of Eneco, Havensteder, and the municipality initially, this slackened after the area agreement was signed. Therefore, the decisions not included in the original area agreement caused frustration and delay, leading to strained relationships. Building on this, during the implementation, decision-making became more difficult because it was looked at within some organisations as just project work, while in the phase before the area agreement was signed, the organisations worked in a completely different way. Because of this worsening of attention, the decision-making was hampered. This could be solved by ensuring continuity by keeping the same team for the entire project, but that is not always achievable. Another option is to make an additional agreement, where this could be facilitated, or a transition period, where the first contributors help their successors to ensure the same conditions continue to apply between them.

Furthermore, it might be a good idea to start from the beginning with a wide range of possible contributors to the project instead of just starting with the usual suspects, being the biggest organisations. This could open up possibilities of a more integral approach (Interviewee #11).
Finally, the alignment with a city or the neighbourhood. To make sure the residents of the neighbourhood support these kinds of transitions and maybe even will more actively participate in them, it can be helpful to involve them in three ways. First, in the policy-making process; secondly, by being as transparent as possible in the communication about the decision-making process; and finally, by providing more education about the energy transition to strengthen awareness about the reasons for the transition. This could also create support, allow residents to participate and remove the knowledge gap barrier.

7.5 Policy Instruments

As mentioned in Chapter 4, some policy instruments are in place already. The climate law, Heat Act, and subsidies. However, the Heat Act is up for replacement, but the replacement has incurrent delays. This frustrated the case in Bospolder-Tussendijken, almost stopping the entire project because of the uncertainty and conflicting signals concerning the new Heat Act (Interviewee #5). Some projects elsewhere have indeed stopped due to the uncertainty surrounding the Heat Act. The idea of implementing the new Heat Act is considered a good idea by the experts interviewed and the organisations the Association of Dutch Municipalities (Dutch: Vereniging van Nederlandse Gemeenten (VNG)), the Interprovincial Consultation (Dutch: Interproviniaal Overleg (IPO)), and the ACM (VNG, 2023; ACM, 2023a). This is because the government is the only stakeholder with the public values as interest. Another aspect the new Heat Act should contain is that the NMDA principle will be abolished. This could already be overturned by financial regulations on heat since the new Heat Act is not expected to take effect before 2025. Mostly, however, clarity about the new Heat Act is needed. For the municipality to take this leading role, implementing the Wgiw (Wet gemeentelijke instrumenten warmtetransitie) is required. This is still in consultation in the parliament, but it will allow municipalities to take the leading role in the neighbourhood approaches with more legal options.

Another barrier mentioned was the disagreement on the enlargement of the project area to Bospolder. This did not happen because Havensteder said that their property had to be connected to the high-temperature grid because it was not ready for the mid-temperature grid. This could be solved by a more ambitious policy, by making a governance condition that houses should be insulated sufficiently to connect to at least the mid-temperature grid. This could be accelerated by sharpening the aim of all rental properties to have at least energy label D or higher in 2030 to energy label B or higher in 2030 instead (Interviewee #12; Sovacool et al., 2023). To achieve this, both housing associations and private landlords will have to get help from financial instruments provided by the government, but this will also help the citizens with their affordability instead of just making their homes future-proof.

Finally, it is essential to set norms. The national government has set goals for the number of houses disconnected from natural gas per year in 2030. Individual cities have set their own goals, like in Rotterdam. It might be time to make these goals enforceable since the time for just talking is over. Therefore, it could be decided to implement a regulation that enforces a minimum number of houses per city or neighbourhood to be disconnected from natural gas before a specific date, with consequences when these numbers are not achieved (Interviewees #10, #11, #12). This would take away much uncertainty and could be the sign of urgency and strength needed in this transition.

7.6 Organisation

Although the energy transition is a well-known term nowadays, it is still relatively new. Therefore, much knowledge is needed, and the most reliable source for knowledge always used to be science.
Close connections between policymakers and scientists are needed to execute the energy transition successfully. In these connections, it is also essential to listen to the entire story and not cherry-pick the parts of the story that fit into policymakers' agendas to validate their choices. Boundary organisations are the logical options to link policy and science fields, with the IPCC being the most well-known global boundary organisation in this field. The most important boundary organisations in the Netherlands are the environmental assessment agency PBL, the Royal Dutch Meteorological Institute KNMI and the research sponsored by the Dutch National Science Foundation NWO (Hoppe & Wesselink, 2014).

Scientists have a critical view and are the players investigating situations without personal interests. This shapes the conditions to investigate the entire playing field in the Netherlands or even Europe and look, without being too context-dependent, at what universal learnings could be taken from this playing field using a scientific method. With these learnings, future processes and approaches can be structured (Interviewee #11).
Next to the role of science in the universal approaches, it can also play an essential role in neighbourhoods themselves. Misinformation is widely available and easily accessible. For this reason, science could play a role in presenting facts and helping citizens understand the importance of the energy transition. However, this might still be a challenge because many citizens distrust the science or say they found other scientists telling another story. Therefore, scientific information must be provided proactively before opinions are deeply embedded in misinformation.

7.7 Leadership

In the Bospolder-Tussendijken case, the municipality is the stakeholder in charge because the national government appointed municipalities as the leading organisations in the local heat transition (Interviewee #2). It is, however, a process based on equivalence between the three main stakeholders because they need each other. However, all stakeholders have an interest in the case. Therefore, an independent, third-party process supervisor might be a good option (Interviewees #5, #7), which could also serve as an independent arbitrator. If the stakeholders split the costs of the independent supervisor, he or she should not have an interest (Interviewee #10).

The role of administrative leadership is the role of elected politicians, so the ministers of the Ministry of Economic Affairs and Climate on the national level, the representatives of the province at the regional level, and the alderman of the municipality at the local level. They are the only leaders with formal positions to allocate public budgets or have a complete overview of the progress on the entire level.

Boundary organisations, like the PBL, should fulfil the adaptive leadership role. With their main job being analysing the current situation, exploring new options, and identifying possible new strategies, this is the role for them and other boundary organisations.

The role of connective leadership should always be for the governmental bodies. They have the possibility and the duty to look after everyone and ensure all citizens and parties are content. Furthermore, governmental bodies are present at multiple levels, so they can connect on multiple levels.

The role of enabling leadership should be for scientists and, optionally, heat or energy companies. They are the stakeholders that shape the conditions for innovations since they continually evaluate the current alternatives.

7.8 Governance Arrangement

This section will present the result of the discussion of how the separate governance arrangement elements described by Termeer are merged into a proposed governance arrangement. This is implemented into a broader structure, focusing on the goals, process, collaboration forms and task distribution. This proposed governance arrangement aims to improve decision-making concerning energy transition in underprivileged neighbourhoods in urban areas. The governance arrangement addresses the national, municipal and neighbourhood levels. The collaboration of all stakeholders and institutions on a local level is shown in Figure 12, and the governance arrangement is shown in Figure 13. These visualisations are also shown in Appendix H, where the national and international context will also be shown.

Because climate change is happening, many measures are needed to reduce greenhouse gas emissions. One is to stop using natural gas in general and in houses for heating and cooking. Next, to stop emissions, another reason to stop using natural gas is that the citizens in Groningen deserve more rest by closing natural gas field exploitation activities there. Furthermore, natural gas will not be affordable anymore, as the prices are already high. To become independent of the impulsive behaviour of autocrats, like Russia starting a war resulting in much higher gas prices, a local and more affordable alternative like a district heating system can be considered. This is a way to become future-proof because the future is without heating by natural gas, and to keep the heating supply of buildings affordable.

On the neighbourhood level, the municipality is the leading stakeholder in the energy transition, and it needs to collaborate with many stakeholders to create as much support as possible. Therefore, other parties like housing associations, neighbourhood councils, and private parties, like heating and construction companies, should be involved. To guide the process and keep the parties together, an independent supervisor could be appointed per neighbourhood because all parties, the municipality as well, have interests in the case and are therefore not completely independent. This differs from what was done in Bospolder-Tussendijken. In this collaboration, it is crucial that the process is transparent from the beginning since this will help build trust between the different parties as they have different interests and instinctive distrust of each other. This will also help parties learn more about and from each other since they all have their own expertise.
Furthermore, it is also essential to include the individual neighbourhood residents. This can be done by allowing them to join the policy-making process by giving them an advisory, non-binding vote on three scenarios within the technical possibilities. This differs from what was done in Bospolder-Tussendijken, which will teach the parties the neighbourhood community's perspective.
Moreover, citizens will learn more about the energy transition through a fully transparent decision-making process and, for example, by collecting possible explanations on information evenings. These explanations could be given by scientists for credibility, and people specialised in bringing information to people with a poorer education to ensure the message is comprehensible. In addition, it could be helpful to let residents living in other neighbourhoods or cities where the transition to district heating has already been completed speak about their experiences (Interviewee #8). This could help to create support among residents of the neighbourhood. Because Bospolder-Tussendijken is a living lab, this was not done.

The municipality will need help from the national government and the European Union by providing incentives and regulations. Moreover, messaging should be aligned through all levels of government, and therefore, the European Union is advised to revisit its decision to label natural gas green. This is because it raises many questions about why it is needed to move away from natural gas. This can harm the sustainability goals set by both the EU and the national government since natural gas produces emissions. The national government could take a far more decisive role, with clear goals anchored in legislation per city or region on how many houses should be disconnected from natural gas every five years. This kind of hierarchical governance could lead to the acceleration of the process and a more predictable process for achieving the goal of underprivileged neighbourhoods becoming natural gas-free and achieving the overarching goal of the Netherlands being natural gas-free. Next, scientists should continue to advise the national government based on their research.

Within municipal organisations, it can be decided when and where local buildings can be disconnected from natural gas to achieve the goals set concerning becoming natural gas-free by higher tiers of government. Municipalities are advised to set intermediate targets for every year to accomplish this. These could be established in the revised transition vision heat, where the order to renovate neighbourhoods is advised to be established again. Municipalities should prevent that only 'low-hanging fruit' neighbourhoods are being disconnected first. A fair distribution of easy and difficult neighbourhoods could be made every five years, anchored in the revised transition vision heat. Here, it is crucial first to

select several more ‘difficult’ neighbourhoods to disconnect with some possibilities to adapt to setbacks. When this has been finalised, the approach should be evaluated and, if needed, revised, resulting in the learnings for future projects. With these learnings implemented, underprivileged neighbourhoods could be disconnected next. This would better prevent residents of underprivileged neighbourhoods from suffering from potential setbacks and potential financial risks. The alternative of district heating systems, mainly valuable in densely populated areas such as cities, is a no-regret measure, meaning that it is flexible because the sources of the district heating can be made more sustainable and, therefore, future-proof. Next, more is learnt by implementing rather than waiting to gain more knowledge and suffering delay while losing precious time.

If the municipal strategy is changed to first implementing and evaluating other difficult neighbourhoods, this has advantages for the underprivileged neighbourhoods. It allows housing associations to insulate in underprivileged neighbourhoods before disconnecting from natural gas. Furthermore, this could prevent residents of an underprivileged neighbourhood who often distrust the government from feeling used as guinea pigs of the energy transition (Interviewee #9; Sovacool et al., 2023). Bospolder-Tussendijken was chosen as a living lab, so this did not happen in Rotterdam.

As mentioned before, the municipalities are the leading stakeholders in the neighbourhoods. Therefore, it is advised that they have a majority share in the district heating infrastructure because they are the stakeholders having public values as interest. Nevertheless, municipalities will have to work with the provincial and national governments. The elected politicians on every level, the minister, the representative of the province, and the alderman, will have important roles. They are ultimately responsible and accountable for achieving the goals regarding the disconnection of natural gas that has to be set by the national government, as earlier mentioned.
Creating one specific responsible alderman function per municipality is valuable since it provides more focus on the topic and can take away lots of noise. The municipality will have to decide in what order and how the neighbourhoods will be made natural gas-free.

On the neighbourhood level, housing associations play an essential role. In neighbourhoods with a high degree of social housing – owned by housing associations, which is usually the case in underprivileged neighbourhoods – the housing associations will have the task of preparing their property for the future as well as they can. Next to disconnecting their homes from the natural gas grid, this is also about applying proper thermal insulation. When the homes have been properly insulated, heating costs for tenants will decrease, and the property could be connected to a more sustainable form of district heating. In Bospolder-Tussendijken, the choice was made to first connect to high-temperature district heating and decide where to insulate in the future.
However, the transition is not for free, and housing associations have limited resources. Therefore, they need help from the (national) government, which also has the duty to help underprivileged citizens, or even primarily.

On the neighbourhood level, private parties will also have an important role, like supplying heat or managing infrastructure. Although they will no longer have full ownership of the district heating grids, they can still participate and bring practical knowledge into the

process. For this knowledge and services, they can still be rewarded and can have a minority share.
On a higher level, private parties and science play an important role in technical innovation. Therefore, they are very important in improving current alternatives, like district heating, and inventing new alternatives for natural gas.
The ACM will keep its role as an independent supervisor of the market and will, in this role, determine a reasonable return for heat.
On the neighbourhood level, the role of the neighbourhood residents could be made more substantial. For example, if the more interested citizens in the neighbourhood, who are present in the neighbourhood councils and initiatives in the neighbourhood, are involved in the decision-making process as full partners, not just as a sounding board. They will be called neighbourhood stakeholders from here on. They get extra responsibilities within this position, like getting as many citizens as possible to information evenings, for example. This is important to achieve a more just energy transition.

The municipality and the private parties, as earlier mentioned, could come to a public-private heating company in the form of a joint venture since this allows keeping the heat infrastructure and supply as separate branches of the company, with a 50+1 share in the heating company for the municipality (Jetten, 2023; AT Osborne, 2023). This gives the municipality the leading role, guaranteeing the public interests, while the private interests are met by financial compensation for their work. Because the municipality will have the majority share, they will have the final decision rights and carry the most risks. To keep the investments for private parties interesting, the new Heat Act should contain that major decisions can only be made with a far-reaching majority, not just 51%. An extra reason to keep private heating companies involved is the recent bankruptcy of the publicly owned heat company Rotterdam. This could be prevented by using the knowledge and expertise of private companies (de Boer, 2023). Since the new Heat Act has not been implemented yet, it is still uncertain whether private parties want to join in a joint venture with a minority share, but they will at least need a sustainable business case. In Bospolder-Tussendijken, the new Heat Act was not approved yet, so no joint venture was formed.
On the neighbourhood level, this joint venture should come to an affordable business case with the housing association and neighbourhood stakeholders, who should have a lawyer to ensure they are not misused in the negotiations (Interviewee #8). Next to this, these parties should come to an area agreement on how to disconnect their neighbourhood from natural gas and how the costs are split. This is important to prevent a split incentive to make sure residents of the underprivileged neighbourhoods benefit from the transition, not only the parties who invest in it. The process towards this agreement is important and politically sensitive, but it is crucial to keep the same focus on the project when the agreement is closed, and changes are made in personnel. This could be done by creating a permanent team for the approximately eight years of the project, which can be agreed upon by signing an extra contract. Because this is not always possible, an alternative could be that the first contributors have an extended transition period with their successors, ensuring the continuity of the process. In Bospolder-Tussendijken, the neighbourhood stakeholders had a less decisive role, and the transition period did not go entirely smoothly.

To reform the energy transition on the local level, some support from the national government is needed. Some policy instruments are fit for this purpose, but some need to

be changed, removed, or added to perform the transition. First, the mentioned existing subsidies (SAH, PAW, Sofie fund) can stay. Next, it is crucial that the new Heat Act, Collective Heat Act, will be approved soon by the parliament to replace the current Heat Act since it has been discussed for a long time already. The delay causes much uncertainty, and a decision might deliver clarity. The new Heat Act will decouple the heating price from the natural gas price, but it is advised to bring this forward by financial instruments. To let the municipalities take the leading role, the Wgiw must be implemented as soon as possible since it will give more legal options to the municipalities. Furthermore, it is advised only to give out subsidies for connections to mid-temperature (or even low-temperature) grids, not the high-temperature grid. The money saved by abolishing the high-temperature subsidy should be used for financial instruments to help households and housing associations in underprivileged neighbourhoods insulate their homes to a level they are ready to connect to the mid-temperature district heating grid. This could be accelerated by sharpening the aim of all rental properties having energy label D or higher in 2030 to energy label B or higher in 2030 instead. Finally, it is advised to implement regulations with clear goals anchored in legislation per city or region on how many homes should be disconnected from natural gas every five years. This would take away much uncertainty and could also be a sign of urgency and strength needed in this transition.

The collaboration of all stakeholders and institutions on a local level is shown in Figure 12, and the governance arrangement is shown in Figure 13.

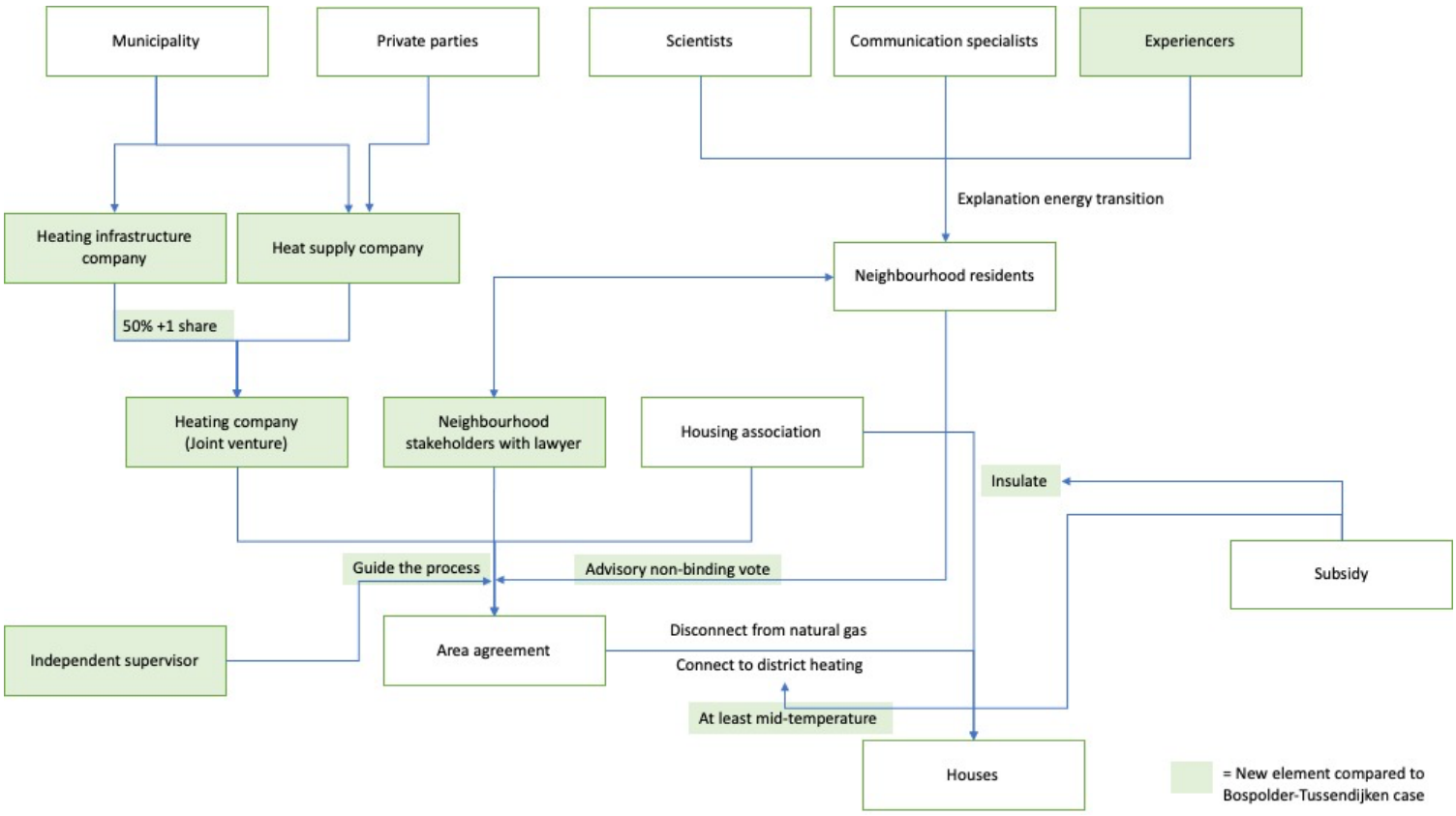

Figure 12: The collaboration of all different stakeholders and institutions

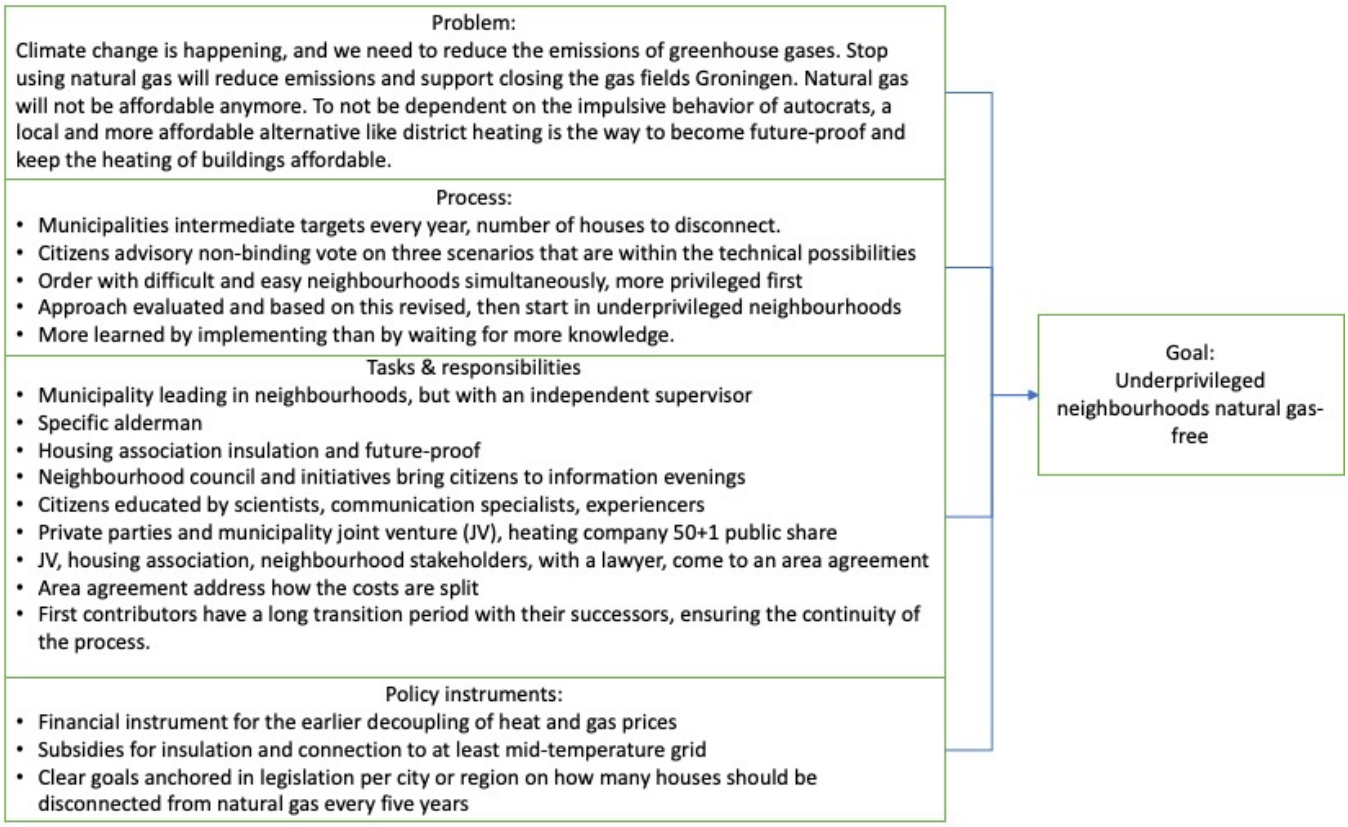

Figure 13: Proposed governance arrangement

7.9 Conclusion

In this chapter, the seven basic design elements for the design of governance arrangements of Termeer, framing, levels to act, timing, alignment, policy instruments, organisation of the science-policy interface, and leadership are discussed, based on interviews and the analyses in the previous chapters.

To make sure as much as possible of the barriers identified in chapters 5 and 6 are addressed, every element is discussed extensively. After discussing the elements, they are merged into the proposed governance arrangements. In this governance arrangement, the problem is framed first. After this, the process is described where it turns out that the higher levels of government should take more decisive roles, and residents should be more involved, for example, by getting an advisory non-binding vote. Underprivileged neighbourhoods should not be used as living labs, and district heating is the most valuable in densely populated areas.

When looking into tasks and responsibilities, the municipality should be the leading stakeholder. Because the municipality has an interest as well, an independent supervisor is advised to be included. The housing association should start by insulating. The municipality and private parties could start a heating company as a joint venture and sign an area agreement with the housing association and neighbourhood stakeholders.

The existing subsidies can stay. Next, the new Heat Act and the Wgiw must be implemented as soon as possible. Moreover, subsidies are advised only to be given for connection to at least a mid-temperature grid. Financial instruments to help households and housing associations in underprivileged neighbourhoods insulate their homes are advised to be increased. This could be accelerated by sharpening the aim of all rental properties to have at least energy label D or higher in 2030 to energy label B or higher in 2030 instead. Finally, it is advised to implement regulations with clear goals anchored in legislation per city or region on how many homes should be disconnected from natural gas every five years.

With this proposed governance arrangement, a more just energy transition could be ensured. This is because the residents will be more involved, both in the policy-making process and in the decision-making process. Furthermore, the transition in underprivileged neighbourhoods will be more sustainable, affordability for residents will increase, and the residents will learn more about the energy transition in a broader perspective.

8. Conclusion & Discussion

To be able to stop climate change as far as possible, it is crucial that everyone will be part of the energy transition. Therefore, this research investigated the case of an underprivileged neighbourhood to examine how the disconnection of houses from natural gas is done in an underprivileged neighbourhood and how this could be improved. In this chapter, the results obtained in the previous chapters will be brought together and evaluated. With this, the sub-questions of this research will be answered. With the answers to the sub-questions, the main research questions can be answered. When the research questions are answered, the research results will be discussed, and the limitations and the validity of the research will be addressed. Finally, recommendations will be given for future research and policy.

8.1 Research Questions

8.1.1 Sub-questions

8.1.1.1 Sub-question 1

SQ1: *What are governance arrangements and what does it mean in relation to decision-making with regard to planning a just energy transition in neighbourhood renovation?*

To be able to answer this question, it was essential to know what definition of governance would be used since it has been defined in multiple ways over the years, also because it can differ per research section what it exactly means. This research is focused on the energy transition of existing houses in a neighbourhood in a city, which can be referred to as urban energy governance. This is defined as how stakeholders in cities interact with energy systems and everything related to them to achieve objectives.
Governance arrangements usually consist of various organisations, where governmental, market, and non-profit organisations come together. The definition used for a governance arrangement in this research is: “A governance arrangement is the ensemble of rules, processes, and instruments that structure the interactions between public and/or private entities to realize collective goals for a specific domain or issue” (Termeer et al., 2011, p. 161). Therefore, governance arrangements are essential for the decision-making process since it is the framework within which the decisions are made.
Governance arrangements can include various stakeholders, which can influence decision-making massively since the inclusion or exclusion of stakeholders will change the dynamics of decision-making. This can, for example, be in the inclusion or exclusion of neighbourhood stakeholders, in the inclusion or exclusion of private parties, or in the inclusion or exclusion of housing associations. The rules included in governance arrangements can help and hamper the decision-making process. They hamper decision-making when they contradict national policy or create uncertainty. They can also help the decision-making, however, if the rules provide handles for the decision-making process or provide incentives.

This is also impactful with regard to planning a just energy transition in a neighbourhood renovation since all the earlier-mentioned factors influence the planning and energy justice of a neighbourhood renovation. This is because more stakeholders and rules can make the decision-making more complex, but without the participation of crucial stakeholders, it could be impossible to perform the neighbourhood renovation. The inclusion of specific stakeholders and rules also impacts energy justice since the interests of stakeholders can both hamper and be in line with energy justice principles. The rules that are in play can

hamper and be in line with the energy justice principles as well. This will be further explained in the following sub-questions.

8.1.1.2 Sub-question 2

SQ2: *Which theoretical framework can be used to get a better insight into the governance arrangements influencing the decision-making with regard to planning and implementation of a just energy transition?*

To get a better insight into the governance arrangements influencing the decision-making with regard to planning and implementation of a just energy transition, three frameworks have been used. First, to get an oversight of the governance arrangements, the four-layer model of Williamson was used. Secondly, the IAD framework was used to get a better insight into the decision-making process. Finally, the energy justice decision-making principles were used to get an insight into the energy justice of the decision-making process.

The institutional analysis is performed with the four-layer model, which orders the institutional environment by separating the institutions into four different layers. With this, the governance arrangements in this case can be identified since the agreements, rules, and instruments are shown. In the third layer, the different agreements on national, municipal, and neighbourhood levels influencing this case are presented, as are the policy instruments. In the first layer, a clear overview of the 'nature' of the neighbourhood is shown, and the laws and regulations influencing this decision-making process are presented in layer two.

The results of the institutional analysis with the four-layer model are also input for the IAD framework, as rules in use and biophysical conditions. Because the IAD framework can be used to decompose the decision-making process into separate building blocks, it is the perfect coat rack to hang the analysis on. The different blocks are also linked within the framework, resulting in the entire process. With this and mainly the external rules, it can be seen how the action situation, the decision-making process with regard to making the neighbourhood natural gas-free, is influenced. However, this does not tell anything about the energy justice of the energy transition decision-making process.

Therefore, the decision-making process was also evaluated by five of the eight energy justice decision-making principles, being affordability, availability, due process, good governance, and sustainability. This gave more insight into the energy justice of the current energy transition of existing houses in the neighbourhood of Bospolder-Tussendijken.

The insights obtained using these frameworks will be presented in answering the following questions.

8.1.1.3 Sub-question 3

SQ3: *What does decision-making look like in Bospolder-Tussendijken and how is it influenced by governance arrangements with regard to planning a just energy transition in neighbourhood renovation?*

The decision-making in Bospolder-Tussendijken consisted of multiple layers. The municipality was the local governmental body and the leading stakeholder in the neighbourhood. The municipality was however restrained by national governance arrangements laid down by the national government, which was restrained by the European Union. In the Dutch Climate Agreement was ordered that municipalities had to make a transition vision heat, which the municipality of Rotterdam did.

On the local level, the municipality closed an agreement with the heat company, Eneco, and the housing association that owns a majority of the property in the neighbourhood, Havensteder. Within this agreement, the project area was disclosed, being a part of Tussendijken. Next to this, clear boundaries were set in this agreement on every aspect of the project. This influenced the decision-making since it created a framework within which decisions could be made, but the fact that the alternative for natural gas would be district heating was already a done deal. The decision to choose this was also driven by the fact that Eneco already had a concession for the neighbourhood and that European and national subsidies were available to connect homes to district heating.
A few weeks after the area agreement, the collaboration agreement was closed with the three parties of the area agreement and the energy-interested neighbourhood stakeholders. This created a way to keep talking with each other. However, this platform is more used to discuss things; not many impactful decisions were made.

The case has also been investigated while looking into energy justice. The area agreement secured availability since everyone who lives within the project area could connect to the district heating grid. Peak boilers secure the security of supply, but concerns are raised about what happens when the primary source fails. With the subsidies, affordability was tried to be ensured. The coupling between gas and heat prices was troubling here, especially with the extremely high gas prices and the fact that Eneco asked for the maximum tariff the ACM allowed in 2023. Because of this, affordability was not fully ensured, especially in this poor neighbourhood. Next to this, the project costs were much higher than expected due to everything being new. Concerning due process, the municipality, Eneco and Havensteder heard the more active citizens when negotiating the collaboration agreement but not in the area agreement, where many important decisions were made. The collaboration agreement negotiations were done separately from the decision-making process to move to district heating. Therefore, the process towards the collaboration agreement was more important than the agreement itself since the process provided handles to keep collaborating. Concerning good governance, the neighbourhood was informed through newsletters, but this was not fully transparent. The information was mainly project-focused and not too much on the entire energy transition. Therefore, this could be improved to involve residents more in the energy transition, to let them understand it better. When looking into sustainability, district heating could be considered more sustainable than natural gas; also with high temperature, it emits much less than natural gas. It does not cover the cooling needs during summer, possibly resulting in emissions by residents to cool their homes.

8.1.1.4 Sub-question 4

SQ4: *What are the key barriers that hamper the current decision-making and how could governance arrangements solve these?*

It is important to mention that the interviewees of the municipality, Havensteder and Eneco, were quite positive about the decision-making process. However, they did mention some barriers, and from the neighbourhood stakeholders came some barriers as well. Two types of barriers are identified: the specific barriers in the case study and those mentioned by experts, which are more general barriers in the energy transition of existing neighbourhoods.

At the beginning of the project, very short lines of communication existed between Eneco, Havensteder, and the municipality, and also very short lines of communication within these organisations, which helped the decision-making process. After signing the area agreement, the attention to the project was different; personnel changes were made in the project team, and the short lines of communication to the top of organisations faded since it changed from a high-impact project to business as usual. Another barrier was the expansion of the project area to Bospolder. Eneco did not want to guarantee a high-temperature connection there, and Havensteder said their property in Bospolder was not ready for mid-temperature because of insufficient insulation, so the expansion did not go ahead. The Heat Act played an important role, both the current and the expected new one. Because of the NDMA principle, the price of heat rose enormously during the energy crisis when gas prices rose, making it way less attractive to switch to district heating. The new proposed Heat Act, the Collective Heat Act, says the district heating grids should be at least 51% publicly owned. This happened after almost seven years of much uncertainty, and it is still uncertain, which could massively impact the business case of Eneco. The uncertainty caused was also due to the national government's failure to push through on becoming natural gas-free but choosing compromises with hybrid alternatives, slowing down the energy transition at the local level. Another barrier from the case study was the lack of possibilities for residents to join the decision-making process. This left an enormous potential untapped in terms of commitment, passion and knowledge. Because the grid was monopolised, this also blocked innovations since the only organisation allowed to exploit the district heating grid was Eneco, and they had no or little incentive to innovate, as they had no competition that could force them to be more innovative, to for example to be able to reduce their costs. A final barrier was that the chosen alternative did not provide cooling.

When looking at the barriers mentioned by experts, the first one concurs with a case barrier, which is uncertainty. This can be from higher levels of government, on the local level, but it hampers the process. Another general barrier is that most of the time, only the easy parts of neighbourhoods or cities in the Netherlands get connected to the district heating grid, although this was not the case in the case study. The affordability of a project could also be a barrier since a fine line exists between being attractive for private parties and unaffordable for citizens. Because neighbourhood renovations are specific, it is hard to take universal learnings, which makes the decision-making process in every neighbourhood or city a new challenge. Collecting support can also frustrate the decision-making process because it is not financially viable without support, but giving support without clear plans is a problem. A final

barrier is the knowledge of citizens and the mixed signals they get, like the EU labelling natural gas green.

Since the designed governance arrangement focuses on the process, rules, and instruments according to the definition of Termeer, most of these barriers could be solved by changing one or multiple of these aspects. This will be elaborated on in the next sub-question.

8.1.1.5 Sub-question 5

SQ5: *How should the governance arrangements be designed to improve complex decision-making in neighbourhoods in the future?*

Answering this sub-question addresses what elements the governance arrangement should contain. The answer to main question 2 describes the actual proposed governance arrangement.

First, the seven design elements for governance arrangements of Termeer, framing, levels to act, timing, alignment, policy instruments, organisation of the science-policy interface, and leadership, should be discussed. These are the basis for the governance arrangement and become part of the rules, processes, and instruments to realise the collective goals of public and/or private parties.

Secondly, a new proposed governance arrangement should tackle as much as possible of the identified barriers that hamper decision-making. Therefore, the governance arrangement elements are discussed one by one to make sure every aspect is covered and all barriers can be addressed. When the separate elements are discussed, they should be merged into a governance arrangement, where the problem is identified and explained first. Then, the process will be explained, where the learning moments will be built into. After this, the roles and responsibilities of different stakeholders are explained. Finally, the policy to support will be described, with some regulations staying, some being removed, and some added to the process.
With the new governance arrangement, the identified barriers should be overcome, and the complex decision-making in neighbourhoods should be improved in the future. The content of the proposed governance arrangement is covered in the answer to main research question 2.

8.1.2 Main Research Questions

8.1.2.1 Main Research Question 1

MRQ1: *What governance arrangements are currently influencing decision-making with regard to having a just energy transition in the neighbourhood "Bospolder-Tussendijken"?*

In the neighbourhood of Bospolder-Tussendijken, the energy transition of existing houses is focused on the disconnection of natural gas and towards the connection of a district heating grid. On the neighbourhood level, this was mainly done by the municipality of Rotterdam, the housing association Havensteder and the heating company Eneco. The decision-making between these parties was influenced in several ways.

First, Eneco was granted a concession in 2010 for an area in Rotterdam. This was long before the project started, but the area also contained Bospolder-Tussendijken. The concession was for the infrastructure and the distribution to end users, making Eneco a monopolist.

Secondly, the national government presented the Climate Agreement, a vital part of the national climate policy, in which municipalities were ordered to provide a transition vision heat. With this, a higher level of government influenced the decision-making about heat transition in Rotterdam and therefore Bospolder-Tussendijken. This was backed up by providing some subsidies for becoming natural gas-free, like the PAW and SAH, and the heating price was already coupled with the gas price to prevent monopolists from abusing their position and protecting citizens.

Thirdly, when the municipality, Eneco and Havensteder came to an area agreement after an intensive negotiation, this clearly impacted the decision-making since the method, high-temperature district heating and the project area were decided. It also instructed how to make decisions per building, where still, for every house or building, a connection agreement needs to be closed with the people living there.

Finally, the collaboration agreement was closed between the municipality, Eneco, Havensteder, and the energy-related stakeholders in the neighbourhood. This influenced the decision-making because although no clear goals were set in the agreement, and no formal decisions were made, it provided a platform to keep talking about the energy transition. With these governance arrangements, a just energy transition is pursued.

The case has also been investigated while looking into energy justice. The area agreement secured availability since everyone living within the project area had the possibility to connect to the district heating grid. Peak boilers secure the security of supply, but concerns are raised about what happens when the primary source fails. With the subsidies, affordability was tried to be ensured. The coupling between gas and heat prices was troubling here, especially with the extremely high gas prices and the fact that Eneco asked for the maximum tariff the ACM allowed in 2023. Because of this, affordability was not fully ensured, especially in this poor neighbourhood. Next to this, the project costs were much higher than expected due to everything being new. Concerning due process, the municipality, Eneco and Havensteder heard the more active citizens when negotiating the collaboration agreement but not in the area agreement, where many important decisions were made. The collaboration agreement negotiations were done separately from the

decision-making process to move to district heating. Therefore, the process towards the collaboration agreement was more important than the agreement itself since the process provided handles to keep collaborating. Concerning good governance, the neighbourhood was informed through newsletters, but this was not fully transparent. The information was mainly project-focused and not too much on the entire energy transition. Therefore, this could be improved to involve residents more in the energy transition, to let them understand it better. When looking into sustainability, district heating could be considered more sustainable than natural gas; also with high temperature, it emits much less than natural gas. It does not cover the cooling needs during summer, possibly resulting in emissions by residents to cool their homes.

Taking together these insights, the case has shown aspects of a just energy transition and an unjust energy transition. The just aspects were that everyone could access the energy, it was more sustainable, and the affordability was tried to be ensured. The unjust aspects were that the residents did not have decision-making power, the affordability was not fully ensured, and the information provision could have been better.

8.1.2.2 Main Research Question 2

MRQ2: *How to design governance arrangements to improve decision-making in underprivileged neighbourhoods in the future?*

When looking at improving, it is essential to know what is malfunctioning. The disconnection of existing neighbourhoods from natural gas is still in its infancy. This results almost automatically in imperfections.
In the decision-making in the Bospolder-Tussendijken case, the main barriers identified were the fact that the attention and decisiveness in the different organisations decreased, the disagreement about the temperature for the district heating when investigating expanding the project area, the uncertainty regarding the (new) Heat Act and the lack of ambition of the national government in general related to the energy transition, the lack of possibilities for residents of the neighbourhood to join the decision-making process, and the fact that the heat delivery was monopolised and the transition did not provide opportunities for cooling. In addition, the barriers resulting from the more general view of experts were the uncertainty, only plucking low-hanging fruit, the affordability, the context dependency, and the mixed signals like the EU naming natural gas green.

To tackle these barriers, a new governance arrangement is proposed. This is based on the seven design elements for a governance arrangement and will be presented in the form of process, roles and responsibilities and the policy needed.
With the goal of underprivileged neighbourhoods natural gas-free and achieving the overarching goal of the Netherlands being natural gas-free, it is important to let everyone know that natural gas is first damaging to the environment but also expensive and often under the control of autocrats, like in Russia, since the gas fields in the Netherlands closed.

A prerequisite for the proposed governance arrangement is that the national government and the EU take more decisive actions to accelerate the transition. Municipalities are advised to set yearly intermediate targets and to involve citizens. It is advised that citizens get an advisory, non-binding vote for the plans in their neighbourhood. The municipalities

are advised to start by disconnecting less difficult and more difficult neighbourhoods simultaneously, but not start in underprivileged neighbourhoods. When the first difficult neighbourhoods have been finished disconnecting, the approach and project have been evaluated, and the learnings are implemented, the disconnection in underprivileged neighbourhoods could start as well. This also provides time to insulate houses in underprivileged neighbourhoods.

District heating is the best alternative in densely populated places like city neighbourhoods. The municipality should be the leading stakeholder in neighbourhoods. However, an independent supervisor of the project is also recommended since municipalities have an interest in the cases of becoming natural gas-free as well. The minister, representative of the province and alderman are responsible on their levels, and a specific alderman is suggested to handle this per municipality. The housing association should make their property future-proof, which also means insulation prior to the disconnection of natural gas, especially with the expected cooling needs in summer. Because the energy transition is dynamic, private heating parties and scientists must keep investigating technical innovations. Next, scientists should advise the national government based on their research.

It is also important to inform residents about the energy transition in general, next to project-centred information. This could be done on information evenings, where scientists and communications specialists could teach them. In addition, it could be helpful to let residents living in other neighbourhoods or cities where the transition to district heating has already been completed speak about their experiences. It is advised that residents involved in the neighbourhood council and the neighbourhood initiatives get a more critical role in the decision-making process but get an extra effort obligation to bring residents to the information evenings as well.

The municipality and the private heating parties could come to a public-private heating company as a joint venture. This gives the municipality the leading role, with a majority of the shares, and this will guarantee the public interests. The recent bankruptcy of the publicly owned heat company Rotterdam is a reason to keep private heating companies involved. This could be prevented by using the knowledge and expertise of private companies.
This joint venture should come to an affordable business case together with the housing association and neighbourhood stakeholders, who should have a lawyer to make sure they are not misused in the negotiations and should next to this, come to an area agreement on how to disconnect their neighbourhood from natural gas, and how the costs are split. This is important to prevent a split incentive. To keep short lines of communication throughout the entire project, first contributors should have an extended transition period with their successors, ensuring the continuity of the process.

The mentioned existing subsidies (SAH, PAW, Sofie fund) should stay. Next, the new Heat Act, Collective Heat Act, and the Wgiw must be implemented as soon as possible since they will give more legal options to the municipalities and end uncertainty. Furthermore, it is advised to only give subsidies for the connection to at least the mid-temperature grid, not the high-temperature grid. The money saved by abolishing the high-temperature subsidy is advised for financial instruments to help households and housing associations in underprivileged neighbourhoods insulate their homes to a level they are ready to connect to

the mid-temperature district heating grid. This could be accelerated by sharpening the aim of all rental properties to have at least energy label D or higher in 2030 to energy label B or higher in 2030 instead. Finally, it is advised to implement regulations with clear goals anchored in legislation per city or region on how many homes should be disconnected from natural gas every five years. This would take away much uncertainty and could also be a sign of urgency and strength needed in this transition.

With this proposed governance arrangement, a more just energy transition could be ensured. This is because the residents will be more involved, both in the policy-making process and in the decision-making process. Furthermore, the transition in underprivileged neighbourhoods will be more sustainable, affordability for residents will increase, and the residents will learn more about the energy transition in a broader perspective.

8.2 Discussion

In this part, the results of this research will be discussed in comparison to the existing research, to discuss if the results add value to the results of previous research, contradict the results of previous research, or confirm the results of previous research.

This research started with identifying the knowledge gap, which came forward because very little to no research has been performed on governance issues concerning energy transition in underprivileged neighbourhoods. Therefore, a knowledge gap exists in the literature concerning the governance arrangements in the energy transition in underprivileged neighbourhoods. This research has addressed this knowledge gap by performing a case study on the neighbourhood renovation of an underprivileged neighbourhood. As a result, the current governance arrangement that influenced the decision-making process has been uncovered, and a proposed future governance arrangement has been designed, which can be a starting point for future research.

Designing a governance arrangement for the energy transition in underprivileged neighbourhoods is crucial because it can help perform a more just and efficient energy transition in underprivileged neighbourhoods. This will impact the lives of the residents in these neighbourhoods but will also help society achieve its climate goals. This is therefore also the added value of this research to research in the broader sense. Energy transition governance in an underprivileged neighbourhood is a complex topic, however. This is because most of the residents of these neighbourhoods are not intrinsically motivated, have other concerns, lack knowledge, and distrust policymakers. Because this topic has been under-researched so far, the research has been exploratory, which means it can be unrepresentative, especially since every underprivileged neighbourhood has its specific context. It can be a good starting point for future research, but this will be elaborated on in paragraph 8.4. Nevertheless, the results contain learnings for future neighbourhood renovations in underprivileged neighbourhoods.

The results of this research can still be compared with previous research. This research found that creating a specific alderman per municipality can create more advantages than just getting more attention. It can also be beneficial during the decision-making process and the implementation. This is because if multiple aldermen are responsible for the process, it can create friction, especially if they are members of different political parties since it is a

politically sensitive process. This finding contradicts the finding of Termeer et al. (2017), who argued that incorporating existing sectors could be helpful during decision-making, implementation, and enforcement of policies, while creating a new domain is mainly beneficial for getting awareness and finding more backing.

This research found that not informing and involving the residents in the decision-making process leads to resistance and less participation. This is in line with what Guerra-Santin et al. (2017) found in their research, where they found that participation is crucial for the long-term viability of these projects. The results of this research add that educating the residents more on the energy transition, in general, could also increase residents' interest in the energy transition and to participate in it. In the same category, this research also confirms the recommendation made by Broers et al. (2022), Broers et al. (2019) and Hoppe (2012) that it is important to involve residents early in the process. The fact that the concession in the Bospolder-Tussendijken case had already been given to Eneco could also be a factor for less involvement of residents. Therefore, this research added the option of involving them by letting them non-bindingly vote on three technically feasible scenarios. Furthermore, experiencers of other neighbourhoods could inform residents about the transition. This provides information to the decision-makers on the position of the residents and information to the residents on the transition. This could also give the residents a choice, which could make them feel more connected to the project.

According to Carley & Konisky (2022), more attention should be paid to how the energy transition could be made accessible to those with a limited income as well. This research investigated a project where people with a limited income in the neighbourhood Bospolder-Tussendijken are helped to participate in the energy transition, making the transition more accessible. This project was focused on neighbourhood renovation, however. Energy efficiency was only vaguely addressed in the future part of the project. Regarding the energy efficiency in such projects, this research proposed to improve this by insulating before disconnecting from natural gas. This makes a difference, especially for the affordability of the residents with lower incomes, because heat that is not needed does not need to be delivered. This is also in line with the research of Sovacool et al. (2023).

Murphy et al. (2012) also mentioned that the current instruments do not, or do not entirely, reach specific sub-groups, such as lower incomes. The results of this research support this finding, although more efforts are being made. To better reach this sub-group, this research recommends multiple instruments, like communication specialists and scientists, but also the input of residents of other neighbourhoods that have already experienced the renovation.

As Vink & Dewulf (2015) mention, the governance arrangements are the framework within which the decisions are made and where the policy is shaped. This research confirms this and confirms that the inclusion or exclusion of stakeholders influences the process (Valkenburg & Cotella, 2016). This comes forward when the role of residents is evaluated. By including these residents more, by including neighbourhood stakeholders in the area agreement, the decision-making will change and is expected to result in a more just energy transition. This can be expected because they will have a say in the decision-making, and therefore, their interests, like insulation or cooling, get a higher priority. The collaboration

agreement in the Bospolder-Tussendijken case also aims to prioritise the interests of neighbourhood stakeholders. However, as all important decisions have already been laid down in the area agreement, this has less impact.

Continuing on the role of stakeholders in these projects, but that of governmental bodies. This research found that the governmental bodies are the only stakeholders with the public value as interest. On the local level, this is the municipality. Therefore, this research agrees with Aylett (2014) that the role of non-governmental organisations is growing and needed in the energy transition. However, this research adds that the leading role should be for a governmental body. This should be determined for different projects, but with local neighbourhood renovations, the municipality should be the leading stakeholder. The municipality has an interest as well, however. Therefore, an independent supervisor could be appointed to guide the process and keep the parties together.

The created governance arrangement also advised a heat company joint venture with a public majority. Private parties oppose this proposal that comes with the new Heat Act since they say it will slow down the energy transition, and they will not invest if they do not get a deciding vote. Although this could be just a negotiation technique, keeping private parties invested in the energy transition is essential. With the option added that major decisions can only be made with a far-reaching majority, so not just 51%, this could be overcome. However, this can also lead to indecision if a far-reaching majority cannot be obtained on points of principle.

8.3 Limitations

In this research, the choice was made to perform a single case study instead of studying multiple cases. This provided the possibility to dive deeper into the case. However, this influenced the conclusions since the results are very much centred around the case in Bospolder-Tussendijken. An effort was made to make the results more universal by interviewing several field experts. This did not cover what an entire other case study would be able to since every case has its own characteristics. This resulted in the fact that the alternative of district heating was very much top of mind. In contrast, other alternatives might be more feasible in other cities, specifically in less densely populated areas.

The case study has been performed in Rotterdam, the second biggest municipality of the Netherlands. In smaller municipalities, the capability and capacity might not be there to perform the energy transition alone. Therefore, this research might not be representative for all cities and neighbourhoods, although multiple municipalities could work together.

Another point of discussion is that the case in Bospolder-Tussendijken was a living lab. This meant that everything that happened was new and that many things are already changed during the execution because no blueprint existed. This makes the results interesting since there is no real wrong or good approach, but the results are also more influenced by the participants' opinions.

The voice of the neighbourhood might be underrepresented in the results. Three neighbourhood representatives were targeted for an interview, and only one was interviewed. The second one indicated in a written response to have no interest in an

interview. However, he did provide extensive information in writing, which has been used in this research. Some questions were left unanswered, however. The last interview with a neighbourhood representative could not be scheduled due to bureaucratic reasons. This influences the balance in the results as six people were interviewed about the case Bospolder-Tussendijken from the municipality, Eneco and Havensteder and only one neighbourhood stakeholder, complemented with the written information from the second stakeholder.

The proposed governance arrangement proposes a joint venture between the municipality and private parties with a majority share for the municipality. It is unclear whether private parties are interested in joining a joint venture like this since they are mostly annoyed with the proposed Heat Act. However, since the new Heat Act has not passed the parliament yet and is not in force, predicting their actual position in a new reality is complicated.

8.4 Future Research

For future research, it could also be interesting to investigate other comparative cases to see if similar barriers can be identified or if completely different barriers are found. When completely other barriers are found, this would confirm the idea that these projects are highly context-dependent. However, if similar barriers are found, this could lead to a more standardised governance arrangement. This could be further researched by the JUST PREPARE project.

Next to comparative cases, it could also be interesting research for the JUST PREPARE project to investigate the case in Bospolder-Tussendijken when the project is finalised. Because the project is still ongoing, some aspects have not become fully clear, such as the impact and effects on residents and how effectively the project progressed. It would also help to interview more residents or resident stakeholders since in this research, that was obstructed but should be researched as well.

In future research, it could be researched if the proposed governance arrangement will be feasible when the laws have finally passed the parliament since that is, at this point, still unclear. It could also be researched if it is feasible to first insulate and after this disconnect in all underprivileged neighbourhoods.

It would be interesting for future research to investigate underprivileged neighbourhoods in smaller municipalities with less populated neighbourhoods or villages to see if and how that will change the decision-making process and the governance arrangements.

Finally, it would be interesting for future research to involve the tax system and other resources in research. It could investigate whether the tax system should be changed for a more effective and just energy transition, while natural gas will be used less, and alternatives come into play.

8.5 Policy Recommendations

The higher levels of government are advised to take more decisive and consistent positions. This applies to the EU and the Dutch national government because if they are inconsistent or too reluctant, it gets harder for local stakeholders to perform neighbourhood renovations because they miss handles, or the inconsistent standings oppose them.
The EU could do this by naming natural gas fossil instead of green. The national government is advised to anchor in legislation how many houses should be disconnected from natural gas every five years. Next, it should approve the Collective Heat Act and Wgiw and bring the decoupling of natural gas and heat prices forward. Finally, the subsidies for connecting to high-temperature district heating are advised to be used for incentives for insulation, and only subsidies for connections to at least mid-temperature district heating should be provided.

On the local level, municipalities are advised to revise their transition visions heat, so that first, difficult neighbourhoods and easier neighbourhoods are being made natural gas-free simultaneously and not start in underprivileged neighbourhoods. Only after these first neighbourhoods have been evaluated and the learnings have been implemented making underprivileged neighbourhoods natural gas-free should start. In these transition visions heat, yearly intermediate goals should be set.

On the neighbourhood level, it is advised to involve residents of underprivileged neighbourhoods more. First, it is crucial to involve residents as soon as possible and let them clarify their position. Secondly, they can get involved by educating about, and with this, enthusing them for, the energy transition. Finally, the active citizens of initiatives and the neighbourhood council should get a seat at the actual decision-making table.

References

Ackermann, F., & Eden, C. (2011). Strategic management of stakeholders: Theory and practice. Long range planning, 44(3), 179-196. https://doi.org/10.1016/j.lrp.2010.08.001

ACM. (2023a). ACM adviseert over wetsvoorstel Wet Collectieve Warmte. ACM.nl. Retrieved November 16, 2023, from, https://www.acm.nl/nl/publicaties/acm-adviseert-over-wetsvoorstel-wet-collectieve-warmte

ACM. (2023b). Welke tarieven mag ik vragen voor het leveren van warmte? ACM.nl. Retrieved September 12, 2023, from https://www.acm.nl/nl/warmtetarieven

Adams, W. C. (2015). Conducting semi-structured interviews. Handbook of practical program evaluation, 492-505. https://doi-org.tudelft.idm.oclc.org/10.1002/9781119171386.ch19

Arts, B., & Leroy, P. (2006). Institutional processes in environmental governance: lots of dynamics, not much change?. Environment and Policy, 47, 267.

AT Osborne. (2023). Rolinneming bij warmtenetten. https://leeuwarden.bestuurlijkeinformatie.nl/Document/View/ed2cbedf-8731-4f53-9ff9-5efaa13273ce

Aylett, A. (2014). Progress and challenges in the urban governance of climate change: Results of a global survey.

Bertoldi, P., Boza-Kiss, B., Della Valle, N., & Economidou, M. (2021). The role of one-stop shops in energy renovation-A comparative analysis of OSSs cases in Europe. Energy and Buildings, 250, 111273. https://doi.org/10.1016/j.enbuild.2021.111273

Bospolder-Tussendijken. (2021). Energie in en met de wijk. Retrieved July 7, 2023, from https://bospoldertussendijken.nl/wp-content/uploads/2023/07/SOK-Botu_def.pdf

Bospolder-Tussendijken. (2023). De wijkraad. Retrieved June 21, 2023, from https://bospoldertussendijken.nl/wijkraad/

Breukers, S., Mourik, R. M., Van Summeren, L. F. M., & Verbong, G. P. (2017). Institutional 'lock-out' towards local self-governance? Environmental justice and sustainable transformations in Dutch social housing neighbourhoods. Energy research & social science, 23, 148-158. https://doi.org/10.1016/j.erss.2016.10.007

Broekhans, B., & Correljé, A. F. (2008). Flood management in the low lands: from probability to risk. WIT Transactions on Ecology and the Environment, 118, 69-79. https://doi.org/10.2495/FRIAR080071

Broers, W., Kemp, R., Vasseur, V., Abujidi, N., & Vroon, Z. (2022). Justice in social housing: Towards a people-centred energy renovation process. Energy Research & Social Science, 88, 102527. https://doi.org/10.1016/j.erss.2022.102527

Broers, W. M. H., Vasseur, V., Kemp, R., Abujidi, N., & Vroon, Z. A. E. P. (2019). Decided or divided? An empirical analysis of the decision-making process of Dutch homeowners for energy renovation measures. Energy Research & Social Science, 58, 101284. https://doi.org/10.1016/j.erss.2019.101284

Brown, R. B. (2006). Doing your dissertation in business and management: the reality of researching and writing. Sage.

Bryson, J. M. (2004). What to do when stakeholders matter: stakeholder identification and analysis techniques. Public management review, 6(1), 21-53. https://doi-org.tudelft.idm.oclc.org/10.1080/14719030410001675722

Buchbinder, E. (2011). Beyond checking: Experiences of the validation interview. Qualitative Social Work, 10(1), 106-122. https://doi-org.tudelft.idm.oclc.org/10.1177/1473325010370189

Carley, S., & Konisky, D. M. (2020). The justice and equity implications of the clean energy transition. *Nature Energy*, *5*(8), 569-577. https://doi.org/10.1038/s41560-020-0641-6

Chaudhari, A. (2022, August 11). Exploratory Research: Pros And Cons. Voxco. Retrieved December 13, 2022, from https://www.voxco.com/blog/exploratory-research-pros-and-cons/

Dagblad010. (2022). PvdA boos: Stedin te traag met gasloskoppeling. Retrieved August 31, 2023, from https://dagblad010.nl/politiek/pvda-boos-stedin-te-traag-met-gasloskoppeling

de Boer, S. (2023). Uitwerking nieuwe warmtewet bepalend voor investeringsklimaat warmtesector. Retrieved Ocotber 24, 2023, from https://www.rabobank.nl/kennis/d011367984-uitwerking-nieuwe-warmtewet - bepalend-voor-investeringsklimaat-warmtesector

Delfshaven Energie Coorperatie. (2023). Home - Delfshaven Energie Coöperatie. Retrieved June 21, 2023, from https://delfshavenenergiecooperatie.nl/

Döringer, S. (2021). 'The problem-centred expert interview'. Combining qualitative interviewing approaches for investigating implicit expert knowledge. International Journal of Social Research Methodology, 24(3), 265-278. https://doi-org.tudelft.idm.oclc.org/10.1080/13645579.2020.1766777

Dudovskiy, J. (2013) Exploratory Research. Retrieved December 13, 2022, from https://research-methodology.net/research-methodology/research-design/exploratory-research/

Duurzaam010. (2021). Aardgasvrij - duurzaam 010. Duurzaam 010. Retrieved October 23, 2023, from https://duurzaam010.nl/aardgasvrije-wijken/

Ebrahimigharehbaghi, S., Qian, Q. K., Meijer, F. M., & Visscher, H. J. (2019). Unravelling Dutch homeowners' behaviour towards energy efficiency renovations: What drives and hinders their decision-making?. Energy Policy, 129, 546-561. https://doi.org/10.1016/j.enpol.2019.02.046

Eden, C., & Ackermann, F. (1998). Making strategy: The journey of strategic management. Sage.

Eneco. (2019). Samenwerking Eneco en SOFIE voor gasloos Bospolder-Tussendijken. Samenwerking Eneco En SOFIE Voor Gasloos Bospolder-Tussendijken. Retrieved August 31, 2023, from https://nieuws.eneco.nl/samenwerking-eneco-en-sofie-voor-gasloos-bospolder-tussendijken/.

Eneco. (n.d.). Warmte voor de wijk Bospolder-Tussendijken. Retrieved August 21, 2023, from https://www.eneco.nl/duurzame-energie/warmte-koeling/bospolder-tussendijken/

Energietransitieteam Rotterdam. (2018). Stappenplan aardgasvrije wijken. Gemeente Rotterdam

European Commission. (n.d.). European Climate Law. Retrieved September 12 , 2023, from https://climate.ec.europa.eu/eu-action/european-climate-law_en

Friese, S., Soratto, J., & Pires, D. (2018). Carrying out a computer-aided thematic content analysis with ATLAS. ti.

Gebiedsovereenkomst. (2021). Gebiedsaanpak Bospolder-Tussendijken.

Gemeente Rotterdam. (2018a). Nieuwe energie voor Rotterdam Coalitieakkoord 2018 – 2022. Rotterdam, Nederland: Gemeente Rotterdam. Https://www.watdoetdegemeente.rotterdam.nl/voorjaarsnota2021/wijken/wijkagenda-bospolder-tuss/Wijkagenda-Bospolder-en-Tussendijken-template.pdf

Gemeente Rotterdam. (2018b). Wijkagenda 2019-2022 [Slide show].

Gemeente Rotterdam (2019) Leidraad werkwijze gebiedsaanpakken aardgasvrij.

Gemeente Rotterdam. (2020). 4,9 miljoen subsidie voor aardgasvrij Bospolder-Tussendijken - Gemeente Rotterdam Persberichten. Retrieved August 31, 2023, from https://persberichtenrotterdam.nl/persberichten/49-miljoen-subsidie-voor-aardgasvrij-bospolder-tussendijken/

Gemeente Rotterdam. (2021). Rotterdam aardgasvrij, 1-41

Gemeenteraad van Rotterdam. (2022). Document RotterdamRaad - [22bb005976] Inspreekbijdrage wijkraad Bospolder Tussendijken tbv cie MHEK 210922 - iBabs RIS. Retrieved October 29, 2023, from https://gemeenteraad.rotterdam.nl/Agenda/Document/51c343ae-5ee3-44bc-bde4-723a544c159d?documentId=99aca980-b71a-4c9c-8e1f-aec32cc41e0f&agendaItemId=58519d96-2687-4c49-89eb-48cc64c67f3d

Google Maps. (n.d.). Retrieved October 23, 2023, from https://www.google.com/maps/place/Bospolder%2FTussendijken,+Rotterdam/@51.9101985,4.4411159,15z/data=!3m1!4b1!4m6!3m5!1s0x47c434ec1d733691:0x73124350ae464cd8!8m2!3d51.9110537!4d4.4404509!16s%2Fm%2F0g9zrc1?entry=ttu

Gustafsson, J. (2017). Single case studies vs. multiple case studies: A comparative study.

Havensteder. (2021) Bospolder-Tussendijken aardgasvrij. Havensteder - Sterk in Wonen. Retrieved August 21, 2023, from https://www.havensteder.nl/News/2235/bospoldertussendijken-aardgasvrij

Hermans, L., Kwakkel, J., Thissen, W., Koppenjan, J., & Bots, P. (2010). Policy analysis of multi-actor systems. The Hague: LEMMA.

Hess, C., & Ostrom, E. (2007). A framework for analyzing the knowledge commons.

Hoppe, R., & Wesselink, A. (2014). Comparing the role of boundary organizations in the governance of climate change in three EU member states. Environmental Science & Policy, 44, 73-85. https://doi.org/10.1016/j.envsci.2014.07.002

Hoppe, T. (2012). Adoption of innovative energy systems in social housing: Lessons from eight large-scale renovation projects in The Netherlands. Energy policy, 51, 791-801. https://doi.org/10.1016/j.enpol.2012.09.026

Hoppe, T., Bressers, J. T. A., & Lulofs, K. R. (2011). Local government influence on energy conservation ambitions in existing housing sites—Plucking the low-hanging fruit?. Energy Policy, 39(2), 916-925. https://doi.org/10.1016/j.enpol.2010.11.016

Hoppe, T., & Bueren, E. (2015). Guest editorial: Governing the challenges of climate change and energy transition in cities. Energy, Sustainability and Society, 5(1), 19. https://doi.org/10.1186/s13705-015-0047-7

Huurdersraad West. (2020). Betaalbare en comfortabele energietransitie voor sociale huurders in Bospolder–Tussendijken (BOTU).

Huurdersraad West. (n.d.). Home. Retrieved August 30, 2023, from http://huurdersraadwest.nl/

Hwang, S. (2008). Utilizing qualitative data analysis software: A review of Atlas. ti. Social Science Computer Review, 26(4), 519-527. https://doi-org.tudelft.idm.oclc.org/10.1177/0894439307312485

Iychettira, K. K., Hakvoort, R. A., & Linares, P. (2017). Towards a comprehensive policy for electricity from renewable energy: An approach for policy design. Energy Policy, 106, 169-182. https://doi.org/10.1016/j.enpol.2017.03.051

Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. Energy Research & Social Science, 11, 174-182. https://doi.org/10.1016/j.erss.2015.10.004

Jetten, R. (2023). Voortgang voorstel Wet collectieve warmte. The Hague: Ministry of Economic Affairs and Climate. Retrieved from https://www.rijksoverheid.nl/documenten/kamerstukken/ 2023/07/06/kamerbrief-wet-collectieve-warmtevoorziening

König, E. (2020, February 24). Het 'Wilde Westen' van Rotterdam moet straks klimaatneutraal wokken. NRC. Retrieved October 29, 2023, from https://www.nrc.nl/nieuws/2019/10/03/het-wilde-westen-van-rotterdam-moet-straks-klimaatneutraal-wokken-a3975580

Lammers, I., & Hoppe, T. (2019). Watt rules? Assessing decision-making practices on smart energy systems in Dutch city districts. Energy research & social science, 47, 233-246. https://doi.org/10.1016/j.erss.2018.10.003

Leonhardt, R., Noble, B., Poelzer, G., Fitzpatrick, P., Belcher, K., & Holdmann, G. (2022). Advancing local energy transitions: A global review of government instruments supporting community energy. Energy Research & Social Science, 83, 102350. https://doi.org/10.1016/j.erss.2021.102350

McGinnis, M. D. (2011). An introduction to IAD and the language of the Ostrom workshop: a simple guide to a complex framework. Policy Studies Journal, 39(1), 169-183. https://doi-org.tudelft.idm.oclc.org/10.1111/j.1541-0072.2010.00401.x

Milchram, C., Märker, C., Schlör, H., Künneke, R., & Van De Kaa, G. (2019). Understanding the role of values in institutional change: the case of the energy transition. Energy, Sustainability and Society, 9, 1-14. https://doi.org/10.1186/s13705-019-0235-y

Ministerie van Binnenlandse Zaken en Koninkrijkrelaties. (2022). Rotterdam (Bospolder-Tussendijken) - Aanvraag Proeftuin Aardgasvrij Wijk (2e ronde). Publicatie | Rijksoverheid.nl. Retrieved September 22, 2023, from https://www.rijksoverheid.nl/onderwerpen/aardgasvrije-wijken/documenten/publicaties/2020/11/16/rotterdam-bospolder-tussendijken---aanvraag-proeftuin-aardgasvrij-wijk-2e-ronde

Ministerie van Binnenlandse Zaken en Koninkrijkrelaties. (2023). *Wat zijn mijn rechten bij renovatie van mijn huurwoning?* Rijksoverheid.nl. Retrieved August 24, 2023, from https://www.rijksoverheid.nl/onderwerpen/woning-huren/vraag-en-antwoord/wat-zijn-mijn-rechten-bij-renovatie-van-mijn-huurwoning

Ministerie van Economische Zaken en Klimaat. (n.d.). Kan ik zelf een energieleverancier kiezen bij blokverwarming of stadsverwarming? Rijksoverheid.nl. Retrieved July 14, 2023, from https://www.rijksoverheid.nl/onderwerpen/energie-thuis/vraag-en-antwoord/kan-ik-een-energieleverancier-kiezen-bij-blokverwarming-of-stadsverwarming

Minkman, E., Visser, V., van Buuren, A., & van Popering-Verkerk, J. (2020). Op zoek naar de energie van Rotterdam. Lerend op weg in de gebiedsaanpakken aardgasvrij Rotterdam.

Mulder, P., Dalla Longa, F., & Straver, K. (2023). Energy poverty in the Netherlands at the national and local level: A multi-dimensional spatial analysis. Energy Research & Social Science, 96, 102892. https://doi.org/10.1016/j.erss.2022.102892

Murphy, L., Meijer, F., & Visscher, H. (2012). A qualitative evaluation of policy instruments used to improve energy performance of existing private dwellings in the

Netherlands. Energy Policy, 45, 459-468. https://doi.org/10.1016/j.enpol.2012.02.056

North, D. C. (1991). Institutions. Journal of economic perspectives, 5(1), 97-112. https://doi.org/10.1257/jep.5.1.97

NOS. (2022). De Jonge: vanaf 2030 geen woningen meer verhuren met slecht energielabel. NOS. Retrieved September 18, 2023, from https://nos.nl/artikel/2431054-de-jonge-vanaf-2030-geen-woningen-meer-verhuren-met-slecht-energielabel

NOS. (2023). Dertien gemeenten vragen Eneco tarief stadsverwarming te verlagen. NOS. Retrieved November 20, 2023, from https://nos.nl/artikel/2464749-dertien-gemeenten-vragen-eneco-tarief-stadsverwarming-te-verlagen

Ostrom, E. (2011). Background on the institutional analysis and development framework. Policy studies journal, 39(1), 7-27. https://doi-org.tudelft.idm.oclc.org/10.1111/j.1541-0072.2010.00394.x

Ostrom, E. (2010). Beyond markets and states: polycentric governance of complex economic systems. American economic review, 100(3), 641-672. https://doi.org/10.1257/aer.100.3.641

De Participatiecoalitie. (2021). LSA: grote samenwerking in BoTu een feit - De Participatiecoalitie. De Participatiecoalitie. Retrieved October 29, from https://departicipatiecoalitie.nl/nieuws/grote-samenwerking-in-botu-een-feit/

Programma Aardgasvrije Wijken. (n.d.-a). Bospolder-Tussendijken, Rotterdam - programma Aardgasvrije wijken. Programma Aardgasvrije Wijken. Retrieved October 29, 2023, from https://aardgasvrijewijken.nl/proeftuinen+op+de+kaart/bospolder-tussendijken+rotterdam/default.aspx

Programma Aardgasvrije Wijken. (n.d.-b). *Voor wie - Programma Aardgasvrije Wijken*. Programma Aardgasvrije Wijken. Retrieved June 21, 2023, from https://aardgasvrijewijken.nl/klp-paw/voor+wie/default.aspx

Raad van State. (n.d.). Toetsing Klimaatwet. Retrieved July12, 2023, from https://www.raadvanstate.nl/klimaatwet/

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., ... & Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. Journal of environmental management, 90(5), 1933-1949. https://doi.org/10.1016/j.jenvman.2009.01.001

Rekenkamer Rotterdam. (2019). Warmte zonder leiding.

Resilient Rotterdam. (n.d.). Veerkrachtig Bospolder-Tussendijken. Retrieved September 22, 2023, from https://www.resilientrotterdam.nl/initiatieven/veerkrachtig-bospolder-tussendijken

Rutherford, J., & Jaglin, S. (2015). Introduction to the special issue-Urban energy governance: Local actions, capacities and politics. Energy Policy, 78, 173-178. https://doi.org/10.1016/j.enpol.2014.11.033

Rijksoverheid. (2019). Klimaatakkoord.

Rijksoverheid. (2023). Deelnemende gemeenten aardgasvrije wijken. Aardgasvrije Wijken | Rijksoverheid.nl. Retrieved September 23, 2023, from https://www.rijksoverheid.nl/onderwerpen/aardgasvrije-wijken/deelnemende-gemeenten-aardgasvrij-maken

RvO. (n.d.). Stimuleringsregeling aardgasvrije huurwoningen (SAH). RvO.nl. Retrieved August 31, 2023, from https://www.rvo.nl/subsidies-financiering/sah#voor-wie%3F-

SCP. (2019). Armoede in kaart 2019. Sociaal en Cultureel Planbureau. https://www.researchgate.net/profile/Benedikt-Goderis2/publication/346563839_Armoede_in_Kaart_2019/links/5fc7683f299bf188d4e9009 d/Armoede-in-Kaart-2019.pdf

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. Journal of business research, 104, 333-339. https://doi.org/10.1016/j.jbusres.2019.07.039

Sovacool, B. K., & Dworkin, M. H. (2015). Energy justice: Conceptual insights and practical applications. Applied energy, 142, 435-444. https://doi.org/10.1016/j.apenergy.2015.01.002

Sovacool, B. K., Upham, P., Martiskainen, M., Jenkins, K. E., Torres Contreras, G. A., & Simcock, N. (2023). Policy prescriptions to address energy and transport poverty in the United Kingdom. Nature Energy, 8(3), 273-283. https://doi-org.tudelft.idm.oclc.org/10.1038/s41560-023-01196-w

Stedin. (n.d.). Wat doet Stedin | Stedin. Stedin. Retrieved October, 14, 2023, from https://www.stedin.net/over-stedin/wat-doet-stedin

Stuiver, M. (2021). Dar ook aangesloten op Warmtenet Nijmegen. Dar. https://www.dar.nl/nieuws/dar-ook-aangesloten-op-warmtenet-nijmegen/

Tambach, M., Hasselaar, E., & Itard, L. (2010). Assessment of current Dutch energy transition policy instruments for the existing housing stock. Energy Policy, 38(2), 981-996. https://doi.org/10.1016/j.enpol.2009.10.050

Termeer, C., Dewulf, A., van Rijswick, H., van Buuren, A., Huitema, D., Meijerink, S., …Wiring, M. (2011). The regional governance of climate adaptation: A framework for

developing legitimate, effective, and resilient governance arrangements. Climate Law,2(2), 159–179. https://doi-org.tudelft.idm.oclc.org/10.1163/CL-2011-032

Termeer, K., Buuren, A. V., Dewulf, A., Huitema, D., Mees, H., Meijerink, S. V., & Rijswick, M. V. (2017). Governance arrangements for the adaptation to climate change. https://doi.org/10.1093/acrefore/9780190228620.013.600

TNO. (2022). Energy Transition | TNO. tno.nl/en. Retrieved November 17, 2022, from https://www.tno.nl/en/about-tno/organisation/units/energy-transition/

TU Delft. (n.d.). MSC Complex Systems Engineering and Management. https://www.tudelft.nl/index.php?id=7494&L=1

Tweede Kamer. (2023, February 8). Wijziging van de Klimaatwet afgerond. Tweede Kamer Der Staten-Generaal. Retrieved July 12, 2023, from https://www.tweedekamer.nl/kamerstukken/plenaire_verslagen/kamer_in_het_kort/wijziging-van-de-klimaatwet-afgerond-1

UNFCCC. (n.d.). The Paris Agreement. UNFCCC. Retrieved July 11, 2023, from https://unfccc.int/process-and-meetings/the-paris-agreement

Universiteit van Amsterdam. (2022, March 21). NWO grant for JUST PREPARE - AISSR. Amsterdam Institute for Social Science Research - University of Amsterdam. Retrieved November 17, 2022, from https://aissr.uva.nl/content/news/2022/03/nwo-grant-for-just-prepare.html?origin=+yxIdW4bRwCjN8rZP+dJdA

Valkenburg, G., & Cotella, G. (2016). Governance of energy transitions: about inclusion and closure in complex sociotechnical problems. Energy, Sustainability and Society, 6, 1-11. https://doi.org/10.1186/s13705-016-0086-8

Van Es, W. (2017). An institutional analysis framework to close the regional water cycle. http://resolver.tudelft.nl/uuid:ba177c27-77c9-4052-8180-6a94774d1869

Veldacademie. (2021). Veerkracht in Bospolder-Tussendijken. https://verhalenvanbotu.nl/wp-content/uploads/2021/06/Rapportage-monitor-Veerkracht-in-BoTu-2-klein.pdf

Verbeek, M. (2014). File:Rotterdam-west foto1 2014-03-09 10.55.jpg. https://en.m.wikipedia.org/wiki/File:Rotterdam-west_foto1_2014-03-09_10.55.jpg

Vink, M. J., & Dewulf, A. (2015). Zonder arena geen spel. Bestuurlijke arrangementen als speelveld voor het omgaan met frameverschillen: illustraties uit het klimaatadaptatiebeleid, (7).

VNG. (2023). VNG en IPO pleiten voor snelle invoering warmtewet. VNG.nl. Retrieved November 16, 2023, from https://vng.nl/nieuws/vng-en-ipo-pleiten-voor-snelle-invoering-warmtewet

Von Soest, C. (2023). Why do we speak to experts? Reviving the strength of the expert interview method. Perspectives on Politics, 21(1), 277-287. https://doi.org/10.1017/S1537592722001116

Wahi, P., Konstantinou, T., Tenpierik, M. J., & Visscher, H. (2023). Lower-Temperature-Ready Renovation: An Approach to Identify the Extent of Renovation Interventions for Lower-Temperature District Heating in Existing Dutch Homes. Buildings, 13(10), 2524. https://doi.org/10.3390/buildings13102524

Williamson, O. E. (1998). Transaction cost economics: how it works; where it is headed. De economist, 146, 23-58. https://doi.org/10.1023/A:1003263908567

Zhong, R. (2022, September 15). In a First Study of Pakistan's Floods, Scientists See Climate Change at Work. Retrieved November 17, 2022, from https://www.nytimes.com/2022/09/15/climate/pakistan-floods-global-warming.html

Appendix A: Coding

In Table 6, the coding scheme used to analyse the interviews is presented.

Table 6: Coding scheme

Code	Definition
Boundary rules	Specify how actors were chosen, the number of actors that participate in the local energy planning project, and how actors enter or leave the decision-making process (Lammers & Hoppe, 2019; Ostrom, 2010);
Position rules	Specify the set of positions that actors hold and how many actors hold a position in the local energy planning decision-making process (Lammers & Hoppe, 2019; Ostrom, 2010);
Choice rules	Specify the sets of actions that can (could have), may or must not (have) been taken and to which actor in what position they are assigned at specific points in time (Lammers & Hoppe, 2019; Ostrom, 2010);
Information rules	Specify the amount and type of information available to participants and the channels of communication between participants (Lammers & Hoppe, 2019; Ostrom, 2010);
Aggregation rules	Specify how decisions are made and have to be mapped, e.g., by an individual actor, or in collaboration with others, to arrive at the outcomes (Lammers & Hoppe, 2019; Ostrom, 2010);
Payoff rules	Specify the costs and benefits that derive from particular actions and outcomes and how these are divided between actors (Lammers & Hoppe, 2019; Ostrom, 2010);
Scope rules	Specify the set of possible outcomes, as well as the jurisdiction and state of outcomes, e.g., if they could be affected or whether they are final or not (Lammers & Hoppe, 2019; Ostrom, 2010).
Rules-in-use	These are the formal laws and regulations that enable and constrain the behaviour of participants (Milchram et al., 2019). These rules may evolve over time because the involved actors change for example (Ostrom, 2010)
Evaluative criteria	These are used to evaluate both the results, and the outcomes, and the process that led to these outcomes (Ostrom, 2011)
Availability	Asks for the possibility everyone to access it and the reliability and security of supply (Sovacool & Dworkin, 2015).
Affordability	Asks not just for bottom prices, but for continuity in pricing, so no huge differences every year. Next to that it also asks for the possibility for everyone to pay their energy, without it being unreasonable parts of their monthly income (Sovacool & Dworkin, 2015).
Due process	asks for the right for all stakeholder to be heard during the policymaking process, especially if the decisions may directly affect them. and they should be able to make their complaints clear to an independent arbitrator (Sovacool & Dworkin, 2015).

Good governance	Asks that everyone should be able to get high quality information if they want to, both about energy and the environment. Next to this, the decision-making process should be transparent. (Sovacool & Dworkin, 2015)
Sustainability	Asks for the use of sustainable resources, or at least to not use natural resources too fast (Sovacool & Dworkin, 2015)
Framing	The problem that has to be solved by the governance arrangement (Termeer et al., 2017)
Levels to act	at which levels of government action has to be taken, so what level of government is most appropriate for the problem (Termeer et al., 2017).
Timing	This does not only mean when to take action, but also in what order the actions have to be taken (Termeer et al., 2017)
Alignment	Alignment across sectoral boundaries (Termeer et al., 2017)
Policy instruments	With this, the actions of individuals and companies can be shaped in a specific direction, to get them involved in the energy transition as well (Termeer et al., 2017)
Organisation	The organisation of the science-policy interface (Termeer et al., 2017)
Leadership	Appropriate forms of leadership (Termeer et al., 2017)
Barriers	Aspects that hinder the decision-making
Important governance	Suggestions that do not fit into one of the categories

Appendix B: Literature Study

The literature was searched for in Scopus. To be able to find literature a search string had to be conducted. The search was conducted in English. The concepts were connected with the AND Boolean, and for all these concepts synonyms were added with the OR Boolean, resulting in the following search string:

TITLE-ABS-KEY (
"Energy transition" OR "energy renovation" OR "energy efficiency" AND
policy OR governance OR approach OR regulation AND
barriers OR goals AND
housing OR household OR neighbourhood AND
participation OR adoption OR decision AND
underprivileged OR poverty OR financial OR deprived OR economic AND
Netherlands OR Dutch OR Europe OR EU)

This search string resulted in 26 papers being found. After checking for accessibility, 21 papers remained. After screening through the titles and abstracts, 10 papers were dropped, since they did not turn out to be relevant for this research. After reading all the remaining 11 papers, seven papers were selected, because the other four turned out to be not relevant after reading the entire article. With these seven papers, backward and forward snowballing was done. This resulted in three more papers being selected, making a total of 10 papers. The papers of Murphy et al. (2012) and Hoppe et al. (2011) were found by backward snowballing. The paper of Broers et al. (2022) was found by forward snowballing. The selected papers can be found in Table 7. The selection process is shown in Figure 14.

Table 7: Literature for Review

Authors	Year	Title
Bertoldi, Boza-Kiss, Della Valle & Economidou	2021	The role of one-stop shops in energy renovation - a comparative analysis of OSSs cases in Europe
Breukers, Mourik, Van Summeren & Verbong	2017	Institutional 'lock-out towards local self-governance? Environmental justice and sustainable transformations in Dutch social housing neighbourhoods.
Broers, Kemp, Vasseur, Abujidi & Vroon	2022	Justice in social housing: Towards a people-centred energy renovation process.
Broers, Vasseur, Kemp, Abujidi & Vroon	2019	Decided or divided? An empirical analysis of the decision-making process of Dutch homeowners for energy renovation measures
Ebrahimigharehbaghi, Qian, Meijer & Visscher	2019	Unravelling Dutch homeowners' behaviour towards energy efficiency renovations: What drives and hinders their decision-making?
Guerra-Santin, Boess, Konstantinou, Herrera, Klein & Silvester	2017	Designing for residents: Building monitoring and co-creation in social housing renovation in the Netherlands.

Hoppe	2012	Adoption of innovative energy systems in social housing: Lessons from eight large-scale renovation projects in The Netherlands
Hoppe, Bressers & Lulofs	2011	Local government influence on energy conservation ambitions in existing housing sites—Plucking the low-hanging fruit?.
Murphy, Meijer & Visscher	2012	A qualitative evaluation of policy instruments used to improve energy performance of existing private dwellings in the Netherlands
Tambach, Hasselaar & Itard	2010	Assessment of current Dutch energy transition policy instruments for the existing housing stock.

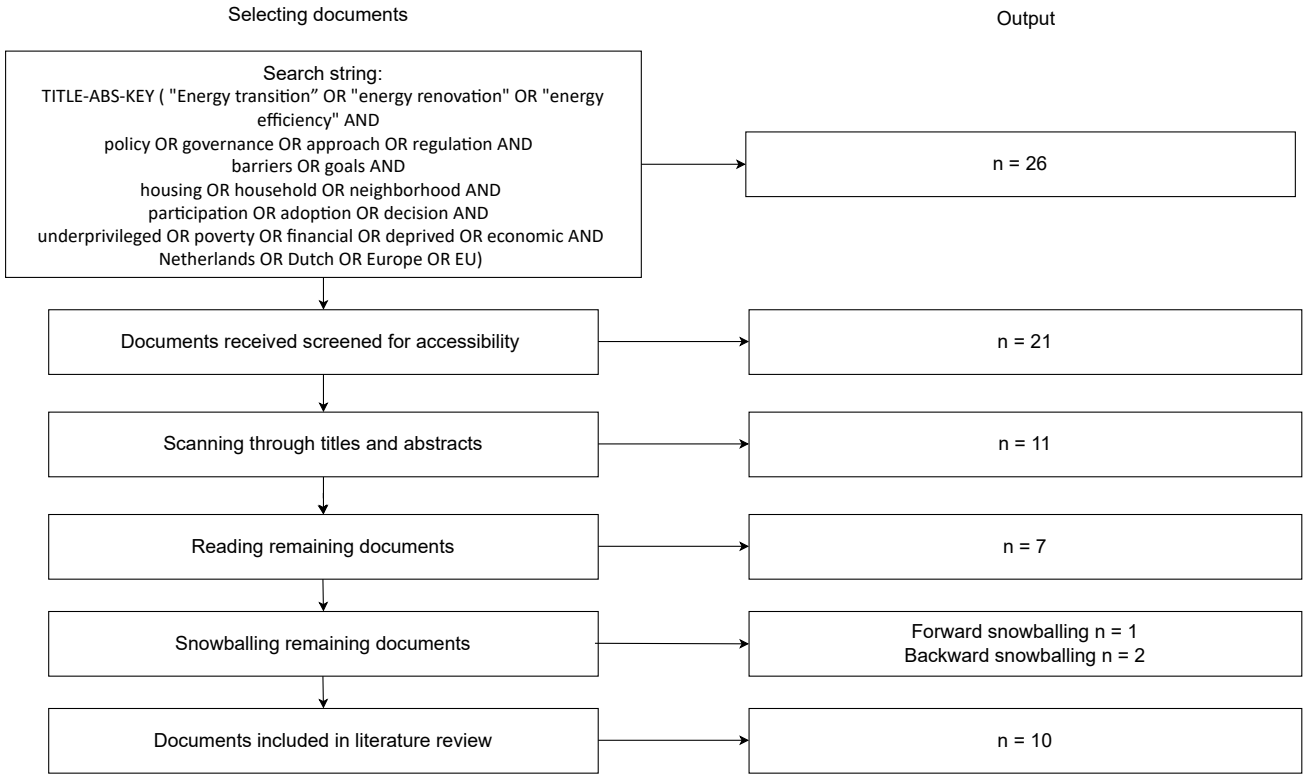

Figure 14: Literature selection process

Appendix C: Interviewees

In Table 8, the interviewees are presented.

Table 8: Interviewees

Interviewee	Function	Organisation
#1	Program manager BoTu natural gas-free	Municipality of Rotterdam
#2	Task manager and public outsourcer	Municipality of Rotterdam
#3	Program manager energy transition	Havensteder
#4	Development manager	Havensteder
#5	Project developer	Eneco
#6	Area manager	Eneco
#7	Chairman	Delfshaven Energy Cooperation
#8	Associate professor	University of Twente
#9	Associate professor	TU Delft
#10	Responsible WKO implementation	Municipality of Rotterdam/Amsterdam
#11	Assistant professor	University of Twente
#12	Assistant professor	University of Twente
#13	Senior asset manager	Woonstad

The informed consent form.

You are being invited to participate in a research study titled *Energy transition in underprivileged neighbourhoods -- A research to design a just energy transition*. This study is being done by Julius Schutte from the TU Delft.

The purpose of this research study is to study how the current governance arrangements influence decision-making with regard to having a just energy transition in neighbourhoods such as Bospolder Tussendijken and how new governance arrangements could be designed to improve decision-making in underprivileged neighbourhoods in the future. The interview will take you approximately *30-45* minutes to complete. The data will be used for research purposes as part of a master's thesis to improve governance arrangements to get more energy justice. We will be asking you questions regarding the decision-making in Bospolder Tussendijken, what hampers the decision-making in your opinion, and how this could be improved.

In the case of in-person interviews, the interviews will be audio-recorded or video-recorded in case of an online interview. As with any online activity, the risk of a breach is always possible. To the best of our ability, your answers in this study will remain confidential. We will minimize any risks by deleting the records and transcripts of the interviews 2 years after finishing the project because the data may be reused for a scientific publication. If that's the case everything will be kept anonymous.

Even though transcripts and recordings will be generated from the interviews and temporarily securely stored within TU Delft, the thesis report will only publish the analysis of the interviews, so no summary or transcript of the interview. All identifiable information will be anonymized. Because of the small neighbourhood there is a possibility that you can be reidentified because of your position in the neighbourhood. The draft of the analysis of the interviews in the thesis can be reviewed by you if you would like to.

Your participation in this study is entirely voluntary and you can withdraw at any time. No financial compensation will be provided for participating in this research. You are free to omit any questions. The master's thesis is expected to be finished in October 2023

In case you need to contact the research team for any reason, you can reach them through the following contact details: (email-addresses, not shared in this public document).

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated [*DD/MM/YYYY*], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
3. I understand that personal information collected about me that can identify me, such as my name, email address, or position, will not be shared beyond the study team.	☐	☐
4. I understand that the (identifiable) personal data I provide will be destroyed at the latest two years after the research ends	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
5. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐

Signatures

_____	_____	_____
Name of participant [printed]	Signature	Date

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Researcher name [printed]	Signature	Date

Appendix D: Interview Protocol Case Stakeholders

Brief introduction

Thank you for wanting to participate in this interview for my thesis. I am conducting my thesis research within TU Delft for my degree in Complex Systems Engineering and Management and as part of the Just Prepare research funded by the Netherlands Organisation for Scientific Research (NWO) on energy transition in underprivileged neighbourhoods. A perhaps fun, additional fact is that I myself live in BoTu, which gives me a connection to it for me, and allows me to put the research in context.

I expect the interview to take about 45 minutes, depending on the answers, of course. The data will be stored on a secure server, as already mentioned in the "informed consent" form you have already signed. This also contains my email address, should you wish to contact me after the interview.

My research mainly focuses on the governance part, and then more specifically on governance arrangements. Now there are several definitions for this, but the one I use in my thesis is: "A governance arrangement is the ensemble of rules, processes, and instruments that structure the interactions between public and/or private entities to realize collective goals for a specific domain or issue" The aim of the research is to gain insight into the governance arrangements used to speed up a just energy transition in Bospolder Tussendijken, and to develop new governance arrangements to speed up this process.
The research has two main research questions, the first on the current situation:

1. *What governance arrangements are currently influencing decision-making with regard to having a just energy transition in the neighbourhood "Bospolder-Tussendijken"?*

The second question which is design-oriented:

2. *How to design governance arrangements to improve decision-making in underprivileged neighbourhoods in the future?*

Interview questions:

IAD

1. What is your role with regard to decision-making regarding the energy transition in BoTU?
    - Within that, what are the challenges you have experienced?
2. Which actors are part of the decision-making process and have (had) influence on it? (Boundary rules)
3. Is there certain division of roles in that? (Position rules)
    - Is everyone equal or is there a hierarchy (within the action arena/when decision-making takes place)?
4. In your opinion, what are the most important decisions taken in this project? (choice rules)
    - And of which is it important that it was not taken?
5. How is information shared? (Information rules)
    - What is the most important information?
        - And with whom and how is it shared?
        - And with whom not?
6. How did you agree on the Area Agreement? (aggregation rules)

- Are there things about the area agreement that you would like to see different in an ideal world?
- What should absolutely be retained?

7. Which rules played a major role in this? (rules in use)
   - What policies or laws and regulations did this have to do with?
   - And did this actually work with or against it from your point of view?
8. What costs and/or benefits has this area agreement had for your organisation (pay-off rules)?
9. To what extent does this agreement and implementation differ from the original plan that was there for your organisation before the agreement? (Scope rules)
   - Are the expected outcomes still the same?
10. When will you be completely satisfied with this project (Evaluative/outcomes)?
11. Are there any aspects that I have overlooked that are of great importance in relation to decision making?
12. Are there any barriers that are hampering the decision-making now?

Energy justice

13. To what extent will the district heating be available to everyone? (availability)
14. And under what conditions? (Affordability)
15. Is everything shared with all (representatives of) citizens and other stakeholders as well? (Good governance)

Design

16. How would you describe the problem? (Framing)
17. To what extent does this feel like a local issue (levels to act)?
    - To what extent do you feel there is too little or too much interference from higher levels of government?
18. Do you feel that action was taken at the right time? (Timing)
19. Do you participate in several sustainability projects? (Alignment)
    - If yes, is it more difficult in this project to align with the other sectors or is it without problems?
20. You are now linked through the GOK, to what extent do you like it? (Policy instruments)
    - Are certain standards also laid down in this or is that perhaps in other governance arrangements?
    - How are citizens included in this?
21. To what extent do you think there is (good) leadership? (Form of leadership)

Thank you for making time for this interview!

Appendix E: Interview Protocol Experts

Brief introduction

Thank you for wanting to participate in this interview for my thesis. I am conducting my thesis research within TU Delft for my degree in Complex Systems Engineering and Management and as part of the Just Prepare research funded by the Netherlands Organisation for Scientific Research (NWO) on energy transition in underprivileged neighbourhoods. A perhaps fun, additional fact is that I myself live in BoTu, which gives me a connection to it for me, and allows me to put the research in context.

I expect the interview to take about 45 minutes, depending on the answers, of course. The data will be stored on a secure server, as already mentioned in the "informed consent" form you have already signed. This also contains my email address, should you wish to contact me after the interview.

My research mainly focuses on the governance part, and then more specifically on governance arrangements. Now there are several definitions for this, but the one I use in my thesis is: "A governance arrangement is the ensemble of rules, processes, and instruments that structure the interactions between public and/or private entities to realize collective goals for a specific domain or issue" The aim of the research is to gain insight into the governance arrangements used to speed up a just energy transition in Bospolder Tussendijken, and to develop new governance arrangements to speed up this process.
The research has two main research questions, the first on the current situation:

1. *What governance arrangements are currently influencing decision-making with regard to having a just energy transition in the neighbourhood "Bospolder-Tussendijken"?*

The second question which is design-oriented:

2. *How to design governance arrangements to improve decision-making in underprivileged neighbourhoods in the future?*

Interview questions:

1. What is your role within the energy transition and within that, what, if any, is the relationship with district heating grids?
2. What do you think are the most important decisions to be made during the preparation of making a neighbourhood natural gas-free?
3. To what extent do you think information should be shared with stakeholders (including residents)?
4. In your opinion, what are the main barriers that hamper decision-making regarding local energy transition and heat networks?
5. How do you ensure that heat is available (and affordable) for everyone?
6. To what extent do you think residents should be involved in decision-making regarding energy transition in general and district heating grids in particular?
7. To what extent do you recognise the criticism that district heating grids are not always as sustainable as claimed?
8. To what extent do you think there are better alternatives for existing buildings than district heating grids?

9. In your opinion, what are currently the most important governance conditions or prerequisites for a just energy transition in existing residential areas, such as BoTu?

10. How would you explain the complexity of achieving heat transition in an existing neighbourhood like BoTu?
11. Which stakeholder do you think should take the lead, and how?
12. In your opinion, what is the perfect time to start implementation?
13. How do you think the alignment and coordination between actors from different sectors should be arranged?
14. What policy instruments do you think are ideally crucial in the achieving a just energy transition and how should they be used?
15. What do you think should be the role of science in the policy-making process?
16. What leadership roles do you think are needed in this type of project, and who should pick up which ones?
17. Are there any contacts or text documents that I could further consult for this research?

Thank you for making time for this interview!

Appendix F: Analysis Case Interviews

Havensteder was a crucial stakeholder in this case because many homes were needed to connect a neighbourhood to the district heating grid; it was impossible with just a few houses (Interviewee #2).
These three stakeholders were the three stakeholders with both high influence and high interest. The municipality as the government, Havensteder as the housing association, and Eneco as the heating company (Interviewee #5).
The province of South Holland was also involved. They did not give subsidies to this project but helped to get some European subsidies for Bospolder-Tussendijken in combination with a couple of other municipalities (Interviewee #2).
They (Tenants Council West) would prefer other options than the district heating grid, like collective solar roofs or more insulation (Interviewee #3).
When more than 70% of the tenants of a building agreed, the remaining tenants could go to court within eight weeks after they are notified that 70% agreed. However, the chance of winning such a dispute was low since the verdict would probably be that the proposal was reasonable (Interviewees #2 and #4).
Although this would only cover part of the costs, it was beneficial to the recipients (Interviewee #3).
With this money[Sofie Fund], the over dimensioning of the pipes was made possible (Interviewee #1).

The municipality of Rotterdam granted Eneco a concession (Interviewee #7).
Eneco, the municipality, and Havensteder decided internally if they would join this project at the end of 2018 (Interviewees #1, #3).
In 2019, it was decided by the municipality to start with the ten-year program of "Veerkrachtig BoTu 2028" (Interviewee #7).
In January 2021, the municipality, Havensteder and Eneco reached the area agreement, which many of the interviewed case stakeholders mentioned as the most important decision (Interviewees #1, #2, #3, #4, #5).
Quickly thereafter, in February 2021, the decision was made to sign the collaboration agreement with the stakeholders of the area agreement and the important energy-concerned stakeholders in the neighbourhood, like Delfshaven Energy Cooperation and actors and initiatives involved in the Veerkrachtig Botu 2028 energy program (Interviewees #2, #7).
The decision was made not to include private owners in the area agreement (Interviewee #5).

Eneco, the municipality, and Havensteder had open books when negotiating the area agreement; they shared almost everything, at least all that was relevant to the case in the beginning. Eneco even shared the business case, which they were not used to before this negotiation (Interviewee #5). This openness helped to build trust between the parties. By sharing this business case, the municipality and Havensteder could see what happened when different buttons were turned (Interviewee #3).
The information sharing was initially not very transparent to the active neighbourhood residents who signed the collaboration agreement. After some time passed, this improved, and the information from the municipality, Eneco, and Havensteder towards the neighbourhood stakeholders improved. Nevertheless, transparency remained suboptimal

because the area agreement was signed around the same time, resulting in two separate discussions. The area agreement was surrounded by secrecy, resulting in the feeling that not all information was shared with the neighbourhood (Interviewee #7).
The information sharing with the residents in the neighbourhood mainly was project-focused, without much education on the entire energy transition (Interviewee #7).
The information sharing with the residents in the neighbourhood mainly was project-focused, without much education on the entire energy transition.
The information sharing of Eneco, the municipality, and Havensteder to the residents went through joint newsletters. In these newsletters, it was communicated for a long time that they were looking into it, and then suddenly: we are starting this project. (Interviewees #1, #2, #4, #5)

The decision to sign the area agreement in 2021 was made together by Eneco, the municipality, and Havensteder. This happened after months of negotiations with three parties with different interests and ideals. They came a long way with the idea that they were committed to doing this, and therefore, all took the risks that were most to their credit. However, this was easier in the first subjects because it was quite logical who took what risks; in the end, with the more sensitive topics, it became more challenging to take on risks and the difficult points were exchanged. Representatives of the three parties indicated in interviews that they operated as equals also because they were dependent on each other. However, as legally determined, the municipality was the leading entity (Interviewees #1, #2, #3, #5).
Almost at the same moment as the signing of the area agreement, Eneco, the municipality, and Havensteder signed the collaboration agreement with the neighbourhood stakeholders. The process towards the signing went smoothly because no specific goals were set, and because of this, there was not much to complain about. Therefore, it was indicated in an interview that the process towards the collaboration agreement provided a basis for further collaboration, more than the agreement itself (Interviewee #7).

The first one is, of course, the area agreement, which had the benefit that a framework was already in place within which the decision-making could take place, which made sure the parties did not have to negotiate that part for every separate street of the project area in the neighbourhood (Interviewee #6).
For Eneco, this is straightforward. The costs were the investment costs in the district heating grid in Bospolder-Tussendijken, which were a high upfront cost, and the benefits are an expected income, potentially for a very long time, resulting eventually in profit for Eneco. Next to this, Eneco has the ambition to be climate neutral by 2035, not only in its activities but also in the energy Eneco delivers to customers, so this was a contribution to achieving that goal as well (Interviewees #5, #6).
For the municipality, this project contained a few benefits and some costs. First, a benefit was that many homes would become natural gas-free, which helped achieve the goal of becoming completely natural gas-free. Another benefit for the municipality was that all distribution stations were located indoors, mostly in buildings of Havensteder, so not in the streets, because of which not a single tree had to be felled. Next to this, the social track was important because it helped the neighbourhood by developing other projects and trying to tackle energy poverty. The costs for the municipality were primarily financial, although some expenses were covered by higher levels of government (Interviewees #1, #2).

For Havensteder, the benefit was also that their property would become natural gas-free, which they had to do because of regulation. With this project, they did not have to do this alone but in collaboration with the municipality and Eneco. They also got the chance to have a lot of insight into their tenants, which could help them solve deeper problems. The costs for Havensteder were primarily financial, but also the fact that because they had to spend money on the connection to the district heating grid, they could not spend this money on, for example, insulation (Interviewee #3, #4).

The project area is much smaller than the initial search area. The entire neighbourhood was an option when starting the project, as shown in Chapter 4 Figure 6. Based on the interests of all stakeholders combined, where the municipality moved a bit towards Havensteder, it was brought back to this project area of three blocks in Tussendijken (Interviewees #1, #5). The possibility of expanding the project area to Bospolder did not make it because of conflicting interests between Eneco and Havensteder (Interviewee #3, #4, #5).
Also, the indoor costs were much higher than expected, which made the project more expensive and could have stopped the project. The connection costs to the district heating grid were 50% higher than expected for Havensteder, eventually leading to Eneco finding other, cheaper connection methods (Interviewee #3).

Multiple interviewees mentioned that eventually, the most important result should be that the residents of Bospolder-Tussendijken were content and did not have too many problems from the district heating grid construction or the fact that they cannot choose their supplier anymore because the only supplier of heat for the neighbourhood is Eneco (Interviewees #1, #2, #3, #4, #5, #6). Building on this, the hope was that the transition would deliver value to the neighbourhood and the residents by creating employment or tackling energy poverty and that it might lead to a bigger energy community because people might become more invested in the energy transition, to work on a more sustainable neighbourhood (Interviewees #2, #7).
Another mentioned criterion is time. Some subsidies are time-limited, and therefore, the project must be finished within the project time because if not, the subsidies will stop, which will badly affect the parties financially. This is already a critical element due to the project costs exceeding their initial expectations when starting the project (Interviewees #1, #6).
The third element that was mentioned a lot by almost all stakeholders was the costs. As mentioned, the costs were higher than expected when starting with the project, but the goal is overall to be as close as possible to the estimated costs (Interviewee #4).

When someone wanted to be connected, Eneco had a connection obligation. Still, some exceptions have been made for complex buildings not owned by Havensteder, where a minimum percentage of 50% of the houses in the building that wanted to connect was needed before they started connecting homes to the district heating grid. (Interviewees #1, #2, #4, #5, #6).

The price for connection to the district heating grid will increase with a kind of inflation correction yearly. All groups paid the same, but only within a group, so owners paid a different price than tenants and landlords, but this is because this was differently arranged with subsidies and other agreements (Interviewee #5).

The subsidies allowed owner-occupiers to switch to district heating for 1,500 euros, about 10% of the actual costs. If they could not afford this, they could take out an interest-free loan (Interviewees #1, #2).
These conditions are only valid during the project time until January 1, 2026. After this, the subsidies expire, and so do the conditions. After this deadline, connecting to the district heating grid is still an option, but in that case, the conditions will be far less attractive (Interviewees #1, #2, #6).

Some local stakeholders were involved in the process, for example, the stakeholders of the Veerkrachtig Botu program (Interviewees #1, #7).

The residents of Bospolder-Tussendijken were informed quite late. Eneco, Havensteder, and the municipality decided they wanted to ensure they had all financial agreements ready before officially informing all residents. When all these were in place, they soon informed the residents (Interviewees #1, #3, #5). The process of these agreements was not fully transparent to the neighbourhood stakeholders involved in the information sharing and even less to the neighbourhood residents (Interviewee #7).
Information evenings and workshops were set up to inform residents, but the question is if and how much residents became aware of this (Interviewee #6).

In this case, the heat was produced anyway, whether it was used for the district heating grid or not, and it still had less emissions than the use of natural gas. The intention is to go to lower temperatures, making this more sustainable. This is still a long-term plan; no concrete plans have been made yet. At least the possibility to preserve is there, which is not the case when keeping natural gas (Interviewees #2, #5, #6).
As mentioned before, peak boilers are used for the security of supply. This gave a strange image to residents because they had to get disconnected from natural gas, but natural gas was still used. Although it was needed to guarantee the security of supply, it could be better for the project to look into a more sustainable backup as well (Interviewee #6).

The first barrier was that at the beginning of the decision-making process for making the neighbourhood natural gas-free, very short lines of communication existed within the organisations of Eneco, Havensteder, and the municipality. However, this slackened after the area agreement was signed (Interviewees #1, #5).
Building on this, during the implementation phase, the decision-making became more difficult because it was looked at within some organisations as just project work. In contrast, the organisations worked completely differently in the phase before the area agreement was signed. Because of this worsening attention, the decision-making was hampered. (Interviewee #1).

A second barrier was the reason behind the lack of an area agreement for Bospolder. Eneco wanted to connect to a lower-temperature district heating grid there because then they could use more sustainable sources to feed the district heating grid. This was impossible with the status of the real estate of Havensteder because Havensteder did not have the financial resources to disconnect all the houses from natural gas and insulate all their properties better, which was needed to connect to a lower temperature district heating grid. Therefore, Havensteder wanted to get a guarantee that the connection would be to a high-

temperature district heating grid there as well because only then could they guarantee their tenants that they would have a warm house in the colder months. Eneco could not agree with this; therefore, the area agreement for Bospolder did not make it (Interviewees #3, #4, #5).

A third barrier is the Heat Act, and in two ways. First of all, because of the principle that heat cannot be more expensive than gas and therefore these prices are coupled, the price of heat also rose enormously during the energy crisis when the gas prices rose, making it way less interesting to switch to district heating. With this, the NMDA principle, which was meant to protect customers from unreasonable heat prices, now is the source of very high heat prices and therefore it is not fulfilling its purpose (Interviewee #3, #7).
Secondly, Minister Jetten of Climate announced in the plans for the new Heat Act, the Collective Heat Act, that the district heating grids should be at least 51% publicly owned. This new proposal came up after almost seven years of a lot of uncertainty, which is still present, which, of course, massively impacts the business case of Eneco (Interviewee #5).

A fourth barrier was the lack of ambition in the national government. In 2018, plans were presented to go completely natural gas-free, but this has been weakened in the last few years, with many intermediate steps. This slowed down the energy transition, and because the higher levels of government did not entirely follow through, the decision-making in the local energy transition was hampered (Interviewee #3).

The fifth barrier was the lack of possibilities for residents to join the decision-making process. This left an enormous potential untapped in terms of commitment, passion and knowledge. When these could be set in a climate council, this would anchor decisions about basic services much better in a neighbourhood (Interviewee #7).

That many homes have to be made natural gas-free (interviewee #5). It is very hard to do so in already existing buildings (interviewee #1). The problem is also framed much more extensively, that a better environment needs to be ensured (Interviewee #6). It is also framed smaller, that the homes of tenants of Havensteder are not future-proof, meaning the houses have to be updated, and district heating is the appropriate alternative (Interviewee #3).

Action is also needed from higher levels of government because they should provide general conditions and incentives. In practice, this happens, although not always as fast and in the direction that every stakeholder wants. This resulted in dissatisfaction with the choices made and the speed achieved by the government within multiple sectors (Interviewees #1, #3, #5, #6).

The choice can also be made to wait until more knowledge is gained, but the reaction of many interviewees was that more is learned by doing than by waiting until a way better option appears in a few years. (Interviewees #1, #2).

Although very short lines of communication existed between the organisations of Eneco, Havensteder, and the municipality initially, this slackened after the area agreement was signed (Interviewees #1, #5).

Building on this, during the implementation, decision-making became more difficult because it was looked at within some organisations as just project work, while in the phase before the area agreement was signed, the organisations worked in a completely different way (Interviewee #1).
This frustrated the case in Bospolder-Tussendijken, almost stopping the entire project because of the uncertainty and conflicting signals concerning the new Heat Act (Interviewee #5).

The municipality is the stakeholder in charge because the national government appointed municipalities as the leading organisations in the local heat transition (Interviewee #2).
It is, however, a process based on equivalence between the three main stakeholders because they need each other (Interviewees #3, #5).
An independent, third-party process supervisor might be a good option (Interviewees #5, #7).

Appendix G: Expert Interviews

Deciding where to start with the disconnection of natural gas homes is essential. One way is to investigate in which neighbourhoods, for example, maintenance work is already planned or where the need for home renovations already exists. This provides valuable input into decision-making based on practical considerations of costs and efficiency. Another way to choose is to investigate which neighbourhood needs an uplift because it is, for example, underprivileged, and this can be improved by making the neighbourhood more sustainable (Interviewee 11).
When this is decided, building trust between the organisations is crucial since private and public parties usually have some natural distrust (Interviewee #13). This can be done by being as transparent as possible.
When starting a project, making sure the juridical steering elements have been established by the municipal council or legal provisions is essential. Otherwise, the project will always be undermined by someone. Furthermore, the financial side of the project needs to be clear. It has to be decided who makes which investments, and the risks and liabilities have to be divided between stakeholders (Interviewee #10).
Furthermore, it is important to make sure that every possibility has been considered before choosing a particular solution for the heat transition since residents will ask questions about other alternatives, so it is beneficial to start with a broad view and then funnel the focus. (Interviewee #12).

According to Interviewee #10, it would be best for stakeholders concerned with the energy transition to inform the residents of a neighbourhood at least two, maybe even four times a year, about the progress of the negotiations. This can be done by either information evenings or newsletters. When reporting, things that did not go as planned should not be concealed unless the very specific case it concerns company secrets. According to Interviewee #13, this is important because the distrust of professional parties has increased over the last few years in society, especially in underprivileged neighbourhoods. However, choosing the right tone of voice is also crucial so that residents do not get the wrong ideas about their positions (Interviewee #12).
It is also important to address why specific alternatives are not an option for the neighbourhood and potential collaborating stakeholders. While doing this, it is also essential to ensure that the information is presented comprehensibly because the residents may not have all the capabilities to understand all technical conditions set for alternatives (Interviewee #12).

The aim has to be to let everyone connect to district heating. Therefore, it is vital that the district heating is available for everyone. However, whether an opportunity exists to connect to district heating is not the only issue; the distrust of governmental bodies, which is very common in underprivileged neighbourhoods, needs to be resolved, and not by someone from the government, but, if possible, by someone living in the neighbourhood or someone specialised in these matters (Interviewee #12).
Next, it could be a primary condition that tenants' houses are insulated to a certain energy label. This would require less heat to warm the houses, increasing the availability of heat to warm houses (Interviewee #12).

One way to keep the heat affordable is to get higher connection figures. Every house that does not connect in an area where the pipes get laid harms the business case of the project, making it more expensive for the houses that do connect (Interviewee #10).
Another critical issue concerning affordability is the exploitation of the district heating grids. These are now usually exploited by private parties, usually energy companies, with an important interest in making a profit. Governmental bodies are the only stakeholders within the complex field interested in the public values as the promise of the constitutional state. In the case of neighbourhood renovations, this is the municipality as the local government (Interviewee #11).
Finally, the price of heat could be more subsided, or at least be uncoupled from the gas price, resulting in more, at least relatively, affordable heat. This could be done since heat is less gas-dependent than it used to be. Also, when the exploitation stays within private hands, the returns of private parties could be an interesting point of discussion if the percentages of profit could be lowered (Interviewee #12).

Especially in an existing neighbourhood, it is essential to include the residents of the neighbourhood. This means that it should not be the case that a finished plan is presented. Instead, at the start of the project, for example, three scenarios could be presented, where every resident can let their thoughts be known, and a vote could be held on the scenarios. In this way, the thoughts of the neighbourhood are clear, and they have at least been consulted this way, although the vote does not have to be binding (Interviewee #10).
It is crucial to clarify the boundaries within the solutions possible. Limitations exist in the techniques and options suitable for a neighbourhood. If this is not done correctly, the wrong expectations of the neighbourhood may be raised, resulting in possible uproar in the neighbourhood and less willing citizens to comply with the project. If these boundaries are made clear, it is also important to get as high a percentage of the neighbourhood as possible to these evenings to ensure everyone affected by the new policy who wants their opinion to be heard has the chance to do so (Interviewee #11).
These different options would probably not differ very much in terms of the solution, but for example, a district heating connection with some extra insulation and higher rent or without insulation and lower rent or stay with the current gas connection. This keeps it understandable for everyone as well. Next, it could also be an option to discuss these scenarios without voting after the discussion since some people might not want to vote in public or for another reason. However, this could also be solved by adding an option of voting blank (Interviewee #12).

Letting everyone in a neighbourhood know how the process works is important because this transparency can take away many suspicions. If communication about decision-making is absent, the possibility arises that individuals may interpret things independently, leading to considerable uproar and uncertainty (Interviewee #10).
However, an even worse scenario is possible when deals are being made without anyone knowing, while the message to the outside world is that the investigation into the suitable sources of heat is still fully ongoing and that they will update everyone as much as possible. When the information that the deal has already been made leaks, this completely disrupts the entire process, once again making clear that transparency is key (Interviewee #11).

When being transparent, it is crucial to ensure the information provision is approachable since most people will not understand all the technical details of these projects, especially in undereducated neighbourhoods (Interviewee #12).
Furthermore, citizens should be informed about climate change and the energy transition in a broader way than just the fact that the transition away from natural gas is needed and the details of the project to achieve this. If residents are better educated, they will understand things better and may be more willing to participate in the transition in a more active role (Interviewee #12).

District heating can be seen as the best alternative to natural gas for collective heat supply, even with only high-temperature heating grids. Although high temperature is not ideal, many options exist to improve this. Because of the electrification of the world, heating with electricity is not an option, according to Interviewee #10.
According to Interviewee #11, an ongoing transition almost guarantees that solutions are suboptimal. This is part of the fact that technology still has to be further developed and that the perfect solutions may be there already but are not qualified as such yet or still have to be developed.
However, the fact that high-temperature district heating with waste incineration as the heat source is used does not necessarily promote sustainability. A case could be made that less sustainable sources are encouraged or at least legitimised (Interviewee #12).

According to Interviewee #10, uncertainty is a barrier to the decision-making process. If the responsibilities are not made clear, such as with the new Heat Act or within coalitions, or the communication to everyone outside the coalition is unclear, the decision-making process will get hampered.

A second barrier to the decision-making process is the fact that most of the time, only the easy parts of neighbourhoods or cities in the Netherlands get connected to the district heating grid, which makes the decision-making in the short-term easier but more difficult in the longer term since then all at once the problematic parts will have to get connected (Interviewee #10).

Another barrier in the decision-making process is affordability, both for the stakeholders performing the transition and for the neighbourhood residents. First, such a project needs to complete a business case because if that is not possible, most private parties will not participate in the project because they are simply not in business to lose money. Therefore, this can also be a barrier to the affordability of citizens since when the focus is mainly on limiting financial costs for companies, this can be at the expense of residents (Interviewee #11).

Interviewee #11 states that the fact that the decision-making process for planning a heat transition is very context-dependent is also a barrier. Therefore, it is hard to take learnings from one neighbourhood and implement them without further ado in another neighbourhood, with a completely different context, which Hoppe & van Bueren (2015) also describe. This makes it hard to take universal lessons because that can only be done to a certain extent, which makes the decision-making process in every neighbourhood or city a new challenge.

According to Interviewee #12, a barrier in the decision-making process is the fact that there has to be support created within the neighbourhood. This makes the decision-making more difficult since enough support is needed. Otherwise, the affordability of the parties building the grid will become critical. On the other hand, residents have to agree before the planning is complete, so one must almost sign a blank cheque, which is challenging to persuade residents to do.

Another barrier is the lack of knowledge by citizens, or at least the mixed signals people get. For example, the European Union gave natural gas the label 'green' because of political pressure from Germany. This results in many people challenging the need to disconnect from natural gas because Germany is moving towards natural gas, and the EU says it is green (Interviewee #12).

One of the things mentioned is the tax system. In the current tax system, a lot of money enters the treasury of the Netherlands from taxes on fossil fuels like natural gas. Taxes are an important source of funds to build and maintain the infrastructure for district heating networks (Interviewee #10).
Another mention of conditions is the subsidies. The idea is that it should only be possible to get subsidies for connecting to the district heating grid when the house is insulated sufficiently to connect to at least the medium-temperature district heating grid, not the high-temperature grid. This is because the heat energy that is not needed does not have to be supplied. Furthermore, housing associations and other landlords need to ensure that their houses have at least an energy label D or higher in 2030. This could be sharpened to a higher energy label, energy label B or higher in 2030 (Interviewee #12).
What stands out with different governance arrangements is that it is now highly fragmented between different municipalities, making it almost worth moving to another city because the heat transition arrangements are more favourable there. The condition here should be to make sure there is a national standard for the heat transition, with a priority for neighbourhoods with fewer means since there the residents usually cannot insulate their houses well, put solar panels on their roofs, or drive electric cars (Interviewee #11).
Next, a condition should be that the energy supply should be owned 51% by the local environment, as already presented in the Climate Agreement (Interviewee #11). The plans for the new Heat Act say that it should be 51% publicly owned, but it should be added that this should also be locally owned (Interviewee #11).

An example that many people might find more relatable is the earthquakes in Groningen, and the fact that natural gas winning has been stopped there (Interviewee #10).
It could be addressed that the disconnection of natural gas also has financial advantages in the long term, with reference to the energy crisis. Moreover, it could relieve stress because the homes will be made future-proof. However, what frame is most efficient is still context-dependent. An efficient frame in one neighbourhood might backfire in another neighbourhood and the other way around because the interests of residents differ per city and neighbourhood (Interviewee #11).
To not be dependent on geopolitical conflicts determining the price of heating anymore because it is produced nearby instead of somewhere far away, so fewer factors are influencing. (Interviewee #12).

The national government needs to decide on a more standardised approach for all municipalities instead of the current situation in which every municipality can choose its own way (Interviewee #11). Furthermore, the national government can take away much uncertainty by simply excluding specific options for heating existing buildings (Interviewee #12). For example, if the national government does not consider hydrogen an alternative, it could help to simply exclude it as an option. Next, the national government could set priorities for different classes of neighbourhoods or cities based on welfare. Another essential task for the national government is to provide the municipalities with the funds to make such transitions happen (Interviewee #11).
The European Union needs to take action to ensure consistent messaging. The European Union declared natural gas, a fossil fuel, as a green or sustainable energy source. To perform an efficient energy transition, this should be revised by naming natural gas a fossil fuel (Interviewee #12).

The choice can also be made to wait until more knowledge is gained, but the reaction of many interviewees was that more is learned by doing than by waiting until a way better option appears in a few years. (Interviewees #10, #11)

This can also be very neighbourhood-specific. It is also an option to wait for linkage opportunities to other renovations to reduce the inconvenience and save some money, as Bospolder-Tussendijken did with the sewer work. This should only be done when it fits very well in the planning; it should not be a reason to postpone the project for years (Interviewee #11).
However, it could be discussed whether it is best to start these living labs in underprivileged neighbourhoods (Interviewee #12).

Incorporating might be a good idea since moving all experts needed towards a new domain could be difficult. If this does not work out, it would create a new barrier, making decision-making and implementation harder (Interviewee #11).
Another reason is that if different aldermen of different political parties are responsible for the project, the process may be frustrated. This is because they both want to push their agenda, resulting in possibly no decisions. Creating a specific policy portfolio for the disconnection of natural gas with only one alderman could help the decision-making process (Interviewees #12, #13).
Furthermore, it might be a good idea to start from the beginning with a wide range of possible contributors to the project instead of just starting with the usual suspects, being the biggest organisations. This could open up possibilities of a more integral approach (Interviewee #11).

Finally, the alignment with a city or the neighbourhood. To make sure the residents of the neighbourhood support these kinds of transitions and maybe even will more actively participate in them, it can be helpful to involve them in three ways. First, in the policy-making process (Interviewee #10); secondly, by being as transparent as possible in the communication about the decision-making process (Interviewee #10); and finally, by providing more education about the energy transition to strengthen awareness about the reasons for the transition (Interviewee #12).

The idea of implementing the new Heat Act is considered a good idea by the experts interviewed (Interviewees #10, #11, #12)
For the municipality to take this leading role, implementing the Wgiw is required (Interviewee #10).
This could be solved by a more ambitious policy, by making a governance condition that houses should be insulated sufficiently to connect to at least the mid-temperature grid (Interviewees #10, #11).
This could be accelerated by sharpening the aim of all rental properties to have at least energy label D or higher in 2030 to energy label B or higher in 2030 instead (Interviewee #12).

It might be time to make these goals enforceable since the time for just talking is over. Therefore, it could be decided to implement a regulation that enforces a minimum number of houses per city or neighbourhood to be disconnected from natural gas before a specific date, with consequences when these numbers are not achieved (Interviewees #10, #11, #12).

Scientists have a critical view and are the players in the field that looks at situations without personal interests. This shapes the conditions to be able to look at the entire playing field in the Netherlands or even Europe and to look without being too context-dependent what universal learnings could be taken from this playing field while using a scientific method. With these learnings future processes and approaches can be structured (interviewee #11)

Scientists have a critical view and are the players investigating situations without personal interests. This shapes the conditions to investigate the entire playing field in the Netherlands or even Europe and look, without being too context-dependent, at what universal learnings could be taken from this playing field using a scientific method. With these learnings, future processes and approaches can be structured (Interviewee #11).
this might still be a challenge because many citizens distrust the science or say they found other scientists telling another story. Therefore, scientific information must be provided proactively before opinions are deeply embedded in misinformation. (Interviewee #12)

If the stakeholders split the costs of the independent supervisor, he or she should not have an interest (Interviewee #10).

In addition, it could be helpful to let residents living in other neighbourhoods or cities where the transition to district heating has already been completed speak about their experiences (Interviewee #8).

Furthermore, this could prevent residents of an underprivileged neighbourhood who often distrust the government from feeling used as guinea pigs of the energy transition (Interviewee #9).

Neighbourhood stakeholders, who should have a lawyer to ensure they are not misused in the negotiations (Interviewee #8).

Appendix H: Governance Arrangement

In Figures 15 and 16 the proposed governance arrangement including national and international context is presented.

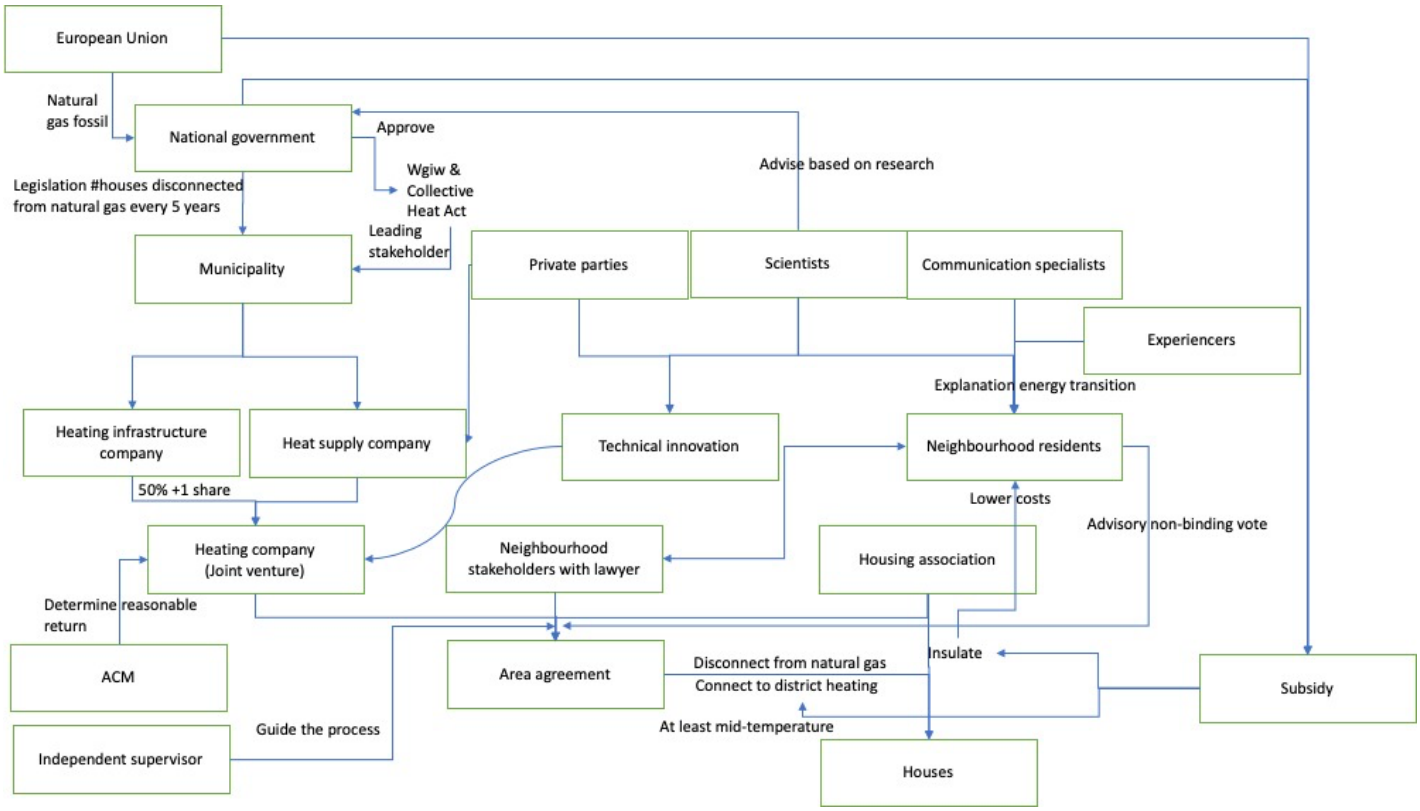

Figure 15: The collaboration of all different stakeholders and institutions including national and international context

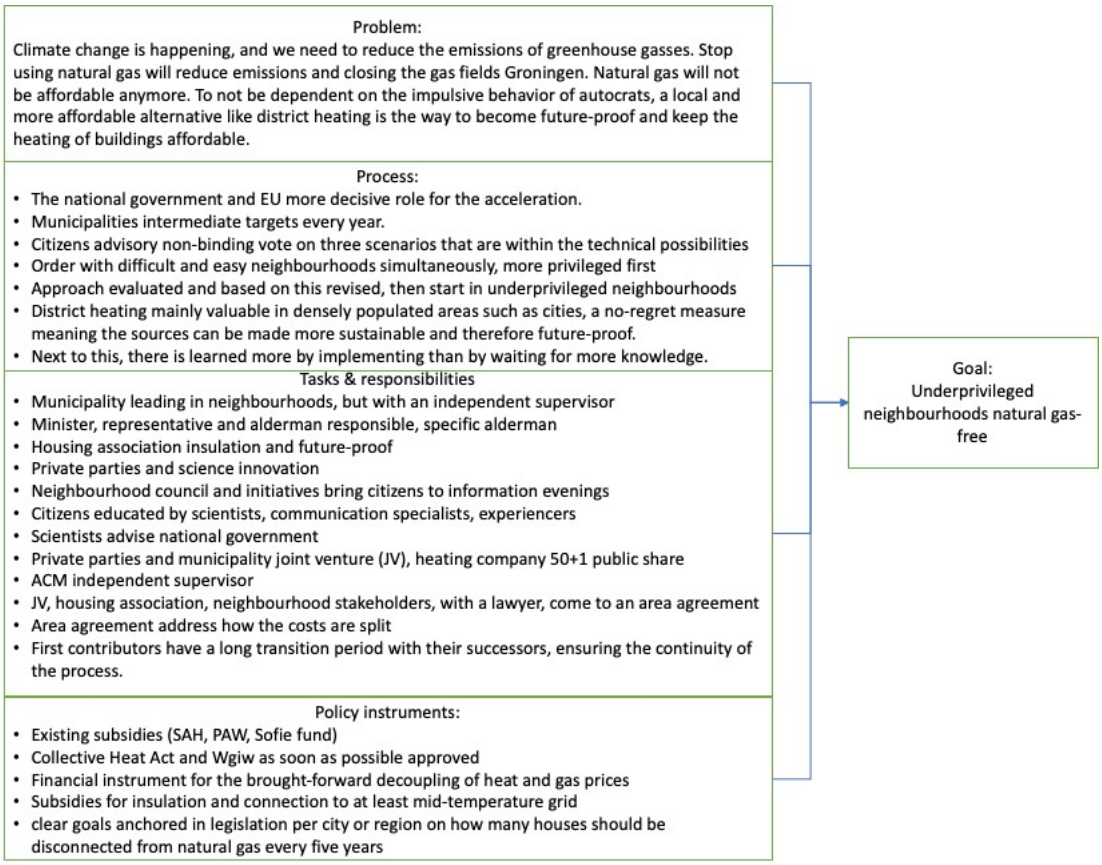

Figure 16: The proposed governance arrangement including national and international context