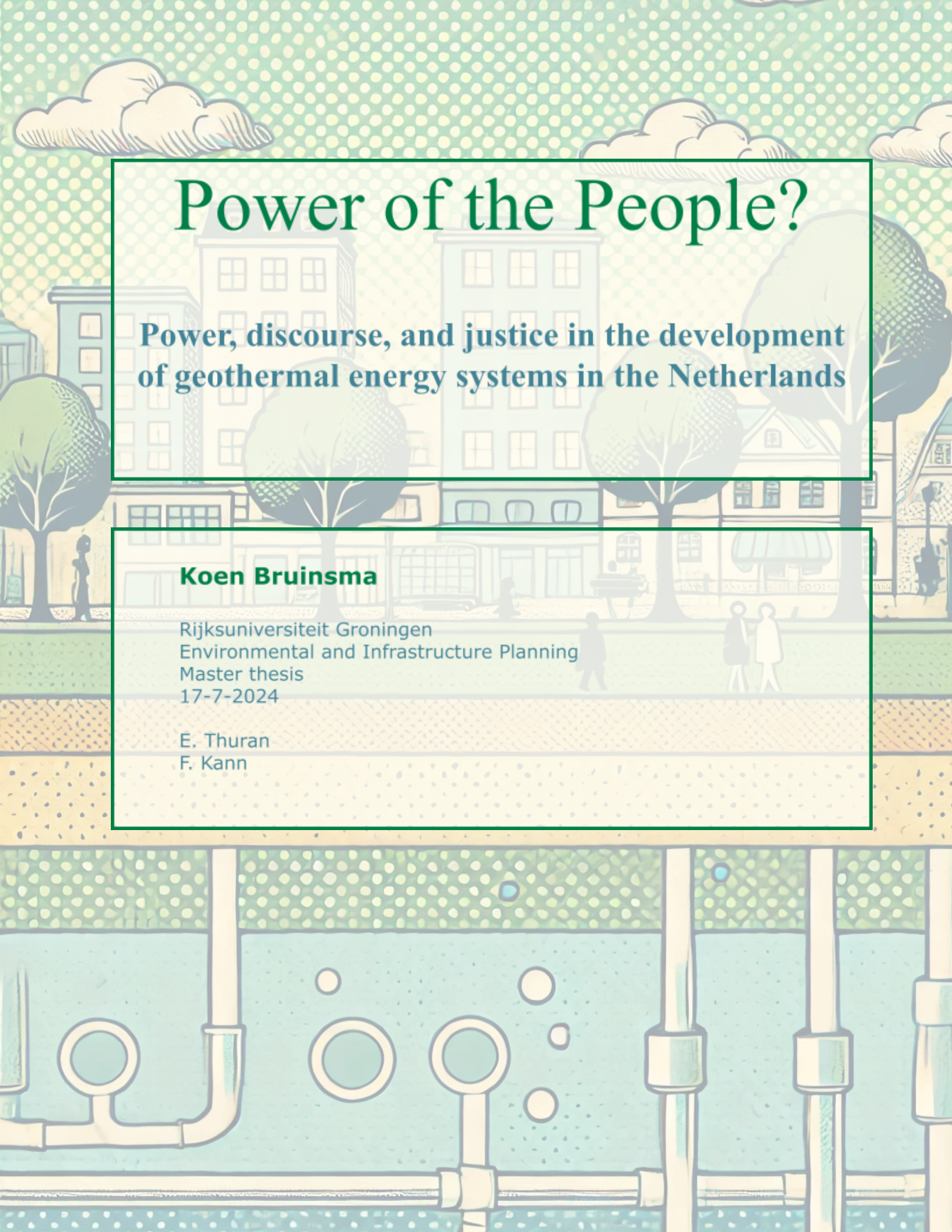


Power of the People?

Power, discourse, and justice in the development of geothermal energy systems in the Netherlands

Koen Bruinsma

Rijksuniversiteit Groningen
Environmental and Infrastructure Planning
Master thesis
17-7-2024

E. Thuran
F. Kann

Acknowledgement

I would like to extend my sincere gratitude to those who have supported me throughout the completion of this thesis.

I am particularly thankful to my supervisors, Dr. Ethemchan Turhan and Dr. Ferry Kann, for their guidance and insightful feedback. Their expertise has been invaluable in helping me develop this work.

I would also like to thank my friend, Niek Kerssies, for his constructive feedback, and my sister, Lieke Bruinsma, for her assistance in finalizing the thesis.

Lastly, I am grateful to my family and friends for their support throughout this process. Their encouragement has been essential to me in reaching this point.

Thank you all for your contributions.

1. Introduction

"The risk of possible earthquakes due to the geothermal heat project of the municipality of Groningen is systematically underestimated" (Braakman, 2017). This sentence killed the geothermal heating project WarmteStad in the Dutch city of Groningen. Although the success of any decarbonization strategy hinges not only on the formulation of robust policies but also on the nuanced understanding of how individuals perceive and engage with these initiatives. To further the transition towards a carbon neutral world, we must broaden our understanding from it being a technical challenge to a discussion involving many differing perceptions, ideas and discourses.

Within the realm of sustainable energy transitions, a noticeable gap in the existing literature concerns to the absence of comprehensive data on the discourse of stakeholders regarding geothermal energy systems in the Netherlands. Despite the increasing emphasis on renewable energy sources, particularly geothermal energy, as a crucial component in the decarbonization process, the perspectives, opinions, and discourses of stakeholders in the Dutch context remain largely unexplored. This literature gap is not merely an oversight; rather, it poses a substantial limitation in our understanding of the social, cultural, and political dynamics surrounding the implementation of geothermal energy systems in the Netherlands in particular and the world in general. Despite growing interest in the social sciences in the social acceptance of the energy transition little attention is being paid to energy justice (Spijkerboer et al., 2022).

To address this missing puzzle piece a nuanced examination of stakeholder discourse by employing a unique methodological approach is required. By integrating Q methodology, a research technique designed to capture subjective viewpoints, with a poststructuralist framework I aim to bridge this gap. This combination allows for a more profound exploration of the multifaceted dimensions inherent in stakeholder perspectives on geothermal energy systems. By applying this methodological synthesis to the case study of WarmteStad in Groningen and the wider Dutch geothermal energy sector, this thesis aims to not only fill the existing literature gap but also to unravel the intricate layers of meaning and power dynamics embedded within stakeholder discourse on geothermal energy. In doing so, it aspires to advance our comprehension of the challenges and opportunities

associated with the integration of geothermal energy systems into the sustainable energy landscape of the Netherlands

In this thesis I employ a study using Q methodology with 15 participants from different sectors involved in the policy making and implementation of geothermal energy systems in the Netherlands, in order to get a better insight in the narratives used surrounding geothermal energy systems and the visions of the future. To better understand the subjective experience of and promote the development of renewable heating sources. This thesis has a focus on the WarmteStad project as a case to gain more insight in the process of implementation of a geothermal energy project in the Netherlands in general.

The findings of this study reveal compelling evidence of distinct differences in the perceptions of individuals regarding key aspects of geothermal energy adoption in the Netherlands. Through the synthesis of Q methodology and a poststructuralist framework, the research aims to uncover nuanced insights into stakeholder perspectives on attitudes towards geothermal energy, the level of government involvement, and the feasibility of such energy systems within the Dutch context.

To get a better understanding of the discourse on geothermal energy systems in the Netherlands. The following main research question is answered:

- "How do stakeholders differently perceive and evaluate the development of geothermal energy systems in the Netherlands in the summer of 2022?"

The summer of 2022 is used as a time reference due to the fact that the data used in this research was collected during that time.

To answer the main research question the following sub questions are discussed:

- "How are discourse and power structures related in the context of the development of geothermal energy systems?"

- "How can Energy Justice be used to evaluate power relations in the context of the development of geothermal energy systems?"

- "How are imaginaries formed by the discourse related to the development of geothermal energy systems?"

The theoretical underpinning of this study draws from a confluence of poststructuralism, energy justice and spatial-imaginaries each contributing distinctive perspectives to elucidate the dynamics surrounding the implementation of geothermal energy systems, particularly within the Dutch context.

Poststructuralism provides a lens through which the opinions and perceptions gathered through the applied methodology can be conceptualized as integral components of "imaginaries." These imaginaries, understood as constructed realities, are not neutral or objective but are instead products of power relations, reflecting the influence of social, political, and economic forces. This theoretical framework allows for an exploration of how knowledge is produced, concepts are formulated, and power operates in shaping the narratives surrounding geothermal energy implementation.

Energy justice, on the other hand, serves as both an evaluative and normative framework to comprehend power relations in the context of geothermal energy studies. Within the realm of energy justice, the study encompasses three critical dimensions: recognition justice, distributional justice, and procedural justice. Recognition justice focuses on acknowledging diverse perspectives and voices in the decision-making process. Distributional justice concerns the equitable allocation of benefits and burdens associated with geothermal energy systems. Procedural justice emphasizes fair and inclusive decision-making processes.

The Dutch debate on geothermal energy systems, as a specific context of study, necessitates an in-depth examination of procedural justice and participation. This involves scrutinizing the mechanisms through which decisions are made, stakeholders are engaged, and the public is involved in the decision-making process. The thesis aims to contribute insights into how procedural justice is operationalized within the Dutch discourse on geothermal energy, shedding light on the nuances of the perception of participation and decision-making processes.

Furthermore, the study incorporates the concepts of spatial-technical imaginaries and sociotechnical imaginaries, employing them to analyze the case of WarmteStad. Spatial-technical imaginaries refer to the collective visions and perceptions of space and technology intertwined in the discourse on geothermal energy. Sociotechnical imaginaries encompass broader societal visions of the relationship between technology and society. By applying these concepts, the research seeks to unravel the intricate interplay of spatial and social dimensions in the perception, implementation, and discourse surrounding geothermal energy systems, with WarmteStad serving as a pertinent case study within this theoretical framework.

In conclusion, this master thesis addresses the complexities surrounding the discourse on geothermal energy adoption, particularly in the Netherlands. Through the synthesis of Q methodology and a poststructuralist framework, it aims to unravel stakeholder perspectives, governmental roles, and feasibility assessments regarding geothermal energy systems. By drawing from theoretical insights in poststructuralism, energy justice, and spatial-imaginaries, the study seeks to offer valuable insights for policy-making and stakeholder collaboration, ultimately contributing to informed decision-making for a more sustainable energy future. This is relevant for the master study in infrastructure and environmental planning as it explores integrating geothermal energy into existing systems, considering diverse stakeholder views, and the government's role in energy transitions. The focus on energy justice and spatial-imaginaries provides a comprehensive view of how energy infrastructure impacts social and spatial dynamics, informing more inclusive and effective environmental policies and projects.

2. Literature review

This chapter delves into the intricate relationship between climate change and geothermal energy, focusing on its relevance to sustainable energy strategies. The discussion begins with an exploration of climate change, identifying its causes and wide-ranging impacts. Section 2.1 addresses how human activities contribute to greenhouse gas emissions, leading to global warming and various environmental changes.

In Section 2.2, we examine the significant role heating plays in energy consumption and its contribution to greenhouse gas emissions in the Netherlands. This section highlights the potential of geothermal energy as a sustainable alternative to traditional heating methods, emphasizing its lower CO2 emissions and the Dutch government's commitment to reducing emissions.
Section 2.3 discusses the historical and current transitions in heat production, tracing the evolution from wood and peat to coal and natural gas, and now to renewable sources like geothermal energy. The section outlines the necessary steps and challenges in shifting towards a sustainable heating system.
Finally, Section 2.4 introduces transition theory, which frames the shift from a natural gas-based heating system to renewable energy sources. This section outlines the phases of transition and discusses the factors influencing the pace and success of adopting geothermal energy.

Overall, this chapter provides a comprehensive overview of the environmental context and technological transitions pertinent to the development and implementation of geothermal energy systems in the Netherlands.

2.1 Climate change

Climate change can be considered as the most defining dilemma of this century. Although its extent and impacts are still an area of debate, the cause of climate change is becoming more clear. Human activities, such as land clearing, agriculture and the burning of fossil fuels are increasing greenhouse gasses in our atmosphere (Healey, 2014). As a result, our atmosphere is heating up, causing a wide variety of effects on the climate, ranging from rising sea levels, ocean acidification, desertification, and unstable weather patterns (Hardy, 2003). Research on climate change has been growing since the nineteenth century, but picked up steam at the end of the previous century. Focus has shifted from natural causes such as volcanism to the effects of human activities (Dunlap et al., 2015). In the early days research on climate change was primarily performed by independent scientists and the World Meteorological Organization. However, these researches lacked the

needed resources to deal with the increasingly complex and interconnected nature of climate change research (Weart, 2008). This led to the creation of the International Panel on Climate Change by the United Nations in 1988, citing that "Certain human activities could change global climate patterns, threatening present and future generations with potentially severe economic and social consequences'' (United Nations, 1988). As a result, the amount of research on climate change increased drastically especially regarding the social aspects related to climate change. Including the concepts energy justice and imaginaries which are a focal point of this research.

2.2 The role of heating and geothermal energy in reducing CO2 emissions in the Netherlands

The use of energy is one of the most important factors contributing to the emission of greenhouse gasses in the Netherlands (Ministerie van Volksgezondheid, Welzijn en Sport, 2022). However, what is the most relevant factor for geothermal energy production is the fact that heating is the main source of energy usage in the Netherlands. According to EBN (2022) heating accounts for 41% of total energy consumption, almost double that of the runner-up, agriculture. To combat climate change the Dutch government has committed itself to reducing CO2 emissions by 49% relative to 1990 (Rijksoverheid, 2022). To achieve this goal, a wide range of measures and regulations are being implemented and developed. Among these measures is the development of geothermal energy sources. The average life-cycle CO2 emission of geothermal energy is less than 10% compared to natural gas, the greatest source of heat in the Netherlands (World Nuclear Association, 2021). It is estimated that a quarter of the heat consumption can be produced by geothermal energy by 2050, accounting for 15% of total CO2 emission reduction (EBN, 2018). This means that geothermal energy has the potential to considerably contribute to the fight against climate change. However, in 2018 geothermal energy production contributed just 0.3% of the total heat production in the Netherlands (EBN, 2018). Therefore, a transition in heat production is needed.

2.3 The transition towards renewable heat production

Transitioning towards a less impactful way of producing heat has become a clear goal of the various dutch levels of governance. Reducing CO2 emissions by 49% relative to 1999, and preventing global temperatures from rising more than 2 °C should significantly reduce the impacts of global warming according to the IPCC (2022). In order to achieve this goal, alternative sources of heating have to be found and developed. Producing heat has been part of the human experience since the invention of fire about 300.000 to 400.000 years ago (Scott, 2018). So for

hundreds of thousands of years wood was the main source of heat for people living in the Netherlands. But around the 13th century, the Dutch started to extract peat from bogs and mires to heat their homes (Gerding et al., 2015). Around 1850 the peat was completely exhausted, and so coal became the primary source of heat. However, in 1948 natural gas was discovered by the Nederlandse Aardolie Maatschappij, which quickly replaced coal, as it was cheaper and could be domestically produced (Boersema, 2022). This process was part of larger changes in infrastructural and institutional developments in the Netherlands (Riemersma et al., 2020). So since the 1960s the Dutch heating infrastructure has relied heavily on natural gas for heating in industry, agriculture and residential buildings. But with the advent of rising global temperatures, and the halt on natural gas extraction in Groningen, the transition toward cleaner and renewable heat sources took off at the end of the 2010s, including the development of geothermal energy systems (Devenish, 2022).

2.4 Transition theory

The transition from a natural gas based heating system to renewable energy sources is indicative of an ongoing paradigm change in Dutch energy systems and policy. According to Van Der Brugge et al. (2005) a transition takes place in four phases. The pre-development phase, the take-off phase, the acceleration phase and the stabilization phase. In the pre-development phase the status quo does not visibly change but under the surface changes are happening. In the take-off phase, the system begins to shift as thresholds for change are reached. During the acceleration phase, the system changes rapidly and is visible through mutually reinforcing changes in ecological, economical, social-cultural and institutional states. Finally, in the stabilization phase the system reaches a new equilibrium and the speed of change decreases. Although the take-off of the transition is hard to pin down, I argue that the 2009 EU Renewable Energy Directive gave the start signal for a transition towards a renewable heating system as this was the first piece of legislation in which specific renewable heating goals were enshrined (Rijksdienst voor Ondernemend Nederland, 2019). Around this time the first geothermal energy systems were being developed in the Netherlands. The first direct use doublet was installed in the Netherlands in 2008, since then 35 other doublets have been installed. Another 70 projects are currently being researched and developed (Geothermie Nederland, 2024). The sharp increase in new sustainable heating projects indicates that the transition is currently in the acceleration phase of the transition.
How fast this development will continue depends on a number of factors.

As with the development of any new kind of technology, uncertainty on the viability of geothermal systems and uncertainty regarding the eventual yield make it difficult

to predict how the future of geothermal energy in the Netherlands will look like. Institutional and social factors also play an important role. As we have seen in the WarmteStad case in Groningen, the development of geothermal systems is dependent on clear legislation, well functioning governmental bodies, and the will to invest in uncertain technologies (Lysias Consulting Group, 2018). Public acceptance of geothermal technologies also plays an important role in future development. For example, in Nieuwegein a geothermal project was canceled after citizens feared for a similar situation as in Groningen, hinting at the ongoing problems with damaged houses as a result of gas extraction induced earthquakes (Venderbosch, 2021). Therefore, it is important to understand how the future of geothermal is seen through the eyes of all the parties involved, from policy makers, to operators and citizens. The goal of this thesis is to get a better insight in the narratives used surrounding geothermal energy systems and the visions of the future. In order to better understand the subjective experience of and promote the development of renewable heating sources.

3. Theoretical background

The development of geothermal energy systems in the Netherlands in the case of this research and the wider world in general is driven by discussions happening at all levels of society. But these discussions are shaped by what is being discussed and by whom. In the next section, First I present a literature review on the necessity of understanding the role of power in language formation and use in general, by explaining the poststructuralist approach to knowledge production. In the second part, I examine the approaches of energy justice and spatial imaginaries from the poststructuralist perspective on power, language, and knowledge production to highlight the importance of understanding the role of power and discourse in the formation of narratives regarding the future of geothermal energy systems.

3.1.1 What is poststructuralism?

Poststructuralism was primarily developed by French philosophers in the ‘60 and ‘70 of the previous century. Its main advocates include prominent names such as Deleuze, Foucault, Kristeva, and Lyotard, who developed unorthodox and critical perspectives on concepts such as power, truth, discourse, and knowledge production (Holmes & Gagnon, 2017). Discourse is understood as socially created ideas organizing how phenomena are spoken about and understood, as well as what counts as knowledge (Sharp, 2009). As the name suggests, poststructuralism differentiates itself from structuralism. As the philosopher Simon Blackburn summarized, structuralism is “The belief that phenomena of human life are not intelligible except through their interrelations. These relations constitute a structure, and behind local variations in the surface phenomena, there are constant laws of abstract structure. (Blackburn, 2008, p. 353). Post-structuralism instead is associated with a variety of views on the relationship between knowledge, power, and language, centered around the common view that knowledge is always fragmented, contextual, and subjective.

The poststructuralist critique was aimed at the reliance on objective truth in social research and a desire for a traditional scientific understanding of language (Adgar, 2018). Instead of understanding language and social practices as transparent representations of objects or concepts, poststructuralism seeks to study how particular social practices work concerning power and the ways of thinking that such practices produce or support. This means that all observations and theoretical systems are part of the world they try to describe or account for, and have an effect on that world. Thus, there is no neutral observation or description of social practices as both the interpretation of the observer and the language used by the observer to describe the phenomenon is shaped by cultural and historical attitudes, assumptions and values that precede and exceed the observer (Woodward et al.,

2009). In this thesis, poststructural perspectives on language, power, and knowledge production allow me to study how the discourse on the future of geothermal energy systems in Groningen is shaped by knowledge production. It asks questions on who and in what way shape discourse in the discussion on the future of geothermal energy systems.

3.1.2 How does power shape meaning?

Prominent poststructural philosopher Foucault characterizes the relationship between power and knowledge as an interconnected relationship. To start, knowledge production is the human interpretation of information processed by the observer. However, Foucault states that the process of producing knowledge from information is not a neutral process. Knowledge and power are not independent and separated. Knowledge production as a process of understanding the world around us is indispensable for the operation of power. Foucault states that on the one hand, power creates knowledge and accumulates information (Townley, 1993). For example, the proliferation of the scientific method in governmental policy regarding geothermal energy. The procedures and the institutions that produce them are part of the assumptions they produce, these assumptions are reinforced through the language used by these institutions (Knights & Willmott, 1985). On the other hand, Derrida argues that in most societies claims of knowledge and truth are a means to establish status, control, and authority over others (Fox, 2014). Fox (2014) gives the example of cultures in which religious principles are guiding. In these societies the authority of rulers may be related to their knowledge of the holy scriptures, or the divine right to rule. But this can be applied to secular societies as well. Where laws and norms can support the claims of the ruling elite to determine what constitutes right and wrong. Science makes similar claims about holding access to the truth through experimentation and observation (Fox, 2014). All these different types of claims of knowledge influence systems of thinking, resource allocation, and the treatment of the object of study, and thus have consequences for access to information, power, resources, and relationships between people.

The relationship between power, knowledge, and language also has consequences for identity and subjectivity. In an effort to deal with the limitations of language in describing reality. Language users attempt to define concepts not through what they are, but through comparison, hierarchization, and differentiation (Holmes & Gagnon, 2017). Concepts are compared to what differentiates them from other concepts. The concepts can be specified through their binary oppositions such as male/female, good/evil, sane/insane, healthy/sick (Mason & Clarke, 2010). People value one above the other. In medicine health is valued greater than sickness, in secular societies, reason may be valued greater than divinity. In each case empowering one of the poles, obscures rivaling voices of the other pole and their

claims to knowledge or alternative readings of concepts. Language has a direct influence on the overall organization of life and society, as it significantly influences the construction of our own identity and what constitutes the identities of others, and, of interest to this thesis, how people identify with places. Constructing concepts like criminality, citizenship, and group identity through language structures our society and personal identity (Mason & Clarke, 2010). For example, some post-structural theorists have criticized systems of thought which are underpinned by patriarchal biases, like psychoanalysis. And have offered alternative feminist readings of social practices which might overcome the oppression of women (Lyotard, 2007). Thus language is not understood as a representation of reality but as a place for political conflict that offers different conceptualizations of personal identity and social practices through contradictory discourses.

A post-structuralist approach to language allows us to ask questions about the role of power in the discourse on the future of geothermal energy in Groningen. This perspective is also useful for other research in sustainability studies, as it enables a critical examination of how language shapes and influences power dynamics within environmental narratives and policies. As mentioned before, power and language are inextricably linked. In my opinion, the role of power in the forming of discourse can be shown by a series of questions. The first two questions relate to knowledge itself. What constitutes as admissible knowledge in a debate? And who has access to this knowledge? The second set of questions is related to the activity of debating the future of geothermal energy. How is the content of the discussion determined? And who can participate in these discussions?
The relation between power and knowledge lies on the one hand in the conscious decision to physically control access to sources of information, like databases, scientific reports, and media coverage, which in turn are given meaning by both the individual interpreting the information, and by the community through discourse on the information. But on the other hand, control of information also lies in who is allowed to take part in the debate, the form, and content of the information, and the very concept of what counts as information (Hall, 1981). Thus power in knowledge production in this conceptualization can be understood as control of participation and content. Control over information implies that this power over access to information is not equally shared amongst all members of the community. It creates advantages and disadvantages for particular individuals or groups. When a certain individual or group holds significant power over access to information, this entity also has the power to decide what knowledge is and can be used to make sense of reality (Pettigrew, 1972). In our daily lives important entities with significant power over access to information and thus wielding a degree of power, are mass media, and nowadays more than ever, social media corporations. However, we can also consider our democratic institutions as having control over information and participation. Since it is the rules of our democratic system that

determine who, where, when, on what topic, and in what form can participate in the public debate. Thus the power and knowledge in this conceptualization are related to control over what constitutes as knowledge, who has access to knowledge, what is discussed, and who can participate in the creation of meaning.

3.2 Energy Justice

In this second part of the theoretical framework, I discuss the concepts of Energy Justice and Spatial Imaginaries from a poststructural perspective. Energy justice has emerged as a research agenda to apply the concept of justice to the material, institutional, economic and social aspects of energy (Kraal, 2018). In the face of the global 'energy transition' towards more renewable and greener energy, scholars are moving towards a human-centered exploration of energy developments (Jenkins et al., 2016). The first question to ask is why would we need to link the concept of justice to energy? When we take a closer look at the energy transition, it becomes clear that the questions that need to be answered hinge on ethical dilemmas (Sovacool & Dworkin, 2014). It revolves around issues like energy security, the diffusion of pollution, the economic costs and benefits of the transition, and how to govern such a transition. All these dilemmas involve aspects of equity and morality for which there are no easy answers. We need a framework for approaching such moral dilemmas because the decisions we make today will have a significant influence on the choices of the next generations. According to Sovacool and Dworkin (2015), the concept of energy justice goes beyond the philosophical debate on what constitutes justice and has real-world implications for people and the environment. First of all, energy justice has material and immaterial impacts on communities and energy corporations. For example, the debate on whether a new nuclear energy plant will be built or if there is a continuation of coal mining will affect not only the physical but also the emotional reaction of local citizens. An example of this is the ongoing protests against the extraction of coal from an opencast mine in the German state of North Rhine-Westphalia, where protestors chained themselves to equipment fearing the destruction of nearby villages and the rising global temperatures (Deutsche Welle, 2021). In other words, changes and challenges in energy activities will impact our economies, environment, and lifestyles. It is essential for communities, policymakers, and scholars to work together to ensure that the development of geothermal energy systems leads to fair and equitable outcomes.

Using energy justice as an approach offers several benefits for the study of power in relation to energy. It is evaluative and normative (Jenkins et al., 2017). On the one hand, it offers an evaluative framework to study how energy systems perform in terms of moving towards a more sustainable and equitable future of energy systems both in the material and immaterial sense (Heffron, 2021). By applying

human rights across the energy life cycle, we can use the concept to explore where injustices occur, who is treated unjustly, and where in the process these injustices occur. On the other hand, Energy Justice offers a normative framework for the application of human rights to the energy cycle. Similar to the evaluative contribution of energy justice, the normative perspective asks three questions. First, how do we solve the injustices which occur in the energy cycle? Secondly, how do we recognize which sections of the population experience injustice? And finally, how do we design processes to prevent injustices? (Sovacool and Dworkin, 2015). Analyzing the energy transition and the development of geothermal energy systems both evaluative and normative presents an opportunity to develop interdisciplinary approaches for the creation of a new process to avoid injustices from occurring, recognize injustice, and remediate where injustices have occurred (Jenkins et al., 2016).

Energy justice is conceptualized in academic literature as consisting of three tenets namely: recognition justice, distributive justice, and procedural justice (Hanke et al., 2021; Jenkins et al., 2016; Sovacool and Dworkin, 2015) In this section, I briefly explain the different forms of energy justice.

3.2.1 Recognition Justice

Recognition justice refers to the recognition of the rights of different communities. Recognition justice is the concept least covered in the academic literature of the three. For example, Todd and Zografos (2005) and Heffron (2021) both mention recognition justice as an integral part of energy justice but both fail to further elaborate on what recognition justice in concrete terms means for the evaluation of energy justice. Recognition justice is linked to distributive and procedural justice as an overarching concept of Energy Justice (Hurlbert and Rayer, 2018). Recognition justice is not the same as participation, as understood in procedural justice, instead, it refers to the process of recognizing that peoples and identities of places are not always valued the same compared to others (McCauley et al., 2013; Walker, 2009). Lack of recognition can occur as a result of dominating cultural, political, and linguistic systems which devalue or misrepresent certain groups in society (Schlosberg, 2003). Thus recognition justice advocates acknowledging various perspectives grounded in ethnic, cultural, social, and gender differences. Although recognition justice is seen by some as separate from distributive and procedural justice, I argue that recognizing energy justice starts with acknowledging that different groups are not valued equally compared to others.

An application of recognition justice is related to the recognition of specific needs of particular social groups in the UK’s policy on fuel poverty. Groups such as the elderly or the sickly rely on higher than average room temperatures (Walker & Day,

2012). For a long time, these groups were stereotyped as "energy poor" and their "inefficient" use of financial and energy resources. Government programs focused on providing information as well as financial incentives to improve their energy efficiency. But there were virtually no attempts to uncover the reasons behind the consumption patterns, or how they experience energy issues (Catney et al., 2013).

3.2.2 Distributive justice

Distributive justice revolves around the distribution of what the father of social justice philosophy, John Rawls, describes as primary goods. Primary goods refer to rights, liberties, powers, opportunities, and material goods (Sovacool and Dworkin, 2015). Distributional justice as a spatial concept includes both the physical unequal placement of energy systems and the immaterial benefits and ills resulting from these energy systems. As Owens (2008) comments on the spatiality of energy systems "questions about the desirability of technologies in principle become entangled with issues that relate to specific localities". For example, a coal fired power plant might bring monetary and living standard benefits to a state, but it also produces local and global pollution. A just society is supposed to distribute these materials, and immaterial goods, like food and pollution, in a just manner. This means that decision-makers should strive to implement fair policies to achieve justice in the world. Decision-makers should weigh the costs and benefits impartially and objectively to maintain or restore a balanced society.

3.2.3 Procedural justice

Procedural justice is concerned with the decision-making process concerning the form of the decision-making process. Common concepts associated with procedural justice are participation and legitimacy (Todd and Zografos, 2005). Walker (2012), presents four key elements of procedural justice: access to information; access to purposeful participation; impartiality of decision-makers; and access to legal processes. In essence procedural justice boils down to the procedures and processes which govern the distribution of material and immaterial costs and benefits of energy systems.

Procedural justice is of particular importance for this thesis because it deals with the questions which arise from the poststructural approach to the discourse on the future of geothermal energy systems.

"What constitutes as admissible knowledge in a debate? Who has access to this knowledge? How is the content of the discussion determined? Who can participate in these discussions?"

Introducing the poststructural concepts of power and knowledge production in energy justices is strongly related to procedural justice. The question "What constitutes as admissible knowledge" is related to the calls from procedural justice to take thoughts, feelings, arguments and decisions seriously from all parties and perspectives in a non-discriminatory way (Walker, 2009). The process surrounding the debate on geothermal energy should be constructed to allow for a wide variety of arguments to be brought forward. Unfortunately, there is a lack of understanding regarding the role of non-academic or scientific arguments in the debate on geothermal energy systems. Therefore, it is hard to argue the level of openness as to what is considered admissible knowledge in the debate on geothermal energy systems in the Netherlands.

Who has access to this knowledge is a question with two sides. On the one hand, the Dutch government and semi-governmental bodies are legally required to actively and passively give access to a wide range of documents (KIA, 2021). On the other hand, the level of understanding regarding the procedures to access the information, and subsequently interpret this information is not equal in society (Hurlbert and Rayer, 2018). This means that some groups and individuals lack power in this sense. How the content of the discussion on geothermal energy systems is determined is largely influenced by where the discussion takes place (Palmgreen & Clarke, 1977). At the national level, the manner in which the future of geothermal energy systems is being discussed often differs from how it is being discussed at lower levels. The discussion at the national level is dominated by the national government, governmental institutions, provinces, and businesses through national policies and strategic vision documents like the National Environmental Vision (Geothermie Nederland, 2020), and international treaties such as the Paris Climate Agreement (Kuiken & Slobben, 2021). While the importance of including citizens in the process is both important and preferred, there is still a lack of experience regarding the active involvement of citizens in the discussions in the Netherlands (Kuiken & Slobben, 2021). Thus I argue that the ability to determine the content of the discussion is lacking for citizens resulting in unequal power distribution.

Procedural justice calls for fair procedures that engage all parties in a non-discriminatory way, and take their thoughts, arguments, and decisions seriously. It assesses whether the form of engagement found in the policy-making process surrounding geothermal energy in Groningen, is just, and where room for improvement is. But it also requires impartial and full disclosure of information by industry and the government, for example how subsidies for geothermal energy are being spent. Thus procedures and processes have a significant influence on the discussion regarding the future of geothermal energy systems in Groningen and the Netherlands.

To conclude Energy Justice provides a three-pronged framework to assess the fairness of not only energy policy but of energy systems in their entirety. By taking a poststructural approach to Energy Justice, we can improve our understanding of the role of power and knowledge production in energy systems. In this context Energy Justice is concerned with the social responsibility of the government, the public and the private sector. The choices made and the language used by the stakeholders have a significant impact on both the development of geothermal energy systems and the social justice of the energy transition.

3.3 Imaginaries

This chapter explores the relationship between spatial imaginaries and socio-technical imaginaries in the context of energy transitions, particularly focusing on geothermal energy systems in Groningen. Spatial imaginaries are collective narratives that shape our understanding of places and spaces, influencing technical practices and socio-spatial dynamics. Despite their importance, the role of space in energy system transformations is often overlooked in academic research.

The transition to sustainable energy involves more than just technological change; it also reshapes social and spatial practices, identities, and relationships. Space is not neutral; it is shaped by power relations and social dynamics, and in turn, it influences how we perceive and implement energy systems. By examining how spatial and socio-technical imaginaries are co-produced, this chapter highlights the power dynamics involved in shaping these narratives and their impact on energy transitions and justice.

Ultimately, the chapter underscores the need to consider both the material and imagined aspects of space in understanding and guiding the development of sustainable energy systems.

3.3.1 Spatial-imaginaries

In this section, I examine the concepts of spatial imaginaries and the co-evolving relationship with socio-technical imaginaries. Spatial imaginaries are collectively held stories, which represent places and spaces and are saturated with tacit understandings of the spatialized world, these collectively held stories shape technical practices. Current academic research lacks an apparent inclusion of space in the study of the transformation of the energy system. Many contributors in the field of energy systems and science and technology studies argue that space is relevant, but have failed to acknowledge the mutually constitutive relationship between energy, space, and society (Chateau et al., 2021; Graham & Rudolph,

2014) While the transition toward a more sustainable energy system does require technological conversion, it also drives spatial and social changes, changing socio-spatial practices, identities, and relations (Calvert, 2015). It has long been claimed by neo-Marxist scholars that space and place, in the geographical sense, are not neutral. Similar to the poststructural interpretation of language. It is the outcome of power and social relations which are situated in time and space and are constantly reshaped by culture and social dynamics (Soja, 2010). Space is both real and imagined, it is dependent on our contextualization and interpretations. This requires us to understand transitions in energy systems as the socio-spatial processes which change and are changed by socio-spatial patterns both real as well as imagined. A socio-technical approach to energy systems involves the recognition that changing energy systems, like the development of geothermal energy systems, is more than the production, transformation, transportation, and consumption of energy (Bridge, 2018). Conceptualizing energy systems as socio-spatial systems and socio-technical systems provide useful information on the creation and advancement of energy transitions. Of particular interest in this thesis is the relation between spatial imaginaries and the role of power and knowledge production.

In line with the poststructuralist notion of the performative nature of language, some spatial scientists have explained spatial imaginaries as performative discourses on spaces and places.
"Spatial imaginaries are stories and ways of talking about places and spaces that transcend language as embodied performances by people in the material world." (Watkins, 2015, p. 509). Geographers create spatial imaginaries through notions such as "globalization", "urbanization" "scales" or "gentrification". They are a result of the collective conscious and unconscious understanding of the relationship between space and the social world. Spatial imaginaries shape the material world through their linguistic use and symbolization (Gregory, 2004). This agency stems from the spatial imaginaries creating and transforming people's perceptions of places and spaces, not individually but as shared collective ideas. For example, the framing of the Dutch provinces of Groningen, Fryslân, Drenthe, and northern Noord-Holland as the Energy Valley of the Netherlands, shapes the collectively held ideas about the use of space, and the identity of these places (New Energy Coalition, 2022). So although many people have not visited these places, their idea of what these places are like are constructed through such framings. As a spatial imaginary Groningen is circulated through text, images and language, and tells a story of Groningen's role as supplier of energy to the Netherlands, symbolized by its gas extraction infrastructure. Such an imaginary materializes when people act in relation to this story.

Spatial imaginaries often involve a process of othering, i.e. they construct an identity based on characteristics of people and the place which sets them apart from other peoples and places (Sharp, 2009). These "otherings" can present hierarchical categorizations, presenting one perspective on places or spaces as the correct interpretation while other perspectives are denoted as unequal (Gregory, 2004). Often othering of places works by using distance to generate perspectives of difference. A common saying heard in Groningen is that the Hague, where the national government resides, is too far away to care about the distant province of Groningen (de Vries, 2021). A difference is being made between the metropolitan area of the Hague, and the rural province of Groningen. Where in some perspectives Groningen is seen as a 'wingewest' or an economically exploited region in service of the industrialized west of the Netherlands (Stam, 2018). Demarcating what is considered as the spatial imaginary of Groningen. And articulating competing interpretations of socio-economic relations within the Netherlands.

3.3.2 Socio-technical imaginaries

Energy researchers have long been aware of the role collective visions of the future play in guiding socio-technical changes in society. These visions of technology and society are termed socio-technical imaginaries (Trencher & van der Heijden, 2019). The study of socio-technical imaginaries links to the intertwining of culture and technology and specifically the role of narratives and discourse in the future of energy systems (Chateau et al., 2021). Socio-technical imaginaries as a concept are useful for capturing how socio-technical systems, like energy systems, reflect wider socio-cultural normative and collective representations of what a desirable society should look like. Different imaginaries can exist at the same time, they are drivers of competition in a contested arena.

To understand how socio-technical imaginaries are becoming collectively shared in a society, researchers have combined socio-technical imaginaries with spatial concepts. Increasingly academic research has focused on the importance of different scales in the study of socio-technical imaginaries (Chateau et al., 2021; Tidwell & Tidwell, 2018). Socio-technical imaginaries are articulated by actors working in networks at different scales and in different times, this shows that places matter in the uptake of national socio-technical imaginaries by region and local actors and vice versa. To take the idea of the Energy Vally as an example, this may be very differently interpreted in different contexts. Local citizens, regional policymakers, national industrial managers or international environmental groups, all draw on their own experiences of space, history, culture and visions of the future to create a different imaginary which might be in conflict with one another (Levenda et al., 2019; Schelhas et al., 2018).

Although these socio-technical imaginaries are not focused on spatiality perse, they still imply that space, both material and imagined, influences the framing and uptake of socio-technical imaginaries, as well as the influence of socio-technical imaginaries on the production of spatial imaginaries. It is a two way relationship. Highlighting the importance of understanding spatial imaginaries and socio-technical imaginaries in the development of geothermal energy systems in Groningen.

3.3.3 Coproduction of spatial imaginaries and socio-technical imaginaries

Because spatial imaginaries are produced by different groups, these groups debate, diversify and contest the concepts, experiences and perspectives of place and space (Davoudi et al., 2018). Similar to socio-technical imaginaries they are built on stories from the past to create a vision of what the future should look like. From the very local to the global, spatial imaginaries contribute to identity-building through the process of othering, creating and differentiating between social groups and articulating anxieties and desires (Chateau et al., 2021; Davoudi et al., 2018; Watkins, 2015). Through this preformative nature, spatial imaginaries are a medium through which socio-spatial relations and practices are produced and changed. This builds on an poststructural ontology in which the material and the symbolic, discourse and practice are not separated but are seen as co-constituted (Chateau et al., 2021).

Taking a poststructural approach to spatial imaginaries and socio-technical imaginaries is a useful way of addressing the co-production between spatial- and socio-technical imaginaries. Certain spatial imaginaries inspire collectives in the production of socio-technical imaginaries. Socio-technical imaginaries convey and contribute to the production of certain spatial imaginaries, in a mutual relationship (Jasanoff & Kim, 2015). They are not the same but contribute and shape each other, see figure X. Jasanoff and Kim (2015) recognize that the social and the spatial are co-produced through the spread of ideas and practices, over time and space. Similarly, existing spatial imaginaries can also shape the development and spread of technologies. Framing Groningen as part of the Energy Vally, reinforces the development of energy infrastructure in Groningen, similarly, the large-scale gas extraction infrastructure reinforces the idea of Groningen as an energy extraction area. Ideas about place and space are essential in the legitimation and framing of socio-technical projects (Chateau et al., 2021) such as the development of geothermal energy systems in Groningen.

Ideas about justice are also featured in spatial imaginaries. Particularly when one is looking at the normative framing of particular socio-technical imaginaries. Although this is more abstract, looking less at the spatiality of socio-technical imaginaries, we can benefit from an extra lens to understand the specific framings of distributive and procedural justice. When we look at geothermal energy systems, we can imagine different ways in which the future is envisioned, e.g. who has the authority to decide on the development of geothermal energy systems, or who is to pay and benefit from this system. These are questions to be answered when imagining the future of geothermal energy systems in Groningen.

3.4 Power and the formation of imaginaries

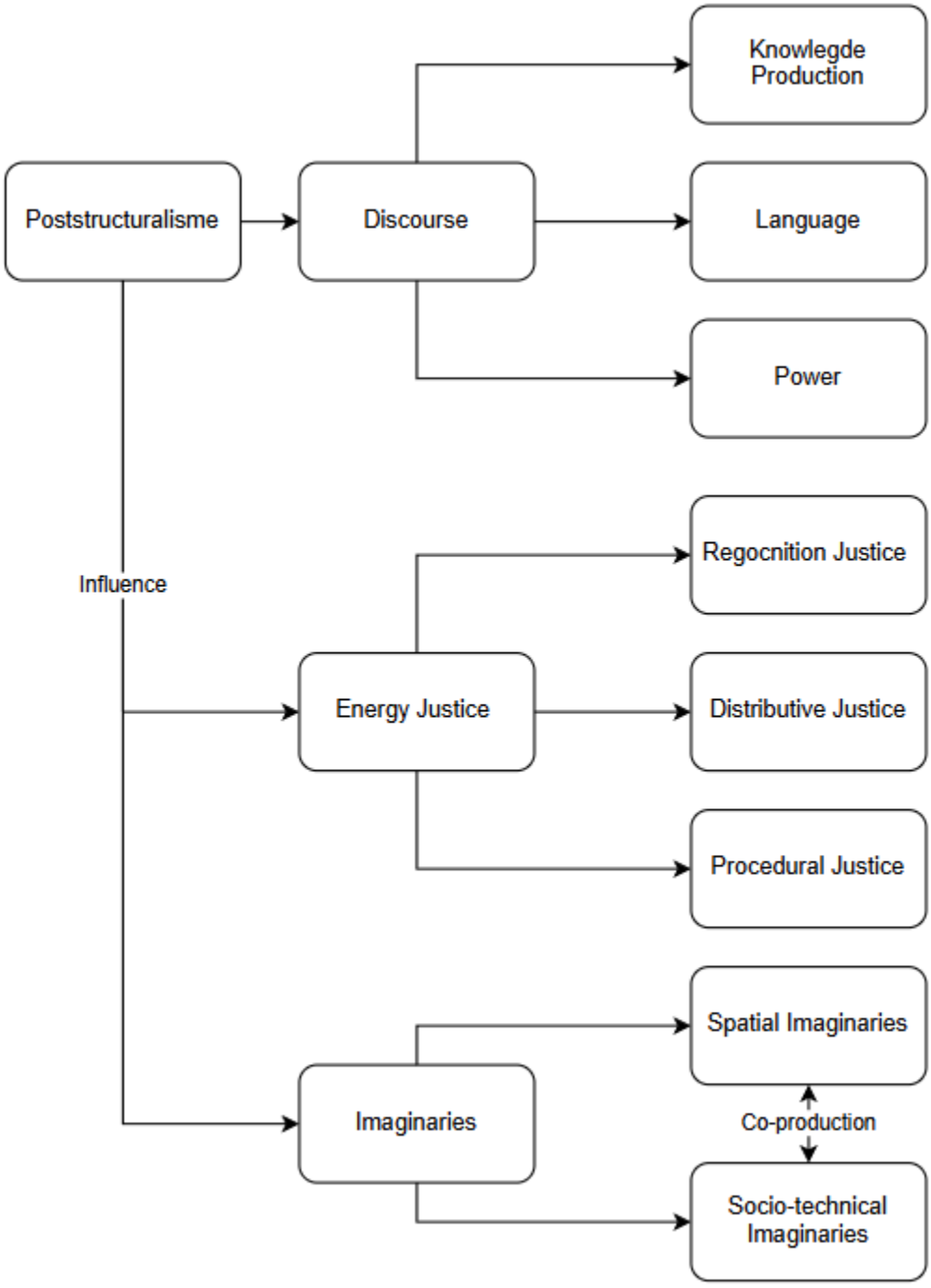
What is of interest to this thesis is the role of power and knowledge production in the shaping of socio-spatial and socio-technical imaginaries. Jasanoff and Kim (2015) in their extensive work on imaginaries have touched upon this topic to a certain extent. Best exemplified by the question: who is constructing the discourse involved in these imaginaries? This thesis is building on this question by examining the role of power and knowledge production in spatial imaginaries. Linking this to the role of power and knowledge production regarding procedural justice. Some overlap might be found between the shaping of imaginaries and the power to determine who is included in the discussion, what counts as information, where the debate on future visions takes place, and who decides on material and social policy. The goal of this thesis is thus to gain better insight into the role of power and knowledge production in the shaping of imaginaries and energy justice.

Power in the shaping of spatial imaginaries and socio-technical systems is first of all found in the power relations imbued in spatial imaginaries. Spatial imaginaries are a product of historic social, political, technical and geographic attitudes, values and perspectives. They are fraught with power relations. The presentation of Groningen as part of the Energy Vally is presented and adopted as unproblematic representations of spaces of the past, the present and the future. However, their role in power clashes is obscured by the process of depoliticisation of space. Dominant spatial imaginaries are naturalized to represent the ‘true’ reality (Davoudi et al., 2018). But as stated before, imaginaries are inherently an area of contest and conflict between various collectives. Power here is associated with the ability to depoliticize spatial imaginaries through studies describing places’s characteristics, identities, and beneficiaries (Watkins, 2015). Presenting Groningen as a ‘wingewest’ carries weight as it implies a range of power relations between different places and groups.

Secondly, power is exerted through imaginaries as they serve as justifications for material action (Davoudi et al., 2018). A great example of this is how Kothari and Wilkinson's (2010) analyze the spatial imaginaries of the British in justifying the colonization of islands in the Indian Ocean. They show, through texts, maps, and interviews that the islands are presented as uninhabited islands open for colonization and exploitation. Justifying the colonization of the islands, a very real material consequence of spatial imaginaries. Similarly, framing Groningen as part of the Energy Vally, can be used as a justification for the development of geothermal energy systems in Groningen. Spatial imaginaries are both a place for power struggles between different views, as well as a tool for power exertion.

In conclusion, this chapter has explored the interconnectedness of spatial and socio-technical imaginaries, emphasizing their mutual influence on the development of energy systems. By examining spatial imaginaries, we gain insight into the collective narratives that shape our understanding of space, which in turn influence technical practices and energy transitions. The chapter highlights the current gap in academic research concerning the role of space in energy system transformations and argues for a more integrated approach that recognizes the co-evolution of spatial and socio-technical imaginaries. Understanding this relationship is crucial for ensuring that the development of energy systems, such as geothermal energy in Groningen, is not only technologically sound but also socially and spatially equitable. By addressing the performative nature of these imaginaries and their role in power dynamics, the chapter sets the stage for a deeper examination of how power and knowledge production shape both spatial and socio-technical imaginaries, ultimately influencing energy justice outcomes.

3.5 Conceptual model



4. Methodology

This chapter outlines the methodological framework employed to explore stakeholder perceptions and evaluations of geothermal energy system development in the Netherlands as of summer 2022. To address the central research question "How do stakeholders differently perceive and evaluate the development of geothermal energy systems?" I employed Q methodology. This innovative approach facilitates a nuanced understanding of subjective viewpoints by systematically analyzing how individuals sort and prioritize statements related to the development of geothermal energy.

Q methodology, with its combination of qualitative and quantitative techniques, allows us to capture the complex, multi-faceted perspectives of diverse stakeholders, ranging from policymakers and industry experts to community members. By employing this method, I aim to uncover distinct viewpoints and evaluate the extent of consensus or divergence in opinions about the opportunities and challenges associated with geothermal energy.

4.1 What is Q methodology?

Q methodology is a mixed-method approach for the scientific study of subjectivity, in a structured form (Cotton and Mahroos-Alsaiari, 2014; Addams and Proops, 2001). According to Robbins and Krueger (2000), subjectivity is an individual's point of view of a real or imagined specific situation, which can be observed as an expression of someone’s behavior. Therefore, subjectivity can be systematically modeled by Q methodology. Q methodology allows researchers to holistically analyze traits of a single person rather than matching traits between individuals as is the aim of R methodologies (Cuppen et al., 2010). In doing so Q methodology aims to uncover shared perspectives of situations without a priory defining categories by the researcher, it preserves the integrity of the participant by letting participants model her/his own subjectivity. Thus, as opposed to R methodology, Q methodology intends to capture a picture of the perspective which exists in the population rather than ascribing the part of the population who adheres to a certain perspective (Curry, Barry, and McClenaghan, 2013). Furthermore, Q methodology is useful to measure the levels of agreement in and between different groups (Robbins and Krueger, 2000). This methodology has been used successfully in a variety of geographic fields, such as public participation (Krueger, Tuler and Webler, 2001), nature conservation (Zabala, Sandbrook and Mukherjee, 2018), energy systems (Cuppen et al., 2010), water management (Raadgever, Mostert and van de Giesen, 2008), urban development (Duenckmann, 2010), forest management (Steelman and Maguire, 1999) and sustainability discourse (Barry and Proops, 1999).

4.2 Why use Q methodology in this thesis?

Using Q methodology is appropriate in this thesis. First of all, Q methodology is useful in uncovering what spatial imaginaries are 'out there' among the various stakeholders involved in geothermal energy in the province of Groningen. There is a lack of knowledge with regards to what spatial imaginaries exist among the stakeholders, Q methodology allows for the uncovering of the different perspectives regarding the future of geothermal energy in the province of Groningen. For example, Gannon *et al.* (2022) use the Q methodology to explore different imaginaries regarding the future development of corridors in East Africa. And Russell (2017) applies Q methodology to study residents' perception of solar energy projects and land use imaginaries in Southern Colorado. Secondly, Q methodology is appropriate for understanding stakeholders' perspectives on the decision-making process and the role of knowledge production regarding geothermal energy in the province of Groningen. I.e. perspectives on procedural justice. As Cotton and Mahroos-Alsaiari (2014) show, Q methodology can be used to evaluate the perspective of actors on stakeholder engagement in environmental impact assessment. And Brown (2019) applies Q methodology to understand stakeholder perspectives about the decision-making process in conservation efforts in the Northern Rockies. Thus, Q methodology is appropriate to uncover what is decided on, by whom and what the role of access to knowledge is in the future of geothermal energy in the province of Groningen.

4.3 The five steps of Q methodology

Q methodology follows a series of five steps which are explained in this section.

1) The first step of a Q study is to develop a concourse of statements related to the research question. A concourse is a set of interrelated claims which represent the discourse on the research question (Robbins and Krueger, 2000; Barry and Proops, 1999; Duenckmann, 2010). Statements are collected from a variety of sources, these include mass media and news articles, public reports, and academic literature. To capture a wide range of opinions about geothermal energy, X statements are collected.
2) To reduce the number of statements to a manageable amount I assemble a Q set of 47 statements. The size of the Q set is arbitrary, and ranges between 45 (Robbins and Krueger, 2000) and 60 (Cuppen et al., 2010) and is based on the available time and resources. Drawing a sample from the concourse was done through an unstructured sampling approach, based on my judgment and pilot testing. The final Q set is meant to be a micro representation of the larger set, thus I ensure that the chosen statements represent a balanced set of key themes, including geothermal energy, spatial imaginaries, procedural justice, access to information, and the role of power.

3) In the next step, participants are asked to sort the set of 25 statements under the condition to sort them from least (-4) to most (4) in accordance with their point of view. Here the instruction is "*Imagine that geothermal energy is going to be implemented in the province of Groningen. Sort the statements according to what you believe should be the most and least important ideas guiding the process."* The statements are sorted in a normal-distribution-shaped grid, as seen in *figure 1*. The relatively large number of spots in the center of the grid allows participants to easily place statements they have no particularly strong opinion on. Following the Q sort process, participants are asked "Why did you choose these statements at the extremes", "Do you miss certain statements, or were certain statements unclear or inappropriate?".

-4	-3	-2	-1	0	1	2	3	4
x	x	x	x	x	x	x	x	x
	x	x	x	x	x	x	x	
		x	x	x	x	x		
			x	x	x			
				x				

Figure 1: Q sort distribution

4) After a number of Q sorts are done, the sorts are correlated using Q factor analysis. The Q factor analysis of the Q sorts is done with the help of dedicated software. This software can measure the mutual connection between the separate statements, it is used to reveal factors, or clusters of common perspectives and reveal groups of participants with shared perspectives (Russell, 2017). The factors represent significantly different aggregations of statements (Robbins and Krueger, 2000). The number of factors extracted from the Q sort depends on the number of sorts. Watts and Stenner (2012a) suggest a factor per 6 sorts. In the factor analysis I choose to do a 3-factor analysis on the basis of 15 Q sorts.
5) The final step in Q methodology is the qualitative interpretation of the Q factor analysis. I interpret the identified factors based on theoretical literature and reviewing individual sorts. This involves a holistic exploration of the patterns revealed, and assigning thematic labels and narratives. Generating a qualitative, theoretically grounded description of the factors which describe the clusters of perspectives (Cotton and Mahroos-Alsaiari, 2014). Furthermore, the factors are compared to uncover similarities and

differences between perspectives. The description of the factors is explained in the section on results.

4.5 Participant selection

The selection of participants aims to encompass a broad range of perspectives. Unlike R studies, Q methodology does not require a representative sample based on predefined demographic characteristics. Instead, it focuses on capturing viewpoints that are significant, as outlined by Watts and Stenner (2012b, p. 71). In this thesis, which examines perceptions within the decision-making process, the most relevant perspectives come from both the general public and key institutions involved in this process.

Key stakeholders were identified through news articles and public reports. However, this approach introduces a bias, as it tends to favor those already featured in existing literature. Furthermore, the final participants are those who responded to invitations, which may skew the results toward individuals who are particularly motivated to voice their opinions or are interested in the subject of this thesis.

4.6 Applying Q methodology in the context of the decision-making process

Finally, to further understand the role of access to knowledge in the creation of spatial imaginaries regarding geothermal energy in the province of Groningen. The perspectives of the participants are viewed in the context of the decision-making process, their position in this process, and their relation to access to knowledge in the process.

Themes	**Stakeholder**	**Technology**	**Process**	**Other technologies**
Knowledge	2, 3, 4	5, 6, 7, 8,	9, 10, 11, 12	24
Values	13, 14, 15, 16	17, 18, 19	1, 20, 21, 22, 23	25

Selection matrix: statements of Q sort per theme

4.7 Ethical considerations

When conducting research using Q methodology, it is essential to address several ethical considerations to ensure both the integrity of the study and the well-being of

participants. Key areas of focus include informed consent, anonymity, the right to withdraw, minimizing bias, and providing feedback to participants.

Before participating in the research, all participants were thoroughly informed about the study's nature and purpose. They were required to sign a written consent form that detailed the research topic, methodology, data handling procedures, participant rights, and their anonymity. Additionally, participants were explicitly asked again during the data collection phase for their consent to record the Q sorts and interviews and to use the data for this research (see Appendix B for the consent form).

The anonymity of participants is of paramount importance. Personal identifiers were removed during data analysis and reporting, ensuring that participants cannot be identified. Only the researcher has access to the participants' contact information, which has not been shared with anyone else.

Maintaining ethical research standards also requires minimizing bias in participant selection and result interpretation. To this end, a conscious effort was made to include a diverse range of participants and data sources while avoiding conflicts of interest.

Finally, participants were encouraged to provide feedback during data collection and interactions. They were also asked whether they wished to be kept informed about the research findings. Several participants expressed interest in receiving the final results, and they will be contacted once the thesis is completed.

5. Results

This chapter presents the findings from the Q methodology analysis, detailing the resulting factors, their correlations, and the interpretations derived from the data. Through the analysis, three distinct factors emerged, each representing a unique perspective on the topic. These factors are essential in understanding the range of viewpoints among participants and provide a foundation for interpreting the underlying attitudes and beliefs.

The analysis begins with a discussion of the factor correlations and characteristics. Factor correlations offer insight into the relationships between the different perspectives, highlighting areas of agreement and divergence among the factors. Understanding these correlations is crucial for interpreting the broader patterns within the data and for identifying the key distinctions between the factors.

Following the correlation analysis, the chapter delves into the interpretation of each factor. The interpretation process involves examining the salient statements that define each factor, which are those that participants rated most positively or negatively. These statements are critical in capturing the essence of each factor and provide a basis for understanding the core beliefs and attitudes represented.

The selection matrix used in the study played a pivotal role in determining how the statements were sorted into factors. This matrix helps to visualize the distribution of participant responses across the factors and aids in identifying the most significant statements for each perspective.

For each of the three factors identified “Pragmatis”, “National Projects”, and “Private Venture” a corresponding crib sheet is provided. These crib sheets offer a detailed view of how different statements were rated within each factor, showcasing the ranking of statements that define the factor's unique viewpoint. By examining these crib sheets, we can better understand the nuances of each factor and the key themes that emerge.

Finally, the chapter concludes with an overall interpretation of the factors. This section synthesizes the findings from the factor analysis, salient statements, and crib sheets, offering a comprehensive view of the different perspectives uncovered in the study. The conclusion highlights the most significant insights gained from the

analysis and sets the stage for further discussion and implications in the subsequent chapters.

From the 15 Q sorts collected, I extracted three distinct factors from the data. These three factors represent the predominant perspectives held by participants regarding geothermal energy systems, their development, and the decision-making process in the Netherlands, with a particular focus on Groningen. *Table 1* provides an overview of these factors, including their themes, Eigenvalues, and the variance they explain. Together, these three factors account for 49% of the total variance in the data (found in Appendix A).

Factor	Theme	Eigenvalue	Explained variance in %	Cumulative percentage in %
1	**Pragmatism**	3.88	26	26
2	**National projects**	2.02	13	39
3	**Private venture**	1.48	10	49

Table 1: The three distinct factors

In the next section, I describe the characteristics and relationships between the different factors. Followed by the interpretation of the factors.

5.1 Factor correlations and characteristics

Of the 15 participants, 11 significantly loaded in one of the three factors. In factor 1, 6 participants loaded significantly, 3 participants in factor 2, and finally, 2 participants in factor 1, as shown in *table 2*. Because the factors represent the real perspectives of participants, there is overlap between the factors. *Table 3*, shows the correlations between the factors, an indication of the uniqueness and overlap between the factors.

Factors:	1	2	3

No. of defining variables	6	3	2
Average relative coefficient	0.800	0.800	0.800
Composite Reliability	0.96	0.923	0.889
SE of factor Z-score	0.200	0.277	0.333

Table 2: factor characteristics

Factors:	Factor 1	Factor 2	Factor 3
Factor 1	1.0000	0.2298	0.2573
Factor 2	0.2298	1.0000	0.2711
Factor 3	0.2573	0.2711	1.0000

Table 3: inter factor correlation

The correlations between the factors imply an interesting aspect of the relationship between the factors. The table shows that the correlation between the factors is quite similar. However, factor 1 has the least overlap with the other factors. Factors 1 and 2 differ the most from each other, but still, show some overlap with one another. This means that on some topics the perspectives of the participants are similar. The overlap can be explained as an expression of similar viewpoints (Watts & Stenner, 2012). This can mean that there is more consensus among the participants, but that the participants have different ways of expressing their opinions and values. The Q analysis shows statements that have a high degree of consensus among the factors. Point of significant overlap between the three factors are first of all, related to the complexity of geothermal energy systems (statement 10, factor 1 +3, factor 2 +2, factor 3 +2), and related to the role of negative news about earthquakes on the development of geothermal energy in the Netherlands (statement 11, factor 1 +3, factor 2 +2, factor 3 +4) and the role of private operators in the future development op geothermal energy in the Netherlands (statement 14, factor 1 +2, factor 2 +1, factor 3 +2).

5.2 Factor interpretation

At the basis of factor interpretation lies the salient statements for the factors. *Table 4* shows the salient statements for each factor, combined with the factor score

associated with the statements. Statements 6, 7, 14, 16, 19, 21, 22, 23 and 25 in *table 4* do not have associate salient values for any of the three factors. The reason for this is that these statements are consensus statements. This means that these statements do not distinguish between any pair of factors. The values of these statements do not differ significantly between the different factors.

		Factors		
no.	Statements	1	2	3
1	The municipality of Groningen must keep control of the development of geothermal systems within the municipality.	+2*	-3**	0*
2	The Groningen city council is well informed about the benefits and risks of geothermal energy.		-4	
3	Ministries and municipalities involved in geothermal energy in the Netherlands are well informed about the most recent technical developments in the geothermal industry.		-2**	
4	The information that the Groningen municipal council receives from external agencies about the risks of geothermal energy are one-sided.			-2**
5	There is a lot of knowledge of the subsurface in Groningen, which offers a unique opportunity for geothermal energy			+3**
6	There is sufficient technical knowledge about geothermal available in the Netherlands.			
7	Geothermal energy can only be developed by combining large-scale deployment of already available technologies with significant investments in new research and development.			
8	In deep geothermal energy, the lack of geological knowledge is the main bottleneck	-3	+3	+3**
9	The Ministry of Economic Affairs and Climate has to finance geothermal pilot projects in Groningen because the costs are too high for private		+3	-1**

	investors			
10	Geothermal energy is too complex for the municipal council to take a well-founded investment decision independently	+3		
11	The development of geothermal energy across the Netherlands is negatively affected by news about earthquakes in Groningen	+3		+4
12	The media should be used by the Ministry of Economic Affairs and Climate to steer the public image of geothermal energy		+4**	
13	The position of the State Supervision of Mines must be independent of the mining industry and the Ministry of Economic Affairs and Climate	+4**		
14	Private operators have a pioneering role in the future development of geothermal energy in the Netherlands			
15	Residents near geothermal projects have confidence in the handling of complaints by the central government			-4*
16	The ultimate responsibility for the safety of geothermal energy projects lies with the extraction license holder of the geothermal project			
17	Geothermal energy is the most important development for Groningen to become the sustainable energy city of Europe	-3	+1**	
18	There will always be people who are against the development of geothermal energy, but you can never please everyone.		+3**	
19	Because a heat exchanger uses little space, it fits well into the existing landscape			
20	Critical opinions on geothermal energy are given the space to be heard in the decision-making process		+2**	
21	Understanding how citizens think about projects in the subsurface is the most important part of the decision-making process around			

	geothermal energy.			
22	A geothermal project must connect to other spatial developments as much as possible			
23	The municipal council represents the interests of citizens in the decision-making process regarding geothermal energy			
24	There is no relationship between geothermal energy and earthquakes, as no "volume" is extracted from the subsurface compared to gas extraction	-4**		
25	I would rather that the government invest in large-scale geothermal projects than build on shore wind parks in Groningen.			

Table 4: salient statements for the three factors

Each factor is analyzed using a structured framework known as a crib sheet. This tool effectively organizes the most significant items within each factor's array. The crib sheet is divided into four key sections. The first section, "Items Ranked at +4 & +3," lists the highest-ranked items within the specific factor. The second section, "Items Ranked Higher in Factor X than Other Factors," highlights items that are ranked higher in this factor compared to others, serving to distinguish the factor from the others being studied. The third section, "Items Ranked Lower in Factor X than Other Factors," includes items that rank lower in this factor compared to others, further helping to differentiate between factors. Finally, the fourth section, "Items Ranked at -4 & -3," contains the lowest-ranked items for each factor (Sandling, 2022).

Themes:	**Stakeholder**	**Technology**	**Process**	**Other technologies**
Knowledge	2, 3, 4	5, 6, 7, 8,	9, 10, 11, 12	24
Values	13, 14, 15, 16	17, 18, 19,	1, 20, 21, 22, 23	25

Selection matrix: statements of Q sort per theme

5.2.1 Factor 1: Pragmatism

Factor 1 has an eigenvalue of 3.88 and explains 26% of the variance. Six participants are significantly associated with factor 1. The participants significantly associated with factor 1 come from various work fields and places in society. Three

participants work in the public sector as experts and policymakers, two work as experts in the private sector, and one is a local citizen.
The first of the three discourses emerging from the analysis is themed on the practical application and development of geothermal energy systems in the Netherlands. This discourse focuses on the limits of both geothermal energy in the Netherlands, and the role the government should play in its development. On the one hand, it sees the role of national government intervention as essential in areas in which the private sector is lacking (09 at +3). While on the other hand, it acknowledges that geothermal energy is not the holy grail in the energy transition (17 at -3).

"Geothermal can play an important role in the energy transition in Groningen, but let's hope it is not the only horse they bet on" (Participant 16, policy advisor on geothermal energy in the private sector)

The role of the government in geothermal energy should be limited to creating legal frameworks for the private sector to operate in. This factor emphasizes the facilitating role of the government because the government is limited by the technical knowledge available at the various governmental bodies (03 at -1; 06 at -1). Therefore, a leading role is envisioned for the private sector in the technical development of geothermal energy systems (14 at +2). However, to prevent "pirate-like activities" (Participant 4, earth scientist in the public sector) it is necessary for different governmental bodies to create regulations independent of industry or the ruling political parties to guide the development of geothermal energy systems (13 at +4; 01 at +1). In the end safety, it is the responsibility of the operators of the geothermal systems (16 at +1) This discourse is positive towards the current decision-making process between the national government and private developers (20 at +1).
The discourse differentiates between the competencies of the national and local governments and citizens. Geothermal energy development is a matter of national decision-making. Geothermal energy is too complex for municipalities to make well-founded decisions on (10 at +2) because the municipalities are ill-informed (02 at -2) and receive only a limited variety of information (04 at 0).
The earthquakes caused by gas extraction in Groningen, and the subsequent lack of empathy made many citizens become vocal about the risks of geothermal energy (11 at +3). And has put a severe dent in the citizens' trust in the government to deal with any negative effects (15 at -2). Therefore this discourse sees the development of geothermal energy systems as a process better kept out of the spotlight (21 at -2; 12 at 0; 19 at 0).

"Most geothermal projects fail because there is a small group of very vocal citizens, who put everything to work to stop the project. Keeping municipal councils hostage

and unable to make proper decisions representing the interests of all citizens" (Participant 5, expert in technical systems in the private sector) (23 at -1; 18 at -1)

Pragmatism does not only refers to the pragmatic interaction between the national government and the private sector regarding the division of responsibilities. Pragmatism also refers to the role of geothermal energy in the energy transition. The discourse is realistic regarding the advantages and limitations of geothermal as an energy source.

"We know enough about the subsurface conditions and geothermal energy, to know that it is not the holy grail in the energy transition" (Participant 4, earth scientist in public sector)

The extensive history of oil and gas exploration in the Netherlands provides a good picture of the Dutch subsurface (05 at +2). However this also means that we have to be pragmatic about the limits of geothermal energy in the Netherlands. We are aware of the seismic risks involved in using geothermal systems in vulnerable areas (24 at -4). Knowledge of the subsurface (08 at -3) or technological systems (07 at -2) is the limiting factor in the development of geothermal energy systems in the Netherlands. Rather geothermal energy has a limited role to play in the energy transition, as one of a plethora of sources of renewable energy needed for the energy transition (25 at 0). There are areas where there is potential for the profitable exploitation of geothermal energy, but it is not the goose with the golden eggs.

Factor interpretation crib sheet for factor 1
Items Ranked at +4 & +3

- 13 De positie van het Staatstoezicht op de Mijnen moet onafhankelijk zijn van de mijnindustrie en het Ministerie van Economische Zaken en Klimaat **+4**
- 09 Het Ministerie van Economische Zaken en Klimaat moet geothermische pilot projecten financieren in Groningen omdat de kosten te hoog zijn voor particuliere investeerders **+3**
- 11 De ontwikkeling van geothermie in heel Nederland wordt negatief beïnvloed door nieuws over aardbevingen in Groningen **+3**

Items Ranked Higher in Factor 1 Array than in Other Factors

- 01 De gemeente Groningen moet zelf regie houden over de ontwikkeling van geothermische systemen binnen de gemeente **+1**
- 02 De Groningse gemeenteraad is goed geïnformeerd over de voordelen en risico's van geothermie **-2**
- 04 De informatie die de Groningse gemeenteraad krijgt van externe bureaus over de risico's van geothermie is eenzijdig **0**
- 14 Private operators hebben een voorlopersrol in de toekomstige ontwikkeling van geothermie in Nederland **+2**
- 16 De eindverantwoordelijkheid voor veiligheid van geothermische energie projecten ligt bij de winning vergunninghouder van het geothermische project **+1**
- 20 Kritische meningen over geothermie krijgen de ruimte om gehoord te worden in het besluitvormingsproces **+1**

Items Ranked Lower in Factor 1 Array than in Other Factors

- 06 Er is in Nederland voldoende technische kennis over geothermie beschikbaar **-1**
- 07 Geothermie kan alleen worden ontwikkeld door grootschalige inzet van reeds beschikbare technologieën en grote investeringen in nieuw onderzoek en ontwikkeling **-1**
- 12 De media moet gebruikt worden door het Ministerie van Economische Zaken en Klimaat om het publieke beeld over geothermie te sturen **0**
- 17 Geothermie is de belangrijkste ontwikkeling voor het uitgroeien van Groningen tot de duurzame energie stad van Europa **-3**
- 18 Er zullen altijd mensen zijn die tegen de ontwikkeling van geothermie zijn, maar je kan nooit iedereen tevreden houden **-1**

- 19 Doordat een warmtewisselaar weinig ruimte gebruikt, past het goed in het bestaande landschap **0**
- 21 Begrijpen hoe burgers over projecten in de bodem denken is het belangrijkste onderdeel van het besluitvormingsproces rondom geothermie **-2**
- 23 De gemeenteraad vertegenwoordigt de belangen van de burgers in het besluitvormingsproces rondom geothermie **-1**
- 25 Ik heb liever dat de overheid investeert in grootschalige geothermische projecten dan dat ze investeert in windparken op het land **0**

Items Ranked at -4 & -3

- 24 Er is geen relatie tussen geothermie en aardbevingen, aangezien er geen 'volume' uit de bodem wordt gehaald zoals bij gaswinning **-4**
- 08 Bij diepe geothermie vormt de gebrekkige geologische kennis het belangrijkste knelpunt **-3**
- 17 Geothermie is de belangrijkste ontwikkeling voor het uitgroeien van Groningen tot de duurzame energie stad van Europa **-3**

5.2.2 Factor 2: National projects

Factor 2 has an eigenvalue of 1.9136 and explains 11% of the variance. Four participants are significantly associate with this factor. These participants all come from non-governmental related sectors. Two participants are directly related to the development of the energy systems in the private sector, one is an expert on energy transition and one is a citizen.

This factor, the second factor to emerge from the Q method analysis, highlights the importance of a leading role for the national government in implementing a energy systems fraught with uncertainty and complexity. The discourse acknowledges the complexity (10 at +2) and lack of knowledge regarding geothermal energy systems (06 at -1) in the Netherlands. It sees a strong role for the national Dutch government in assuming some risks and guiding the decision making process. But at the same time, this discourse has the brightest outlook on the potential of geothermal energy systems in the Netherlands (17 at +2; 19 at +2).

Compared to the other discourses, factor 2 puts less emphasis on the role of the private sector (14 at 0). But they agree on the limited role of local governmental institutions (01 at -3). Instead the discourse prioritizes the role of the national Dutch government. The shift from local to national policy is explained as this discourse sees local governments, on the one hand as too politized (23 at -1).

"Because local politics is driven by emotions and not always by facts. It is not the right place to make such decisions. It is the forum where the loudest voices are given the most attention, while decisions on the energy transition should be driven by factual arguments" (participant 17, Project leader in the energy sector)

Furthermore, decision making regarding geothermal energy and the energy transition is considered as too complex for local governments (10 at +2). Although this discourse considers local governments relatively well informed compared to the other discourses, it is still seen as insufficient (02 at -2; 04 at 0). This is exemplified by participant 7 (developer of energy systems in the private sector) (03 at -2):

"There is a difference between the level of knowledge between the ministries and the municipalities. National institutions have a long history of making policy on mining and gas extraction, while this is often very new for policy makers at the municipal level."

Therefore the national government should take an active stance in guiding the development of geothermal energy systems in the Netherlands. Both in terms of

providing financial support for geothermal projects (09 at +4) as well as supporting the immaterial part of the process. National institutions should be aimed at promoting the development of geothermal energy (13 at -3) this also requires them to take responsibility (16 at -2). Although opposition towards geothermal energy systems will not disappear (18 at +3), the opinion of citizens is important in the decision making process (20 at +1; 21 at -1) and should be actively addressed (12 at +3; 15 at -1).

They are relatively optimistic about the potential role of geothermal energy in the energy transition (17 at +2). Even though the level of technical knowledge regarding geothermal energy systems in the Netherlands is not yet sufficient (06 at -1) this is not considered as a barrier to the exploitation of geothermal energy. Because technical knowledge can be imported from abroad, there is no need to develop new systems (07 at -1). Moreover, as a result of the long history of oil and gas exploration there is plenty of geological information in the Netherlands (05 at 0; 08 at -4). Although earthquakes in Groningen associated with gas extraction have had a negative impact on public opinion (11 at +1), they are confident that these mistakes will not be repeated in the future development of geothermal energy systems (24 at +1). There is a relatively high confidence in the national government to compensate those negatively impacted by geothermal projects (15 at -1). All in all, this discourse has a positive outlook on the development of geothermal energy promoted by an active national government.

Factor interpretation crib sheet for factor 2

Items Ranked at +4 & +3

- 09 Het Ministerie van Economische Zaken en Klimaat moet geothermische pilot projecten financieren in Groningen omdat de kosten te hoog zijn voor particuliere investeerders **+4**
- 12 De media moet gebruikt worden door het Ministerie van Economische Zaken en Klimaat om het publieke beeld over geothermie te sturen **+3**
- 18 Er zullen altijd mensen zijn die tegen de ontwikkeling van geothermie zijn, maar je kan nooit iedereen tevreden houden **+3**

Items Ranked Higher in Factor 2 Array than in Other Factors

- 02 De Groningse gemeenteraad is goed geïnformeerd over de voordelen en risico's van geothermie **-2**
- 04 De informatie die de Groningse gemeenteraad krijgt van externe bureaus over de risico's van geothermie is eenzijdig **0**
- 15 Omwonende van geothermieprojecten hebben vertrouwen in de afhandeling van klachten door de rijksoverheid **-1**
- 17 Geothermie is de belangrijkste ontwikkeling voor het uitgroeien van Groningen tot de duurzame energie stad van Europa **+2**
- 19 Doordat een warmtewisselaar weinig ruimte gebruikt, past het goed in het bestaande landschap **+2**
- 20 Kritische meningen over geothermie krijgen de ruimte om gehoord te worden in het besluitvormingsproces **+1**
- 21 Begrijpen hoe burgers over projecten in de bodem denken is het belangrijkste onderdeel van het besluitvormingsproces rondom geothermie **-1**
- 24 Er is geen relatie tussen geothermie en aardbevingen, aangezien er geen 'volume' uit de bodem wordt gehaald zoals bij gaswinning **+1**

Items Ranked Lower in Factor 2 Array than in Other Factors

- 03 Ministeries en gemeenten betrokken bij geothermie in Nederland zijn goed geïnformeerd over de meest recente technische ontwikkelingen in geothermische industrie **-2**
- 05 In Groningen is veel kennis van de ondergrond en dat biedt een unieke kans voor geothermie **0**
- 06 Er is in Nederland voldoende technische kennis over geothermie beschikbaar **-1**

- 07 Geothermie kan alleen worden ontwikkeld door grootschalige inzet van reeds beschikbare technologieën en grote investeringen in nieuw onderzoek en ontwikkeling **-1**
- 11 De ontwikkeling van geothermie in heel Nederland wordt negatief beïnvloed door nieuws over aardbevingen in Groningen **+1**
- 14 Private operators hebben een voorlopersrol in de toekomstige ontwikkeling van geothermie in Nederland **0**
- 16 De eindverantwoordelijkheid voor veiligheid van geothermische energie projecten ligt bij de winning vergunninghouder van het geothermische project **-2**
- 23 De gemeenteraad vertegenwoordigt de belangen van de burgers in het besluitvormingsproces rondom geothermie **-1**

Items Ranked at -4 & -3

- 08 Bij diepe geothermie vormt de gebrekkige geologische kennis het belangrijkste knelpunt **-4**
- 01 De gemeente Groningen moet zelf regie houden over de ontwikkeling van geothermische systemen binnen de gemeente **-3**
- 13 De positie van het Staatstoezicht op de Mijnen moet onafhankelijk zijn van de mijnindustrie en het Ministerie van Economische Zaken en Klimaat **-3**

5.2.3 Factor 3: Private venture

The third emerging discourse, which accounts for 11% of the variance, considers the development of geothermal energy as a business opportunity in particular areas (14 at +2). Knowledge and experience from the oil and gas industry could be transferred to geothermal energy to make it profitable and safe (05 at +3). In contrast to the National Project discourse, the private venture discourse has little confidence in the state's ability to develop and manage geothermal energy systems.

"The municipality of Groningen should not have taken it upon themselves to decide on the geothermal project in the first place. They lack the necessary expertise and experience to make such a complex decision" (participant 8, senior director at geothermal projects)

The failed geothermal project WarmteStad in Groningen (10 at +2), and the handling of the Groningen earthquakes are negatively impacting the public perception of geothermal energy. There is a lot of negative news surrounding geothermal energy in the Netherlands, this is hurting the development and expansion of these systems (11 at +4). Citizens do not trust the national authorities (15 at -4). Civil opposition has already stopped some geothermal projects. And despite attempts of the municipalities (23 at 0) to oversee their development in Groningen, there is simply not enough knowledge available (13 at -3; 04 at -2)Therefore, geothermal energy should not be considered a public matter but a commercial activity (14 at +2). This discourse aims to distance citizens from the decision-making process (21 at -2; 20 at 0), instead, private parties are at the helm of the future of geothermal in the Netherlands (14 at +2), representing commercial interests.

This discourse is realistic about the future of geothermal energy in the Netherlands. As a business case, the Netherlands is an opportunity. Through the years, the experience of the oil and gas industry has created a good understanding of the subsurface (05 at +3), and the necessary technical knowledge (06 at +1; 07 at +1) to further its development where it is safe and profitable (09 at +1). But where this is not possible yet, new technology and geological knowledge has to be invested in (07 at +1; 08 at +3)

"As a result of over 60 years of experience extracting gas in Groningen, we have a very good understanding of what our subsurface conditions are. We learned that there is plenty of opportunity for geothermal energy in the Netherlands. We also learned that Groningen is not one of these opportunities." ((17 at -2) Participant 10, energy expert, municipality)

The private venture discourse does not take the government out of the equation. Where the responsibility for safety and profitability lies with the private sector (16 at +1; 09 at +1) it does require national governmental intervention to promote geothermal energy as a viable alternative energy source and bring together the necessary experience and resources(13 at -3; 03 at +1; 25 at +2).

Factor interpretation crib sheet for factor 3

Items Ranked at +4 &+3

- 11 De ontwikkeling van geothermie in heel Nederland wordt negatief beïnvloed door nieuws over aardbevingen in Groningen **+4**
- 05 In Groningen is veel kennis van de ondergrond en dat biedt een unieke kans voor geothermie **+3**
- 08 Bij diepe geothermie vormt de gebrekkige geologische kennis het belangrijkste knelpunt **+3**

Items Ranked Higher in Factor 3 Array than in Other Factors

- 03 Ministeries en gemeenten betrokken bij geothermie in Nederland zijn goed geïnformeerd over de meest recente technische ontwikkelingen in geothermische industrie **+1**
- 06 Er is in Nederland voldoende technische kennis over geothermie beschikbaar **+1**
- 07 Geothermie kan alleen worden ontwikkeld door grootschalige inzet van reeds beschikbare technologieën en grote investeringen in nieuw onderzoek en ontwikkeling **+1**
- 14 Private operators hebben een voorlopersrol in de toekomstige ontwikkeling van geothermie in Nederland **+2**
- 16 De eindverantwoordelijkheid voor veiligheid van geothermische energie projecten ligt bij de winning vergunninghouder van het geothermische project **+1**
- 23 De gemeenteraad vertegenwoordigt de belangen van de burgers in het besluitvormingsproces rondom geothermie **0**
- 25 Ik heb liever dat de overheid investeert in grootschalige geothermische projecten dan dat ze investeert in windparken op het land **+2**

Items Ranked Lower in Factor 3 Array than in Other Factors

- 04 De informatie die de Groningse gemeenteraad krijgt van externe bureaus over de risico’s van geothermie is eenzijdig **-2**

- 09 Het Ministerie van Economische Zaken en Klimaat moet geothermische pilot projecten financieren in Groningen omdat de kosten te hoog zijn voor particuliere investeerders **+1**
- 19 Doordat een warmtewisselaar weinig ruimte gebruikt, past het goed in het bestaande landschap **0**
- 20 Kritische meningen over geothermie krijgen de ruimte om gehoord te worden in het besluitvormingsproces **0**
- 21 Begrijpen hoe burgers over projecten in de bodem denken is het belangrijkste onderdeel van het besluitvormingsproces rondom geothermie **-2**

Items Ranked at -4 & -3

- 15 Omwonende van geothermieprojecten hebben vertrouwen in de afhandeling van klachten door de rijksoverheid **-4**
- 02 De Groningse gemeenteraad is goed geïnformeerd over de voordelen en risico's van geothermie **-3**
- 13 De positie van het Staatstoezicht op de Mijnen moet onafhankelijk zijn van de mijnindustrie en het Ministerie van Economische Zaken en Klimaat **-3**

5.3 Factor Interpretation

		Factors		
no.	Statements	1	2	3
1	The municipality of Groningen must keep control of the development of geothermal systems within the municipality.	+1*	-3**	-1*
2	The Groningen city council is well informed about the benefits and risks of geothermal energy.			-3
3	Ministries and municipalities involved in geothermal energy in the Netherlands are well informed about the most recent technical developments in the geothermal industry.	-1*	-2*	+1**
4	The information that the Groningen municipal council receives from external agencies about the risks of geothermal energy are one-sided.			-2**
5	There is a lot of knowledge of the subsurface in Groningen, which offers a unique opportunity for geothermal energy		0**	+3
6	There is sufficient technical knowledge about geothermal available in the Netherlands.			-1**
7	Geothermal energy can only be developed by combining large-scale deployment of already available technologies with significant investments in new research and development.			
8	In deep geothermal energy, the lack of geological knowledge is the main bottleneck	-3	-4	+3**
9	The Ministry of Economic Affairs and Climate has to finance geothermal pilot projects in Groningen because the costs are too high for private investors	+3**	+4**	-1**
10	Geothermal energy is too complex for the municipal council to take a well-founded			

	investment decision independently			
11	The development of geothermal energy across the Netherlands is negatively affected by news about earthquakes in Groningen	+3	+1**	+4
12	The media should be used by the Ministry of Economic Affairs and Climate to steer the public image of geothermal energy		+3**	
13	The position of the State Supervision of Mines must be independent of the mining industry and the Ministry of Economic Affairs and Climate	+4**	-3	-3
14	Private operators have a pioneering role in the future development of geothermal energy in the Netherlands			
15	Residents near geothermal projects have confidence in the handling of complaints by the central government	-2*	-1*	-4*
16	The ultimate responsibility for the safety of geothermal energy projects lies with the extraction license holder of the geothermal project		-2**	
17	Geothermal energy is the most important development for Groningen to become the sustainable energy city of Europe	-3	+2**	
18	There will always be people who are against the development of geothermal energy, but you can never please everyone.		+3**	
19	Because a heat exchanger uses little space, it fits well into the existing landscape			
20	Critical opinions on geothermal energy are given the space to be heard in the decision-making process			
21	Understanding how citizens think about projects in the subsurface is the most important part of the decision-making process around geothermal energy.			
22	A geothermal project must connect to other spatial developments as much as possible			

23	The municipal council represents the interests of citizens in the decision-making process regarding geothermal energy		-1*	
24	There is no relationship between geothermal energy and earthquakes, as no "volume" is extracted from the subsurface compared to gas extraction	-4**	+1**	-1**
25	I would rather that the government invest in large-scale geothermal projects than build on shore wind parks in Groningen.			

Table 6: significant statements per factor

In conclusion, the empirical data analysis revealed three distinct discourses regarding the development of geothermal energy systems in the Netherlands. The correlations between the factors suggest varying degrees of consensus and divergence among participants' viewpoints. Factor 1 emphasizes the practical application of geothermal energy and advocates for a facilitating role of the government while acknowledging the technical limits of geothermal energy in the energy transition. Factor 2 highlights the importance of a leading role for the national government in guiding the development of geothermal energy systems, with less emphasis on the role of the private sector. Factor 3 views geothermal energy primarily as a business opportunity, advocating for private sector leadership and distancing citizens from the decision-making process.

Each discourse presents unique perspectives on the complexities, risks, and potential of geothermal energy in the Netherlands. Factor 1 underscores the importance of balancing governmental intervention with private sector involvement, while Factor 2 emphasizes the need for national leadership and support. Factor 3 focuses on the commercial aspect of geothermal energy, advocating for private sector dominance in decision-making.

Overall, the findings offer valuable insights into stakeholder perceptions and priorities regarding the development of geothermal energy systems, providing a foundation for informed policy-making and stakeholder engagement in the sustainable energy transition. These diverse perspectives underscore the need for tailored approaches that address the multifaceted challenges and opportunities associated with geothermal energy adoption in the Netherlands.

But what does this mean for the practical challenges related to geothermal energy systems in the Netherlands? The findings from the Q methodology analysis provide important considerations for the practical implementation of geothermal energy

systems in the Netherlands: governmental role, public perception and engagement, private sector involvement and technical expertise.

The differing perspectives on the role of the government suggest that policymakers should carefully balance governmental intervention with private sector involvement. While some stakeholders advocate for a facilitating role of the government, others emphasize a stronger leadership role at the national level. Policymakers need to navigate these divergent views to create effective policies that support the development and regulation of geothermal energy systems.

The analysis highlights the significance of public perception and engagement in the implementation of geothermal energy projects. Stakeholder discourse indicates varying levels of trust in governmental authorities and concerns about safety and environmental impacts. Therefore, it is crucial for project developers and policymakers to engage with local communities, address concerns transparently, and ensure public participation in decision-making processes.

The perspectives advocating for a prominent role of the private sector underscore the importance of creating a conducive environment for private investment in geothermal energy projects. This may involve providing financial incentives, streamlining regulatory processes, and fostering collaboration between public and private entities.

Stakeholder discourse emphasizes the importance of technical knowledge and expertise in the successful implementation of geothermal energy systems. Policymakers could improve the policy process by for example prioritizing investments in research and development to enhance understanding of subsurface conditions, technological advancements, and risk mitigation strategies.

In conclusion, the Q methodology analysis revealed diverse perspectives on geothermal energy development in the Netherlands. These insights highlight the possible need to balance governmental intervention and private sector involvement, address public concerns transparently, foster collaboration between stakeholders, and prioritize investments in technical expertise. Addressing these considerations could be crucial for successful practical implementation of geothermal energy systems in the Netherlands, guiding the country's transition to a more sustainable energy future.

6. Synthesis of theory and empirics

This section will discuss the relationship between the academic theories on discourse, power and energy justice underpinning this thesis and the research conducted here. Throughout this thesis, I have observed the practical implications of the concepts of power and discourse. Therefore, I will use this section to link my research with these concepts. It is important to distinguish between the findings of my research and what the theories can tell us as researchers. I will begin by explaining my thoughts on poststructural ideas related to power, discourse, energy justice, and imaginaries. Following this, I will connect the outcomes of the factors to these concepts.

Initially not considered part of my research, I will delve into my views on the relationship between being a researcher in this field and the power structures that we, as researchers, are part of and influence. Without going too deeply into the philosophical ontology of my viewpoint, the core assumption of this relationship lies in the agent-structure relationship. This concept suggests that an individual agent's actions can transform the structure in which the agent acts and that the structure of the relationships between the actor, other actors, and the environment influences the actions of the actor (Friedman & Starr, 2002). Consequently, my actions as a researcher are influenced by political, cultural, social, economic, and physical structures, while simultaneously transforming these structures to varying extents.

To make this more concrete, I highlight the interplay between energy justice and the methodology used in this thesis, particularly regarding who is involved and how the results are interpreted.

The most important aspect of the researcher's role is determining who is included in the study, touching on recognition and procedural justice. Research is inherently limited by time and resources, necessitating decisions about who and what to include, especially in the complex field of social studies. Recognition justice revolves around acknowledging power differences between groups. In this thesis, I have influence over who is included in the study. As a personal and academic conviction, I believe that weaker groups should be explicitly involved in social research to empower them and strive for justice. However, this depends on my perception of distinct identities, such as defining what constitutes a "citizen." Moreover, individuals are too complex to be defined by a single label. This pursuit of justice is limited by my understanding as a researcher. Q methodology attempts to address this by grouping based on similar relative opinions rather than characteristics, as in R methodology. However, I cannot definitively say if this provides more or less justice. On one hand, all groups have equal standing in the study; on the other

hand, it does not acknowledge power differences between individuals and groups. Thus, I leave this question to those more skilled in the philosophy of science.

Procedural justice concerns how decisions are formed, what constitutes knowledge, and who should be involved. Like recognition justice, the researcher decides who is involved in the research process. Procedural justice also focuses on what is discussed, how it is discussed, and what constitutes useful data. Due to the limited scope of research, decisions must be made about what to include.

Finally, I will discuss the interplay between energy justice and the factors identified in this study. To clarify the interpretation of these factors, *table 7* presents a matrix showing the factors alongside the three aspects of energy justice.

Factors / Energy Justice	Pragmatism	National Projects	Private Venture
Recognition	- National government - Local governments - Private sector - Citizens	- National government - Local governments - Citizens	- Private sector - National government
Distribution	- Citizens	- Citizens	- Private sector
Procedural	- National government	- National government - Citizens	- Private sector - National government

Table 7: factors and Energy Justice

In each of the three aspects of energy justice there are varying perspectives on what is considered fair and equitable. The unresolved questions regarding who the stakeholders are, who stands to benefit, and who should be involved in the development of geothermal energy in the Netherlands have significant implications for the sector's future. These unsettled issues can lead to a range of complications, including diverse interests clashing, legal uncertainties, and power struggles among different groups (Geels, 2002; Lammers & Arentsen, 2017).

Such diverging views can undermine long-term planning and investment in geothermal projects (Geels, 2002; Lammers & Arentsen, 2017). Investors may be hesitant to commit funds to projects where stakeholder roles and benefits are unclear, leading to financial instability and slow progress in the sector. Public acceptance is also at risk; if local communities and other key stakeholders feel excluded or unfairly treated, opposition to geothermal projects can grow, causing delays and additional costs.

Moreover, effective risk management becomes challenging without a clear understanding of stakeholder responsibilities and benefits (Lammers & Arentsen, 2017). Uncertainty in these areas can result in inadequate preparation for potential environmental and operational risks, further complicating project execution and sustainability. This, in turn, affects investor confidence, as the perceived risks associated with geothermal energy projects increase without clear governance and stakeholder involvement.

Addressing these fundamental questions is crucial for ensuring that geothermal energy can contribute effectively to the Netherlands' sustainable development goals. Clarifying stakeholder roles and benefits fosters a stable investment climate, encourages public support, and enhances risk management strategies. This will not only bolster investor confidence but also ensure that geothermal energy projects are planned and executed in a way that aligns with the principles of energy justice.

7. Conclusion and discussion

This thesis delves into the imperative task of transitioning the Dutch energy system towards renewable heat sources to combat the escalating climate crisis. Despite its potential, geothermal energy's current contribution in the Netherlands remains minimal, largely due to uncertainties surrounding its future, including technological feasibility, institutional support, and public acceptance.

Central to this thesis is the exploration of power dynamics in shaping discourse surrounding the development of geothermal energy systems. Power manifests in diverse forms, influencing knowledge production, access to information, and participation in shaping discourse. Through the lenses of energy justice and socio-technical imaginaries, this study emphasizes the ethical considerations and interplay of social, spatial, technical, and power aspects in the discourse.

To get a better understanding of the discourse on geothermal energy systems in the netherlands. The following main research question is answered:

- ? "How do stakeholders differently perceive and evaluate the development of geothermal energy systems in the Netherlands in the summer of 2022?"

This question is addressed using Q methodology, a valuable approach for studying stakeholder perspectives and attitudes. The analysis reveals three distinct factors: Pragmatism, emphasizing limitations and the role of government; National Projects, highlighting the importance of geothermal energy for the Dutch energy landscape; and Private Venture, accentuating minimal government involvement. These factors underscore differing attitudes toward geothermal energy's development and implementation.

These factors underscore two significant insights. Firstly, none of them entirely dismiss geothermal energy as a sustainable heating source. However, they reveal a distinct division regarding the approach and entities responsible for the development and implementation of geothermal energy systems. Hence, comprehending the discourse and power dynamics among stakeholders is essential for unlocking the potential of geothermal energy in the Netherlands.

Identifying these factors holds significance within the discourse surrounding the future of energy systems and the concomitant transition process. The development of geothermal energy systems, as well as energy systems in a broader context, constitutes a multifaceted endeavor, necessitating collaboration among numerous stakeholders. Comprehensive comprehension of diverse perspectives proves

indispensable in evaluating the feasibility and acceptance of proposed solutions, discerning barriers, and recognizing opportunities. This understanding facilitates the formulation and successful implementation of enduring policies. Moreover, the appreciation of varied discourses fosters transparency by incorporating diverse viewpoints and interests of all stakeholders. Lastly, it furnishes invaluable insights into emerging ideas, trends, and innovations, enabling the exploration of novel pathways for the advancement of sustainable energy systems through collective intelligence.

Given the existing gap in academic knowledge concerning the discourse surrounding the development of geothermal energy systems in the Netherlands, this thesis serves as an initial exploration into the topic. However, further research is essential to deepen our understanding. It is recommended that future studies broaden participant inclusion to encompass a more diverse array of perspectives. Additionally, longitudinal research efforts should be undertaken to track how perspectives evolve over time. Moreover, conducting more comprehensive investigations can shed light on individual motivations and illuminate the functioning of knowledge production across various stages of the development process.

Ultimately, by advancing our comprehension of stakeholder perspectives, we can foster more informed and inclusive dialogues that contribute to the establishment of an equitable and sustainable energy future in the Netherlands.

8. Reflection

This section is dedicated to a in depth discussion of the implications and significance of the findings in this thesis. Relating my findings to existing literature.

My results show both common ground and a major difference between the factors. The factors show there is a shared idea that geothermal energy can contribute to the energy transition as a sustainable heat source in the Netherlands. But there is a gap between the factors when it comes to who and how the development and implementation of geothermal energy systems in the Netherlands should be done. To summarize the question is not if geothermal energy should be pursuit in the Netherlands, but how and by who.

Understanding and stating where actors have diverging ideas can open new windows of discourse, providing new opportunities for policy change (Schmidt, 2011). This thesis serves as a way to create such new opportunities for change.

With the climate crisis on going, there is a need for a paradigm shift in energy policy, but times of change are uncertain. Therefore, we need to communicate about our perceptions of the problem and future solutions.

Conflict resolution is needed to overcome such a complex and uncertain problem as the energy transition. According to Itten (2018), successful conflict resolution requires high level of inclusion combined with either low administrative and political restrictions or low complexity. Because this is highly complex, there is a need for low restriction to the decision making process. This is similarly prescribed in Energy Justice. This includes a open and equitable discussion on how and who should implement geothermal energy systems.

Existing bodies of knowledge regarding the study of discourse surrounding geothermal energy systems are scare and far between. There are general studies tackling the role of discourse in the policy process. Discourse encompasses the concepts and ideas relevant for policy, and the interactive processes of communication and policy formulation that serve to generate and disseminate these ideas (Schmidt & Radaelli, 2004).

From the perspective of imaginaries it is interesting to see that there is a common spatial-technical imaginary regarding the future of geothermal energy. It seems to have a place in the imaginaries held by the stakeholders. But there is significant variation in the social imaginary. Stakeholders differ in their attitudes towards the

social and institutional arrangements necessary to implement change and develop geothermal energy systems in the Netherlands.

It is interesting to see that the concepts associated with Energy Justice emerging as the point of concern. Perhaps this is because of the complexity associated with such social arrangements, in comparison to the relative simplicity of the technical aspects of geothermal energy.

While this thesis offers significant insights into the discourses surrounding geothermal energy systems in the Netherlands, it is essential to acknowledge its limitations. Firstly, the study's reliance on a limited sample size may not adequately capture the diversity of perspectives within the population, leading to restricted generalizability. Secondly, the interpretation of factors identified in the research is inherently subjective, contingent upon the researcher's perspective, thus potentially yielding different interpretations by other researchers. Moreover, the subjective nature of Q methodology introduces susceptibility to biases inherent in the researcher, affecting the reliability of the findings. Lastly, this thesis is constrained by its focus on general viewpoints at a specific juncture in time and context. While it seeks to uncover generalized perspectives, this approach lacks detailed insights into participants' motives. Furthermore, its temporal and contextual limitations hinder a comprehensive understanding of evolving perspectives and dynamics surrounding geothermal energy systems.

Discourse, power, and energy justice both shape and are shaped by this thesis. As the researcher, I wield power over how the study is designed, analyzed, and presented. The interplay between discourse and power lies at the thesis's core, yet the research itself becomes part of the discourse it examines. This thesis is co-created through dialogues with interview participants, interactions with colleagues, family, and friends, and by the discussions it may provoke about geothermal energy.

Moreover, Q methodology here is not just a neutral analytical tool; it is also a process of data interpretation. As such, it is inherently influenced by the researcher’s perspective and subject to the larger structure-agent dynamics of discourse and power. Through my interpretive role in categorizing, analyzing, and presenting findings, I, as an agent, shape the emerging discourse on geothermal energy, while also being shaped by it. Thus, this thesis is a product not of isolated analysis but of a research process situated within broader social and personal structures. My prior experiences, the people I have engaged with, the sources I have consulted, and even the subjective aspects of Q methodology all influence the discourse I ultimately present.

Ultimately, I decided on the research method, the statements to include in the Q sorts, and the interview questions. This decision-making process inevitably limits which and to what extent all voices are heard, leaving many questions regarding participants' imaginaries, feelings, and reasoning unanswered.

I understand that this thesis is limited by the fact that much of researching discourse is clouded by the subjectivity and biased nature of me as a researcher. However, the social issues of power, justice, and discourse require the researcher to employ one things humans excel at compared to ‘objective’ statistical tests and methods: understanding social contexts. That is why this thesis is able to contribute to our understanding of the development of geothermal energy systems in the Netherlands. The true difficulty does not lie in the technical but social viability of the energy transition.

9. Appendix

Appendix A: Raw data

PQMethod2.35 Geothemalv1
PAGE 1
Path and Project Name: C:\PQMethod\projects/Geotherm
Aug 16 22

Correlation Matrix Between Sorts

SORTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 P1	100	22	62	30	17	13	11	42	18	39	32	19	54	24	37	45	28
2 P2	22	100	54	38	30	24	-5	-10	30	2	35	4	26	-8	53	15	18
3 P4	62	54	100	50	37	26	19	25	28	25	51	21	82	31	25	43	16
4 P5	30	38	50	100	17	1	20	18	23	30	87	-3	24	23	29	34	44
5 P6	17	30	37	17	100	12	8	-11	16	-14	16	-5	22	6	16	18	27
6 P7	13	24	26	1	12	100	31	17	21	20	4	82	19	12	-18	64	-24
7 P8	11	-5	19	20	8	31	100	33	-14	33	16	29	16	9	-6	34	9
8 P9	42	-10	25	18	-11	17	33	100	26	91	14	23	18	29	19	20	15
9 P10	18	30	28	23	16	21	-14	26	100	11	19	-11	13	10	39	27	0
10 P11	39	2	25	30	-14	20	33	91	11	100	23	29	18	17	28	20	24
11 P12	32	35	51	87	16	4	16	14	19	23	100	13	25	29	23	38	48
12 P13	19	4	21	-3	-5	82	29	23	-11	29	13	100	23	11	-32	57	-25
13 P14	54	26	82	24	22	19	16	18	13	18	25	23	100	10	4	39	7
14 P15	24	-8	31	23	6	12	9	29	10	17	29	11	10	100	-26	37	8
15 P3	37	53	25	29	16	-18	-6	19	39	28	23	-32	4	-26	100	-12	28
16 P16	45	15	43	34	18	64	34	20	27	20	38	57	39	37	-12	100	21
17 P17	28	18	16	44	27	-24	9	15	0	24	48	-25	7	8	28	21	100

PQMethod2.35 Geothemalv1
PAGE 2
Path and Project Name: C:\PQMethod\projects/Geotherm
Aug 16 22

Unrotated Factor Matrix

	Factors							
SORTS	1	2	3	4	5	6	7	8
1 P1	0.7064	-0.0618	0.1026	-0.1552	0.4071	-0.0508	0.0020	0.3478

2 P2	0.4780	-0.3999	-0.4332	-0.3027	-0.2713	-0.0993	-0.1563	-0.0382
3 P4	0.8286	-0.1068	-0.2769	-0.0658	0.3457	-0.0456	-0.1383	-0.1941
4 P5	0.6743	-0.3672	0.0609	0.3753	-0.2837	0.0544	-0.2472	-0.1578
5 P6	0.3166	-0.2540	-0.4455	0.0713	0.0731	-0.1566	0.6671	-0.0967
6 P7	0.4260	0.6780	-0.3435	-0.2334	-0.3476	0.0298	0.0818	0.0602
7 P8	0.3638	0.3688	0.2016	0.1861	-0.1782	-0.4817	0.2234	-0.4516
8 P9	0.5174	0.2321	0.7263	-0.2555	0.0692	0.0871	0.1248	-0.0858
9 P10	0.3790	-0.2212	-0.0873	-0.4411	-0.1837	0.6080	0.2036	-0.1390
10 P11	0.5525	0.1796	0.7156	-0.2245	-0.0710	-0.0947	-0.0179	0.0050
11 P12	0.6828	-0.2964	-0.0004	0.4476	-0.2684	0.0739	-0.2808	-0.0187
12 P13	0.3751	0.7872	-0.1777	-0.0732	-0.1987	-0.1224	-0.1614	0.2007
13 P14	0.6223	0.0557	-0.2654	-0.1013	0.5703	-0.1969	-0.1848	-0.0960
14 P15	0.3706	0.2165	0.1147	0.4387	0.2508	0.5720	0.1186	-0.1273
15 P3	0.3273	-0.6534	0.1617	-0.5066	-0.1822	-0.1162	0.0251	0.0503
16 P16	0.6847	0.4117	-0.2298	0.1764	-0.1210	0.1368	0.1495	0.2616
17 P17	0.3844	-0.4760	0.2417	0.4050	-0.0985	-0.1984	0.2809	0.3958
Eigenvalues	4.8546	2.6858	1.9354	1.5255	1.1980	1.1191	0.9186	0.7224
% expl.Var.	29	16	11	9	7	7	5	4

Cumulative Communalities Matrix

	Factors 1 Thru							
SORTS	1	2	3	4	5	6	7	8
1 P1	0.4990	0.5029	0.5134	0.5375	0.7032	0.7057	0.7057	0.8267
2 P2	0.2285	0.3884	0.5760	0.6677	0.7413	0.7511	0.7756	0.7770
3 P4	0.6865	0.6979	0.7746	0.7789	0.8984	0.9005	0.9196	0.9573
4 P5	0.4546	0.5895	0.5932	0.7340	0.8145	0.8174	0.8785	0.9034
5 P6	0.1002	0.1647	0.3632	0.3682	0.3736	0.3981	0.8432	0.8525
6 P7	0.1815	0.6411	0.7591	0.8136	0.9344	0.9353	0.9420	0.9456
7 P8	0.1323	0.2683	0.3090	0.3437	0.3754	0.6074	0.6574	0.8613
8 P9	0.2677	0.3216	0.8491	0.9144	0.9192	0.9268	0.9423	0.9497
9 P10	0.1437	0.1926	0.2002	0.3948	0.4286	0.7982	0.8396	0.8589
10 P11	0.3052	0.3375	0.8496	0.9000	0.9050	0.9140	0.9143	0.9143
11 P12	0.4662	0.5540	0.5540	0.7544	0.8264	0.8319	0.9107	0.9111
12 P13	0.1407	0.7604	0.7920	0.7974	0.8368	0.8518	0.8779	0.9181
13 P14	0.3873	0.3904	0.4608	0.4710	0.7963	0.8351	0.8692	0.8784
14 P15	0.1373	0.1842	0.1973	0.3898	0.4527	0.7799	0.7940	0.8102
15 P3	0.1071	0.5340	0.5602	0.8168	0.8500	0.8635	0.8641	0.8666
16 P16	0.4688	0.6383	0.6911	0.7223	0.7369	0.7556	0.7780	0.8464
17 P17	0.1478	0.3744	0.4328	0.5968	0.6065	0.6459	0.7248	0.8815
cum% expl.Var.	29	44	56	65	72	78	84	88

Factor Matrix with an X Indicating a Defining Sort

	Loadings		
QSORT	1	2	3
1 P1	0.5360X	0.3086	0.3617
2 P2	0.6287X	0.2961	-0.3051
3 P4	0.6612X	0.5742	0.0884
4 P5	0.7326X	0.1386	0.1929
5 P6	0.4118	0.2950	-0.3264
6 P7	-0.1798	0.8348X	0.1731
7 P8	-0.0133	0.3027	0.4660X
8 P9	0.1813	0.0055	0.9034X
9 P10	0.4249X	0.1404	0.0040
10 P11	0.2435	0.0015	0.8890X
11 P12	0.6892X	0.2201	0.1749
12 P13	-0.2968	0.7717X	0.3291
13 P14	0.4006	0.5430X	0.0737
14 P15	0.1021	0.2697	0.3379
15 P3	0.6926X	-0.2835	0.0122
16 P16	0.1891	0.7630X	0.2706

17	P17	0.6042X	-0.1954	0.1721
% expl.Var.		22	18	15

Free Distribution Data Results

QSORT		MEAN	ST.DEV.
1	P1	0.000	2.041
2	P2	0.000	2.041
3	P4	0.000	2.041
4	P5	0.000	2.041
5	P6	0.000	2.041
6	P7	0.000	2.041
7	P8	0.000	2.041
8	P9	0.000	2.041
9	P10	0.000	2.041
10	P11	0.000	2.041
11	P12	0.000	2.041
12	P13	0.000	2.041
13	P14	0.000	2.041
14	P15	0.000	2.041
15	P3	0.000	2.041
16	P16	0.000	2.041
17	P17	0.000	2.041

Factor Scores with Corresponding Ranks

No.	Statement	No.	Factors 1		2		3	
1	De gemeente Groningen moet zelf regie houden over de o	1	0.50	8	-1.24	22	-0.10	16
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over d	2	-0.93	21	-1.48	24	-1.53	24
3	Ministeries en gemeenten betrokken bij geothermie in N	3	-0.21	15	-1.36	23	0.43	9
4	De informatie die de Groningse gemeenteraad krijgt van	4	0.32	9	0.38	11	-1.01	22
5	In Groningen is veel kennis van de ondergrond en dat b	5	0.07	10	0.50	10	1.60	2
6	Er is in Nederland voldoende technische kennis over ge	6	0.52	7	0.90	7	-0.62	19
7	Geothermie kan alleen worden ontwikkeld door grootscha	7	-0.18	14	-0.72	20	0.06	12
8	Bij diepe geothermie vormt de gebrekkige geologische k	8	-0.02	12	-1.97	25	1.37	3
9	Het Ministerie van Economische Zaken en Klimaat moet g	9	-0.21	16	1.40	2	-0.52	18
10	Geothermie is te complex voor de gemeenteraad om zelfs	10	0.72	6	1.04	6	0.91	5
11	De ontwikkeling van geothermie in heel Nederland wordt	11	1.36	3	1.38	3	2.05	1
12	De media moet gebruikt worden door het Ministerie van	12	-0.93	22	1.11	5	0.55	7
13	De positie van het Staatstoezicht op de Mijnen moet o	13	2.23	1	-0.64	19	-1.47	23
14	Private operators hebben een voorlopersrol in de toeko	14	0.75	5	0.63	9	1.07	4
15	Omwonende van geothermieprojecten hebben vertrouwen in	15	-1.05	23	-0.46	16	-1.99	25
16	De eindverantwoordelijkheid voor veiligheid van geothe	16	1.70	2	-0.49	17	0.55	7
17	Geothermie is de belangrijkste ontwikkeling voor het u	17	-1.56	24	-0.33	13	-0.95	21
18	Er zullen altijd mensen zijn die tegen de ontwikkeling	18	-0.58	20	1.43	1	0.03	14
19	Doordat een warmtewisselaar weinig ruimte gebruikt, pa	19	-0.50	19	0.67	8	0.30	10
20	Kritische meningen over geothermie krijgen de ruimte o	20	0.99	4	1.20	4	0.19	11
21	Begrijpen hoe burgers over projecten in de bodem denke	21	-0.38	18	-0.36	15	-0.95	21
22	Een geothermieproject moet zoveel mogelijk aansluiten	22	0.04	11	-0.36	15	0.03	14
23	De gemeenteraad vertegenwoordigt de belangen van de bu	23	-0.08	13	-0.53	18	-0.00	15
24	Er is geen relatie tussen geothermie en aardbevingen,	24	-2.33	25	-0.85	21	-0.52	18
25	Ik heb liever dat de overheid investeert in grootschal	25	-0.23	17	0.15	12	0.49	8

Correlations Between Factor Scores

	1	2	3
1	1.0000	0.1865	0.3044
2	0.1865	1.0000	0.2705

Factor Scores -- For Factor 1

No.	Statement	No.	Z-SCORES
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	2.226
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	1.704
11	De ontwikkeling van geothermie in heel Nederland wordt negat	11	1.357
20	Kritische meningen over geothermie krijgen de ruimte om geho	20	0.985
14	Private operators hebben een voorlopersrol in de toekomstige	14	0.753
10	Geothermie is te complex voor de gemeenteraad om zelfstandig	10	0.719
6	Er is in Nederland voldoende technische kennis over geotherm	6	0.517
1	De gemeente Groningen moet zelf regie houden over de ontwikk	1	0.502
4	De informatie die de Groningse gemeenteraad krijgt van exter	4	0.316
5	In Groningen is veel kennis van de ondergrond en dat biedt e	5	0.073
22	Een geothermieproject moet zoveel mogelijk aansluiten bij an	22	0.043
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	-0.021
23	De gemeenteraad vertegenwoordigt de belangen van de burgers	23	-0.080
7	Geothermie kan alleen worden ontwikkeld door grootschalige i	7	-0.180
3	Ministeries en gemeenten betrokken bij geothermie in Nederla	3	-0.205
9	Het Ministerie van Economische Zaken en Klimaat moet geother	9	-0.207
25	Ik heb liever dat de overheid investeert in grootschalige ge	25	-0.230
21	Begrijpen hoe burgers over projecten in de bodem denken is h	21	-0.384
19	Doordat een warmtewisselaar weinig ruimte gebruikt, past het	19	-0.501
18	Er zullen altijd mensen zijn die tegen de ontwikkeling van g	18	-0.581
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over de voor	2	-0.931
12	De media moet gebruikt worden door het Ministerie van Econom	12	-0.931
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-1.053
17	Geothermie is de belangrijkste ontwikkeling voor het uitgroe	17	-1.561
24	Er is geen relatie tussen geothermie en aardbevingen, aangez	24	-2.329

Factor Scores -- For Factor 2

No.	Statement	No.	Z-SCORES
18	Er zullen altijd mensen zijn die tegen de ontwikkeling van g	18	1.431
9	Het Ministerie van Economische Zaken en Klimaat moet geother	9	1.402
11	De ontwikkeling van geothermie in heel Nederland wordt negat	11	1.383
20	Kritische meningen over geothermie krijgen de ruimte om geho	20	1.203
12	De media moet gebruikt worden door het Ministerie van Econom	12	1.111
10	Geothermie is te complex voor de gemeenteraad om zelfstandig	10	1.038
6	Er is in Nederland voldoende technische kennis over geotherm	6	0.905
19	Doordat een warmtewisselaar weinig ruimte gebruikt, past het	19	0.672
14	Private operators hebben een voorlopersrol in de toekomstige	14	0.632
5	In Groningen is veel kennis van de ondergrond en dat biedt e	5	0.505
4	De informatie die de Groningse gemeenteraad krijgt van exter	4	0.377
25	Ik heb liever dat de overheid investeert in grootschalige ge	25	0.148
17	Geothermie is de belangrijkste ontwikkeling voor het uitgroe	17	-0.328
21	Begrijpen hoe burgers over projecten in de bodem denken is h	21	-0.364
22	Een geothermieproject moet zoveel mogelijk aansluiten bij an	22	-0.364
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-0.462
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	-0.495
23	De gemeenteraad vertegenwoordigt de belangen van de burgers	23	-0.531
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	-0.636
7	Geothermie kan alleen worden ontwikkeld door grootschalige i	7	-0.724
24	Er is geen relatie tussen geothermie en aardbevingen, aangez	24	-0.852
1	De gemeente Groningen moet zelf regie houden over de ontwikk	1	-1.245
3	Ministeries en gemeenten betrokken bij geothermie in Nederla	3	-1.356
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over de voor	2	-1.481
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	-1.969

Factor Scores -- For Factor 3

No.	Statement	No.	Z-SCORES
11	De ontwikkeling van geothermie in heel Nederland wordt negat	11	2.053
5	In Groningen is veel kennis van de ondergrond en dat biedt e	5	1.595
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	1.372
14	Private operators hebben een voorlopersrol in de toekomstige	14	1.074
10	Geothermie is te complex voor de gemeenteraad om zelfstandig	10	0.915
12	De media moet gebruikt worden door het Ministerie van Econom	12	0.553
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	0.553
25	Ik heb liever dat de overheid investeert in grootschalige ge	25	0.489
3	Ministeries en gemeenten betrokken bij geothermie in Nederla	3	0.426
19	Doordat een warmtewisselaar weinig ruimte gebruikt, past het	19	0.299
20	Kritische meningen over geothermie krijgen de ruimte om geho	20	0.190
7	Geothermie kan alleen worden ontwikkeld door grootschalige i	7	0.064
18	Er zullen altijd mensen zijn die tegen de ontwikkeling van g	18	0.032
22	Een geothermieproject moet zoveel mogelijk aansluiten bij an	22	0.032
23	De gemeenteraad vertegenwoordigt de belangen van de burgers	23	-0.000
1	De gemeente Groningen moet zelf regie houden over de ontwikk	1	-0.095
24	Er is geen relatie tussen geothermie en aardbevingen, aangez	24	-0.521
9	Het Ministerie van Economische Zaken en Klimaat moet geother	9	-0.521
6	Er is in Nederland voldoende technische kennis over geotherm	6	-0.617
21	Begrijpen hoe burgers over projecten in de bodem denken is h	21	-0.947
17	Geothermie is de belangrijkste ontwikkeling voor het uitgroe	17	-0.947
4	De informatie die de Groningse gemeenteraad krijgt van exter	4	-1.010
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	-1.468
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over de voor	2	-1.532
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-1.989

Descending Array of Differences Between Factors 1 and 2

No.	Statement	No.	Type 1	Type 2	Difference
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	2.226	-0.636	2.862
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	1.704	-0.495	2.198
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	-0.021	-1.969	1.948
1	De gemeente Groningen moet zelf regie houden over de ontwikk	1	0.502	-1.245	1.746
3	Ministeries en gemeenten betrokken bij geothermie in Nederla	3	-0.205	-1.356	1.151
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over de voor	2	-0.931	-1.481	0.550
7	Geothermie kan alleen worden ontwikkeld door grootschalige i	7	-0.180	-0.724	0.543
23	De gemeenteraad vertegenwoordigt de belangen van de burgers	23	-0.080	-0.531	0.451
22	Een geothermieproject moet zoveel mogelijk aansluiten bij an	22	0.043	-0.364	0.407
14	Private operators hebben een voorlopersrol in de toekomstige	14	0.753	0.632	0.121
21	Begrijpen hoe burgers over projecten in de bodem denken is h	21	-0.384	-0.364	-0.020
11	De ontwikkeling van geothermie in heel Nederland wordt negat	11	1.357	1.383	-0.026
4	De informatie die de Groningse gemeenteraad krijgt van exter	4	0.316	0.377	-0.061
20	Kritische meningen over geothermie krijgen de ruimte om geho	20	0.985	1.203	-0.217
10	Geothermie is te complex voor de gemeenteraad om zelfstandig	10	0.719	1.038	-0.319
25	Ik heb liever dat de overheid investeert in grootschalige ge	25	-0.230	0.148	-0.377
6	Er is in Nederland voldoende technische kennis over geotherm	6	0.517	0.905	-0.387
5	In Groningen is veel kennis van de ondergrond en dat biedt e	5	0.073	0.505	-0.432
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-1.053	-0.462	-0.591
19	Doordat een warmtewisselaar weinig ruimte gebruikt, past het	19	-0.501	0.672	-1.173
17	Geothermie is de belangrijkste ontwikkeling voor het uitgroe	17	-1.561	-0.328	-1.233
24	Er is geen relatie tussen geothermie en aardbevingen, aangez	24	-2.329	-0.852	-1.477
9	Het Ministerie van Economische Zaken en Klimaat moet geother	9	-0.207	1.402	-1.609
18	Er zullen altijd mensen zijn die tegen de ontwikkeling van g	18	-0.581	1.431	-2.013
12	De media moet gebruikt worden door het Ministerie van Econom	12	-0.931	1.111	-2.042

Path and Project Name: C:\PQMethod\projects/Geotherm
Aug 16 22

Descending Array of Differences Between Factors 1 and 3

No.	Statement	No.	Type 1	Type 3	Difference
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	2.226	-1.468	3.694
4	De informatie die de Groningse gemeenteraad krijgt van exter	4	0.316	-1.010	1.327
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	1.704	0.553	1.151
6	Er is in Nederland voldoende technische kennis over geotherm	6	0.517	-0.617	1.134
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-1.053	-1.989	0.936
20	Kritische meningen over geothermie krijgen de ruimte om geho	20	0.985	0.190	0.795
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over de voor	2	-0.931	-1.532	0.601
1	De gemeente Groningen moet zelf regie houden over de ontwikk	1	0.502	-0.095	0.597
21	Begrijpen hoe burgers over projecten in de bodem denken is h	21	-0.384	-0.947	0.563
9	Het Ministerie van Economische Zaken en Klimaat moet geother	9	-0.207	-0.521	0.314
22	Een geothermieproject moet zoveel mogelijk aansluiten bij an	22	0.043	0.032	0.011
23	De gemeenteraad vertegenwoordigt de belangen van de burgers	23	-0.080	-0.000	-0.080
10	Geothermie is te complex voor de gemeenteraad om zelfstandig	10	0.719	0.915	-0.196
7	Geothermie kan alleen worden ontwikkeld door grootschalige i	7	-0.180	0.064	-0.244
14	Private operators hebben een voorlopersrol in de toekomstige	14	0.753	1.074	-0.321
18	Er zullen altijd mensen zijn die tegen de ontwikkeling van g	18	-0.581	0.032	-0.613
17	Geothermie is de belangrijkste ontwikkeling voor het uitgroe	17	-1.561	-0.947	-0.614
3	Ministeries en gemeenten betrokken bij geothermie in Nederla	3	-0.205	0.426	-0.631
11	De ontwikkeling van geothermie in heel Nederland wordt negat	11	1.357	2.053	-0.696
25	Ik heb liever dat de overheid investeert in grootschalige ge	25	-0.230	0.489	-0.719
19	Doordat een warmtewisselaar weinig ruimte gebruikt, past het	19	-0.501	0.299	-0.800
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	-0.021	1.372	-1.394
12	De media moet gebruikt worden door het Ministerie van Econom	12	-0.931	0.553	-1.484
5	In Groningen is veel kennis van de ondergrond en dat biedt e	5	0.073	1.595	-1.523
24	Er is geen relatie tussen geothermie en aardbevingen, aangez	24	-2.329	-0.521	-1.808

Path and Project Name: C:\PQMethod\projects/Geotherm
Aug 16 22

Descending Array of Differences Between Factors 2 and 3

No.	Statement	No.	Type 2	Type 3	Difference
9	Het Ministerie van Economische Zaken en Klimaat moet geother	9	1.402	-0.521	1.923
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-0.462	-1.989	1.527
6	Er is in Nederland voldoende technische kennis over geotherm	6	0.905	-0.617	1.521
18	Er zullen altijd mensen zijn die tegen de ontwikkeling van g	18	1.431	0.032	1.399
4	De informatie die de Groningse gemeenteraad krijgt van exter	4	0.377	-1.010	1.387
20	Kritische meningen over geothermie krijgen de ruimte om geho	20	1.203	0.190	1.012
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	-0.636	-1.468	0.832
17	Geothermie is de belangrijkste ontwikkeling voor het uitgroe	17	-0.328	-0.947	0.619
21	Begrijpen hoe burgers over projecten in de bodem denken is h	21	-0.364	-0.947	0.583
12	De media moet gebruikt worden door het Ministerie van Econom	12	1.111	0.553	0.558
19	Doordat een warmtewisselaar weinig ruimte gebruikt, past het	19	0.672	0.299	0.373
10	Geothermie is te complex voor de gemeenteraad om zelfstandig	10	1.038	0.915	0.123
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over de voor	2	-1.481	-1.532	0.050
24	Er is geen relatie tussen geothermie en aardbevingen, aangez	24	-0.852	-0.521	-0.331
25	Ik heb liever dat de overheid investeert in grootschalige ge	25	0.148	0.489	-0.342
22	Een geothermieproject moet zoveel mogelijk aansluiten bij an	22	-0.364	0.032	-0.396
14	Private operators hebben een voorlopersrol in de toekomstige	14	0.632	1.074	-0.442
23	De gemeenteraad vertegenwoordigt de belangen van de burgers	23	-0.531	-0.000	-0.531
11	De ontwikkeling van geothermie in heel Nederland wordt negat	11	1.383	2.053	-0.670
7	Geothermie kan alleen worden ontwikkeld door grootschalige i	7	-0.724	0.064	-0.787
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	-0.495	0.553	-1.047
5	In Groningen is veel kennis van de ondergrond en dat biedt e	5	0.505	1.595	-1.090
1	De gemeente Groningen moet zelf regie houden over de ontwikk	1	-1.245	-0.095	-1.149
3	Ministeries en gemeenten betrokken bij geothermie in Nederla	3	-1.356	0.426	-1.782
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	-1.969	1.372	-3.342

Path and Project Name: C:\PQMethod\projects/Geotherm
Aug 16 22

Exact Factor Scores (á la SPSS) in Z-Score and T-Score units

No.	Statement	No.	Factors 1		2		3	
1	De gemeente Groningen moet zelf regie houden over de o	1	1.10	61	-0.85	42	-0.45	46
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over d	2	-0.41	46	-1.09	39	-1.34	37
3	Ministeries en gemeenten betrokken bij geothermie in N	3	0.21	52	-1.19	38	-0.03	50
4	De informatie die de Groningse gemeenteraad krijgt van	4	0.05	51	0.49	55	-0.80	42
5	In Groningen is veel kennis van de ondergrond en dat b	5	0.09	51	0.19	52	1.84	68
6	Er is in Nederland voldoende technische kennis over ge	6	0.50	55	0.65	56	-0.38	46
7	Geothermie kan alleen worden ontwikkeld door grootscha	7	-0.33	47	-1.00	40	0.71	57
8	Bij diepe geothermie vormt de gebrekkige geologische k	8	0.31	53	-2.98	20	1.21	62
9	Het Ministerie van Economische Zaken en Klimaat moet g	9	-0.79	42	1.72	67	-0.23	48
10	Geothermie is te complex voor de gemeenteraad om zelfs	10	0.63	56	1.04	60	-0.02	50
11	De ontwikkeling van geothermie in heel Nederland wordt	11	0.89	59	0.92	59	2.18	72
12	De media moet gebruikt worden door het Ministerie van	12	-1.28	37	0.95	60	1.20	62
13	De positie van het Staatstoezicht op de Mijnen moet o	13	2.52	75	0.46	55	-1.85	32
14	Private operators hebben een voorlopersrol in de toeko	14	0.84	58	0.79	58	0.33	53
15	Omwonende van geothermieprojecten hebben vertrouwen in	15	-0.77	42	-0.21	48	-1.88	31
16	De eindverantwoordelijkheid voor veiligheid van geothe	16	1.53	65	-0.53	45	0.49	55
17	Geothermie is de belangrijkste ontwikkeling voor het u	17	-1.50	35	-0.12	49	-1.06	39
18	Er zullen altijd mensen zijn die tegen de ontwikkeling	18	-0.80	42	0.91	59	-0.17	48
19	Doordat een warmtewisselaar weinig ruimte gebruikt, pa	19	-0.51	45	0.86	59	0.23	52
20	Kritische meningen over geothermie krijgen de ruimte o	20	0.50	55	0.80	58	-0.01	50
21	Begrijpen hoe burgers over projecten in de bodem denke	21	-0.28	47	-0.37	46	-0.81	42
22	Een geothermieproject moet zoveel mogelijk aansluiten	22	-0.05	49	-0.38	46	0.25	52
23	De gemeenteraad vertegenwoordigt de belangen van de bu	23	0.24	52	-0.43	46	-0.03	50
24	Er is geen relatie tussen geothermie en aardbevingen,	24	-2.21	28	-0.67	43	0.02	50
25	Ik heb liever dat de overheid investeert in grootschal	25	-0.46	45	0.06	51	0.61	56

Factor Q-Sort Values for Each Statement

No.	Statement	No.	Factor Arrays 1	2	3
1	De gemeente Groningen moet zelf regie houden over de ontwikk	1	1	-2	-1
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over de voor	2	-2	-3	-3
3	Ministeries en gemeenten betrokken bij geothermie in Nederla	3	0	-3	1
4	De informatie die de Groningse gemeenteraad krijgt van exter	4	1	0	-2
5	In Groningen is veel kennis van de ondergrond en dat biedt e	5	1	1	3
6	Er is in Nederland voldoende technische kennis over geotherm	6	1	1	-1
7	Geothermie kan alleen worden ontwikkeld door grootschalige i	7	0	-2	0
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	0	-4	3
9	Het Ministerie van Economische Zaken en Klimaat moet geother	9	-1	3	-1
10	Geothermie is te complex voor de gemeenteraad om zelfstandig	10	2	2	2
11	De ontwikkeling van geothermie in heel Nederland wordt negat	11	3	3	4
12	De media moet gebruikt worden door het Ministerie van Econom	12	-2	2	1
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	4	-1	-3
14	Private operators hebben een voorlopersrol in de toekomstige	14	2	1	2
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-3	-1	-4
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	3	-1	1
17	Geothermie is de belangrijkste ontwikkeling voor het uitgroe	17	-3	0	-2
18	Er zullen altijd mensen zijn die tegen de ontwikkeling van g	18	-2	4	0
19	Doordat een warmtewisselaar weinig ruimte gebruikt, past het	19	-1	1	1
20	Kritische meningen over geothermie krijgen de ruimte om geho	20	2	2	0
21	Begrijpen hoe burgers over projecten in de bodem denken is h	21	-1	0	-2
22	Een geothermieproject moet zoveel mogelijk aansluiten bij an	22	0	0	0
23	De gemeenteraad vertegenwoordigt de belangen van de burgers	23	0	-1	0
24	Er is geen relatie tussen geothermie en aardbevingen, aangez	24	-4	-2	-1
25	Ik heb liever dat de overheid investeert in grootschalige ge	25	-1	0	1

Variance = 4.000 St. Dev. = 2.000

Factor Q-Sort Values for Statements sorted by Consensus vs. Disagreement (Variance across Factor Z-Scores)

No.	Statement	No.			
1	De gemeente Groningen moet zelf regie houden over de ontwikk	1	1	-2	-1
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over de voor	2	-2	-3	-3
3	Ministeries en gemeenten betrokken bij geothermie in Nederla	3	0	-3	1
4	De informatie die de Groningse gemeenteraad krijgt van exter	4	1	0	-2
5	In Groningen is veel kennis van de ondergrond en dat biedt e	5	1	1	3
6	Er is in Nederland voldoende technische kennis over geotherm	6	1	1	-1
7	Geothermie kan alleen worden ontwikkeld door grootschalige i	7	0	-2	0
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	0	-4	3
9	Het Ministerie van Economische Zaken en Klimaat moet geother	9	-1	3	-1
10	Geothermie is te complex voor de gemeenteraad om zelfstandig	10	2	2	2
11	De ontwikkeling van geothermie in heel Nederland wordt negat	11	3	3	4
12	De media moet gebruikt worden door het Ministerie van Econom	12	-2	2	1
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	4	-1	-3
14	Private operators hebben een voorlopersrol in de toekomstige	14	2	1	2
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-3	-1	-4
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	3	-1	1
17	Geothermie is de belangrijkste ontwikkeling voor het uitgroe	17	-3	0	-2
18	Er zullen altijd mensen zijn die tegen de ontwikkeling van g	18	-2	4	0
19	Doordat een warmtewisselaar weinig ruimte gebruikt, past het	19	-1	1	1
20	Kritische meningen over geothermie krijgen de ruimte om geho	20	2	2	0
21	Begrijpen hoe burgers over projecten in de bodem denken is h	21	-1	0	-2
22	Een geothermieproject moet zoveel mogelijk aansluiten bij an	22	0	0	0
23	De gemeenteraad vertegenwoordigt de belangen van de burgers	23	0	-1	0
24	Er is geen relatie tussen geothermie en aardbevingen, aangez	24	-4	-2	-1
25	Ik heb liever dat de overheid investeert in grootschalige ge	25	-1	0	1

Variance = 4.000 St. Dev. = 2.000

Factor Q-Sort Values for Statements sorted by Consensus vs. Disagreement (Variance across Factor Z-Scores)

			Factor Arrays		
No.	Statement	No.	1	2	3
10	Geothermie is te complex voor de gemeenteraad om zelfstandig	10	2	2	2
14	Private operators hebben een voorlopersrol in de toekomstige	14	2	1	2
22	Een geothermieproject moet zoveel mogelijk aansluiten bij an	22	0	0	0
23	De gemeenteraad vertegenwoordigt de belangen van de burgers	23	0	-1	0
21	Begrijpen hoe burgers over projecten in de bodem denken is h	21	-1	0	-2
2	De Groningse gemeenteraad is goed geÃ¯nformeerd over de voor	2	-2	-3	-3
25	Ik heb liever dat de overheid investeert in grootschalige ge	25	-1	0	1
11	De ontwikkeling van geothermie in heel Nederland wordt negat	11	3	3	4
7	Geothermie kan alleen worden ontwikkeld door grootschalige i	7	0	-2	0
20	Kritische meningen over geothermie krijgen de ruimte om geho	20	2	2	0
19	Doordat een warmtewisselaar weinig ruimte gebruikt, past het	19	-1	1	1
17	Geothermie is de belangrijkste ontwikkeling voor het uitgroe	17	-3	0	-2
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-3	-1	-4
4	De informatie die de Groningse gemeenteraad krijgt van exter	4	1	0	-2
5	In Groningen is veel kennis van de ondergrond en dat biedt e	5	1	1	3
6	Er is in Nederland voldoende technische kennis over geotherm	6	1	1	-1
1	De gemeente Groningen moet zelf regie houden over de ontwikk	1	1	-2	-1
3	Ministeries en gemeenten betrokken bij geothermie in Nederla	3	0	-3	1
24	Er is geen relatie tussen geothermie en aardbevingen, aangez	24	-4	-2	-1
18	Er zullen altijd mensen zijn die tegen de ontwikkeling van g	18	-2	4	0
9	Het Ministerie van Economische Zaken en Klimaat moet geother	9	-1	3	-1
12	De media moet gebruikt worden door het Ministerie van Econom	12	-2	2	1
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	3	-1	1
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	0	-4	3
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	4	-1	-3

Factor Characteristics

	Factors		
	1	2	3
No. of Defining Variables	8	4	3

Average Rel. Coef.	0.800	0.800	0.800
Composite Reliability	0.970	0.941	0.923
S.E. of Factor Z-Scores	0.174	0.243	0.277

Standard Errors for Differences in Factor Z-Scores

(Diagonal Entries Are S.E. Within Factors)

Factors	1	2	3
1	0.246	0.299	0.327
2	0.299	0.343	0.368
3	0.327	0.368	0.392

Distinguishing Statements for Factor 1

(P < .05 ; Asterisk (*) Indicates Significance at P < .01)

Both the Factor Q-Sort Value (Q-SV) and the Z-Score (Z-SCR) are Shown.

		Factors					
		1		2		3	
No.	Statement	No.	Q-SV	Z-SCR	Q-SV	Z-SCR	Q-SV	Z-SCR
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	4	2.23*	-1	-0.64	-3	-1.47
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	3	1.70*	-1	-0.49	1	0.55
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	0	-0.02*	-4	-1.97	3	1.37
19	Doordat een warmtewisselaar weinig ruimte gebruikt, past het	19	-1	-0.50	1	0.67	1	0.30
12	De media moet gebruikt worden door het Ministerie van Econom	12	-2	-0.93*	2	1.11	1	0.55
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-3	-1.05	-1	-0.46	-4	-1.99
24	Er is geen relatie tussen geothermie en aardbevingen, aangez	24	-4	-2.33*	-2	-0.85	-1	-0.52

Distinguishing Statements for Factor 2

(P < .05 ; Asterisk (*) Indicates Significance at P < .01)

Both the Factor Q-Sort Value (Q-SV) and the Z-Score (Z-SCR) are Shown.

		Factors					
		1		2		3	
No.	Statement	No.	Q-SV	Z-SCR	Q-SV	Z-SCR	Q-SV	Z-SCR
18	Er zullen altijd mensen zijn die tegen de ontwikkeling van g	18	-2	-0.58	4	1.43*	0	0.03
9	Het Ministerie van Economische Zaken en Klimaat moet geother	9	-1	-0.21	3	1.40*	-1	-0.52
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-3	-1.05	-1	-0.46	-4	-1.99
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	3	1.70	-1	-0.49*	1	0.55
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	4	2.23	-1	-0.64	-3	-1.47
1	De gemeente Groningen moet zelf regie houden over de ontwikk	1	1	0.50	-2	-1.24*	-1	-0.10
3	Ministeries en gemeenten betrokken bij geothermie in Nederla	3	0	-0.21	-3	-1.36*	1	0.43
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	0	-0.02	-4	-1.97*	3	1.37

Distinguishing Statements for Factor 3

(P < .05 ; Asterisk (*) Indicates Significance at P < .01)

Both the Factor Q-Sort Value (Q-SV) and the Z-Score (Z-SCR) are Shown.

			Factors					
			1		2		3	
No.	Statement	No.	Q-SV	Z-SCR	Q-SV	Z-SCR	Q-SV	Z-SCR
5	In Groningen is veel kennis van de ondergrond en dat biedt e	5	1	0.07	1	0.50	3	1.60*
8	Bij diepe geothermie vormt de gebrekkige geologische kennis	8	0	-0.02	-4	-1.97	3	1.37*
16	De eindverantwoordelijkheid voor veiligheid van geothermisch	16	3	1.70	-1	-0.49	1	0.55*
20	Kritische meningen over geothermie krijgen de ruimte om geho	20	2	0.99	2	1.20	0	0.19
6	Er is in Nederland voldoende technische kennis over geotherm	6	1	0.52	1	0.90	-1	-0.62*
4	De informatie die de Groningse gemeenteraad krijgt van exter	4	1	0.32	0	0.38	-2	-1.01*
13	De positie van het Staatstoezicht op de Mijnen moet onafhan	13	4	2.23	-1	-0.64	-3	-1.47
15	Omwonende van geothermieprojecten hebben vertrouwen in de af	15	-3	-1.05	-1	-0.46	-4	-1.99*

Consensus Statements -- Those That Do Not Distinguish Between ANY Pair of Factors.

All Listed Statements are Non-Significant at P>.01, and Those Flagged With an * are also Non-Significant at P>.05.

			Factors					
			1		2		3	
No.	Statement	No.	Q-SV	Z-SCR	Q-SV	Z-SCR	Q-SV	Z-SCR
2*	De Groningse gemeenteraad is goed geÃ¯nformeerd over de voor	2	-2	-0.93	-3	-1.48	-3	-1.53
7	Geothermie kan alleen worden ontwikkeld door grootschalige i	7	0	-0.18	-2	-0.72	0	0.06
10*	Geothermie is te complex voor de gemeenteraad om zelfstandig	10	2	0.72	2	1.04	2	0.91
11	De ontwikkeling van geothermie in heel Nederland wordt negat	11	3	1.36	3	1.38	4	2.05
14*	Private operators hebben een voorlopersrol in de toekomstige	14	2	0.75	1	0.63	2	1.07
21*	Begrijpen hoe burgers over projecten in de bodem denken is h	21	-1	-0.38	0	-0.36	-2	-0.95
22*	Een geothermieproject moet zoveel mogelijk aansluiten bij an	22	0	0.04	0	-0.36	0	0.03
23*	De gemeenteraad vertegenwoordigt de belangen van de burgers	23	0	-0.08	-1	-0.53	0	-0.00
25	Ik heb liever dat de overheid investeert in grootschalige ge	25	-1	-0.23	0	0.15	1	0.49

QANALYZE was completet at 18:37:31

Appendix B: Consent form

VERKLARING GEÏNFORMEERDE TOESTEMMING

Onderzoeksproject: Koen Bruinsma's master scriptie

Deze masterscriptie onderzoekt de verschillende verhalen en perspectieven op de rol van kennis en macht in de ontwikkeling van geothermische energie in Groningen. Het onderzoek verzamelt gegevens over meningen, percepties en kennis van respondenten over beleidsvormingsprocessen in Groningen. De methodes die in het onderzoek gebruikt worden zijn diepte interviews met belangrijke belanghebbende, Q-methodologiek, welke een methode voor het wetenschappelijk bestuderen van menselijke subjectiviteit is, en analyses van beleidsdocumenten.

U bent uitgenodigd om als geïnterviewde deel te nemen aan dit onderzoek.

Uw toestemming geeft aan dat:

1. U bent geïnformeerd over het doel van het onderzoek;
2. U hebt spontaan en in volledige vrijheid aanvaard om geïnterviewd te worden;
3. U toestemming geeft voor het gebruik van geanonimiseerde interview gegevens voor
4. U instemt met het gebruik van geanonimiseerde interviewgegevens voor de onderzoeksdoelen van het project, inclusief de publicatie ervan.

Ik verklaar dat ik me ervan bewust ben dat:

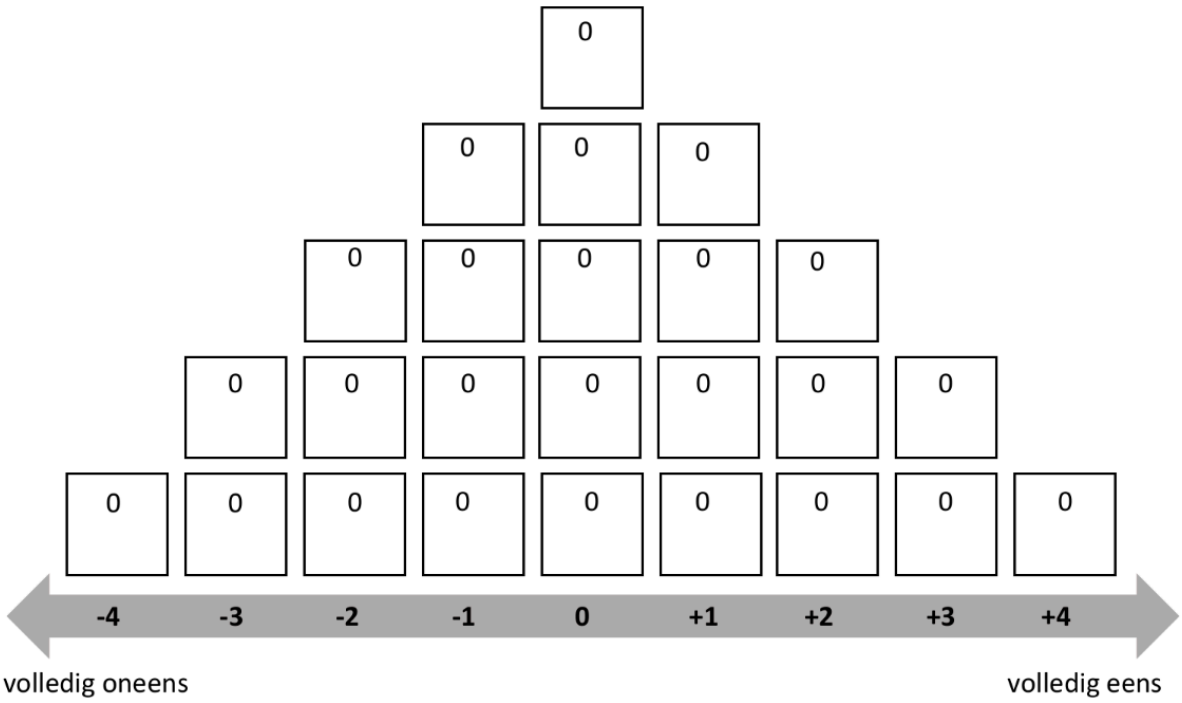
- het onderzoek omvat het verzamelen van individuele reacties, meningen, evaluaties
- elke deelnemer vrij is om opheldering te vragen over de procedure voor het verzamelen van gegevens en over elk ander aspect van het project;
- elke deelnemer vrij is om op elk moment de sessie te verlaten;
- de eventuele weigering tot deelname of het afzien tijdens de sessie geen nadelige gevolgen zal hebben voor de deelnemer;
- persoonsgegevens verzameld voor onderzoeksdoeleinden niet worden doorgegeven aan derden;
- de verzamelde persoonsgegevens anoniem worden uitgewerkt;
- het onderzoek wordt uitgevoerd rekening houdend met het onderzoeksethiek beleid van de Rijksuniversiteit Groningen (zie https://www.rug.nl/about-ug/policy-and-strategy/research-ethics/?lang=en)

Datum_____

Handtekening_____

Als u meent onjuist te zijn behandeld tijdens dit interview of voor meer informatie over het onderzoeksproces, neem dan contact op met de scriptiebegeleider, Dr. Ethemcan Turhan (e.turhan@rug.nl), Universitair Docent Ruimtelijke Ordening

Appendix C: Q sort grid



Appendix D: Participant instructions

Toekomstbeelden over de rol van geothermie in de energietransitie

Master Thesis Research

Koen Bruinsma

De manier waarop we denken en communiceren over het verloop van de energietransitie stuurt de ruimtelijke ontwikkeling in het Groninger landschap.

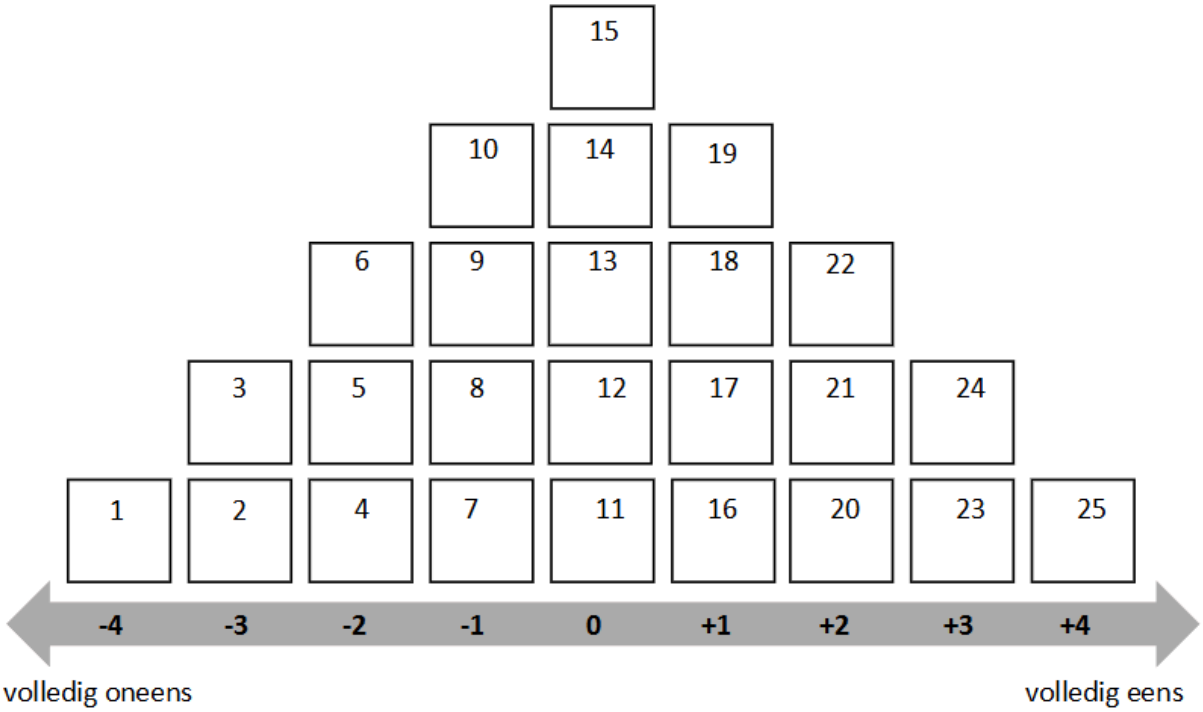
Om te verkennen welke perspectieven er over de toekomst van geothermie bestaan, ben ik benieuwd naar uw persoonlijke mening over de stellingen op slide 4.

Stelt u zich daarom voor dat er in de gemeente Groningen opnieuw geothermie wordt toegepast. Lees de instructies op de volgende slide. Sorteer vervolgens de stellingen op slide 4.

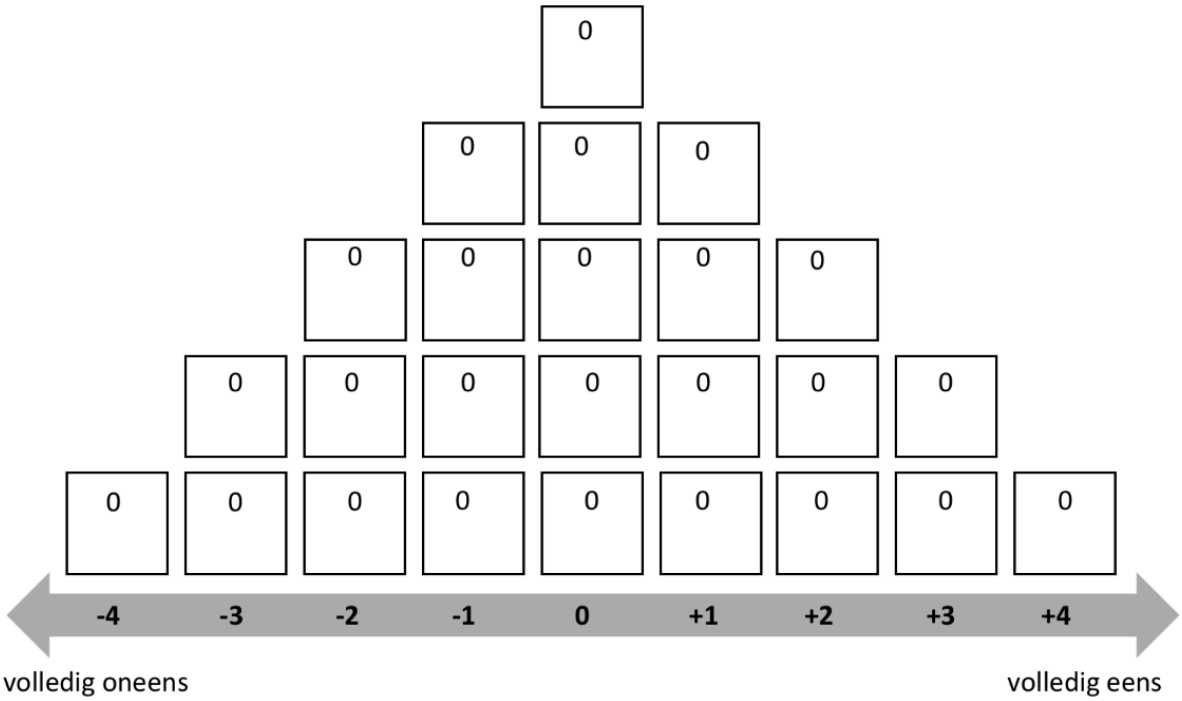
Instructies

- Lees alle statements door.
- Sorteer de uitspraken waar u het volgens u persoonlijk het minst (-4) tot het meest (+4) mee eens bent met betrekking tot het ontwikkelingsproces. Het doel is te bepalen met welke stellingen u het relatief meer en minder mee eens bent.
- Het is van belang dat alle statements in het raster worden ingevuld.
- Elk vakje kan slechts 1 statement bevatten.
- Heeft u geen kennis van de situatie in de Gemeente Groningen, neem dan een gemeente in uw hoofd waar u wel kennis van heeft of gemeenten in Nederland in het algemeen.
- Heeft u over een stelling geen mening of geen kennis over een stelling vul deze dan zoveel mogelijk in het midden (0) in.
- Zie de volgende slide voor een voorbeeld.

Voorbeeld



1. De gemeente Groningen moet zelf regie houden over de ontwikkeling van geothermische systemen binnen de gemeente
2. De Groningse gemeenteraad is goed geïnformeerd over de voordelen en risico's van geothermie
3. Ministeries en gemeenten betrokken bij geothermie in Nederland zijn goed geïnformeerd over de meest recente technische ontwikkelingen in geothermische industrie.
4. De informatie die de Groningse gemeenteraad krijgt van externe bureaus over de risico's van geothermie is eenzijdig
5. In Groningen is veel kennis van de ondergrond en dat biedt een unieke kans voor geothermie
6. Er is in Nederland voldoende technische kennis over geothermie beschikbaar
7. Geothermie kan alleen worden ontwikkeld door grootschalige inzet van reeds beschikbare technologieën en grote investeringen in nieuw onderzoek en ontwikkeling
8. Bij diepe geothermie vormt de gebrekkige geologische kennis het belangrijkste knelpunt
9. Het Ministerie van Economische Zaken en Klimaat moet geothermische pilot projecten financieren in Groningen omdat de kosten te hoog zijn voor particuliere investeerders
10. Geothermie is te complex voor de gemeenteraad om zelfstandig een gefundeerd investeringsbesluit te kunnen nemen
11. De ontwikkeling van geothermie in heel Nederland wordt negatief beïnvloed door nieuws over aardbevingen in Groningen
12. De media moet gebruikt worden door het Ministerie van Economische Zaken en Klimaat om het publieke beeld over geothermie te sturen
13. De positie van het Staatstoezicht op de Mijnen moet onafhankelijk zijn van de mijnindustrie en het Ministerie van Economische Zaken en Klimaat
14. Private operators hebben een voorlopersrol in de toekomstige ontwikkeling van geothermie in Nederland
15. Omwonende van geothermieprojecten hebben vertrouwen in de afhandeling van klachten door de rijksoverheid
16. De eindverantwoordelijkheid voor veiligheid van geothermische energie projecten ligt bij de winning vergunninghouder van het geothermische project
17. Geothermie is de belangrijkste ontwikkeling voor het uitgroeien van Groningen tot de duurzame energie stad van Europa
18. Er zullen altijd mensen zijn die tegen de ontwikkeling van geothermie zijn, maar je kan nooit iedereen tevreden houden.
19. Doordat een warmtewisselaar weinig ruimte gebruikt, past het goed in het bestaande landschap
20. Kritische meningen over geothermie krijgen de ruimte om gehoord te worden in het besluitvormingsproces
21. Begrijpen hoe burgers over projecten in de bodem denken is het belangrijkste onderdeel van het besluitvormingsproces rondom geothermie.
22. Een geothermieproject moet zoveel mogelijk aansluiten bij andere ruimtelijke ontwikkelingen
23. De gemeenteraad vertegenwoordigt de belangen van de burgers in het besluitvormingsproces rondom geothermie
24. Er is geen relatie tussen geothermie en aardbevingen, aangezien er geen 'volume' uit de bodem wordt gehaald zoals bij gaswinning
25. Ik heb liever dat de overheid investeert in grootschalige geothermische projecten dan dat ze investeert in windparken op het land.



10. Reference list

Addams, H., & Proops, J. L. R. (2001). *Social discourse and environmental policy : an application of Q methodology*. Edward Elgar Pub.

Adgar, H. (2018, June 13). *A Critical Evaluation of Poststructuralism's Contribution to Security*. E-International Relations. https://www.e-ir.info/2018/06/13/a-critical-evaluation-of-poststructuralisms-contribution-to-security/#:~:text=A%20common%20criticism%20of%20poststructuralism

Barry, J., & Proops, J. (1999). Seeking sustainability discourses with Q methodology. *Ecological Economics*, *28*(3), 337–345. https://doi.org/10.1016/s0921-8009(98)00053-6

Blackburn, S. (2008). *The Oxford dictionary of philosophy* (p. 353). Oxford University Press.

Boersema, W. (2022). *Gronings goud : over de macht van het gas en de rol van Rusland*. Ambo|Anthos.

Braakman, T. (2017, November 10). *WarmteStad: van voorbeeldproject tot fiasco*. Www.rtvnoord.nl. https://www.rtvnoord.nl/nieuws/186000/warmtestad-van-voorbeeldproject-tot-fiasco

Bridge, G. (2018). The map is not the territory: A sympathetic critique of energy research's spatial turn. *Energy Research & Social Science*, *36*, 11–20. https://doi.org/10.1016/j.erss.2017.09.033

Brown, S. R. (2019). Q Methodology in Research on Political Decision Making. *Oxford Research Encyclopedia of Politics*. https://doi.org/10.1093/acrefore/9780190228637.013.980

Calvert, K. (2015). From "energy geography" to "energy geographies." *Progress in Human Geography*, *40*(1), 105–125. https://doi.org/10.1177/0309132514566343

Catney, P., Dobson, A., Hall, S. M., Hards, S., MacGregor, S., Robinson, Z., Ormerod, M., & Ross, S. (2013). Community knowledge networks: an action-orientated approach to energy research. *Local Environment*, *18*(4), 506–520. https://doi.org/10.1080/13549839.2012.748729

Chateau, Z., Devine-Wright, P., & Wills, J. (2021). Integrating sociotechnical and spatial imaginaries in researching energy futures. *Energy Research & Social Science*, *80*, 102207. https://doi.org/10.1016/j.erss.2021.102207

Cotton, M. D., & Mahroos-Alsaiari, A. A. (2014). Key actor perspectives on stakeholder engagement in Omani Environmental Impact Assessment: an application of Q-Methodology. *Journal of Environmental Planning and Management*, *58*(1), 91–112. https://doi.org/10.1080/09640568.2013.847822

Cuppen, E., Breukers, S., Hisschemöller, M., & Bergsma, E. (2010). Q methodology to select participants for a stakeholder dialogue on energy options from biomass in the Netherlands. *Ecological Economics*, *69*(3), 579–591. https://doi.org/10.1016/j.ecolecon.2009.09.005

Curry, R., Barry, J., & McClenaghan, A. (2013). Northern Visions? Applying Q methodology to understand stakeholder views on the environmental and resource dimensions of sustainability. *Journal of Environmental Planning and*

Management, *56*(5), 624–649. https://doi.org/10.1080/09640568.2012.693453
Davoudi, S., Raynor, R., Reid, B., Crawford, J., Sykes, O., & Shaw, D. (2018). Policy and Practice Spatial imaginaries: Tyrannies or transformations? *Town Planning Review*, *89*(2), 97–124. https://doi.org/10.3828/tpr.2018.7
de Vries, B. (2021, March 17). *Ver van Den Haag: "Oost-Groningen blijft altijd een wingewest."* Nos.nl. https://nos.nl/artikel/2372980-ver-van-den-haag-oost-groningen-blijft-altijd-een-wingewest
Deutsche Welle. (2021, October 1). *Germany: Climate Activists Occupy Excavators to Block Coal Mine Expansion*. Dw.com. https://www.dw.com/en/germany-climate-activists-occupy-excavators-to-block-coal-mine-expansion/a-59379291
Devenish, A. (2022, January 5). *Dutch municipalities are tasked to lead the heat transition to quit gas – do they have the right tools for the job?* Going Dutch. https://www.going-dutch.org/news-1/dutch-municipalities-are-tasked-to-lead-the-heat-transition-to-quit-gas-do-they-have-the-right-tools-for-the-job
Duenckmann, F. (2010). The village in the mind: Applying Q-methodology to re-constructing constructions of rurality. *Journal of Rural Studies*, *26*(3), 284–295. https://doi.org/10.1016/j.jrurstud.2010.01.003
Dunlap, R. E., Brulle, R. J., & American Sociological Association. Task Force On Sociology And Global Climate Change. (2015). *Climate change and society : sociological perspectives : report of the American Sociological Association's Task Force on Sociology and Global Climate Change*. Oxford University Press.
EBN. (2018). Masterplan Aardwarmte in Nederland . In *EBN*. https://www.ebn.nl/wp-content/uploads/2018/05/20180529-Masterplan-Aardwarmte-in-Nederland.pdf
EBN. (2022). Energy in Figures. In *EBN*. https://www.ebn.nl/wp-content/uploads/2022/01/14253-EBN-Infographic-2022_A4-final_ENGELS.pdf
Fox, N. J. (2014). Post-structuralism and postmodernism. In W. C. Cockerham, R. Dingwall, & S. R. Quah (Eds.), *The Wiley-Blackwell Encyclopedia of Health, Illness, Behavior and Society*. Wiley.
Friedman, G., & Starr, H. (2002). *Agency, Structure and International Politics*. Routledge.
Gannon, K. E., Pettinotti, L., Conway, D., Surminski, S., Ndilanha, E., & Nyumba, T. (2022). Delivering the Sustainable Development Goals through development corridors in East Africa: A Q-Methodology approach to imagining development futures. *Environmental Science & Policy*, *129*, 56–67. https://doi.org/10.1016/j.envsci.2021.12.013
Geels, F. W. (2002). Technological Transitions as Evolutionary Reconfiguration processes: a multi-level Perspective and a case-study. *Research Policy*, *31*(8-9), 1257–1274. https://doi.org/10.1016/s0048-7333(02)00062-8
Geothermie Nederland. (2020, September 24). *Publicatie Nationale Omgevingsvisie*. Alles over Aardwarmte. https://allesoveraardwarmte.nl/publicatie-nationale-omgevingsvisie/

Geothermie Nederland. (2022). *Ontwikkeling van aardwarmte in Nederland*. Alles over Aardwarmte. https://allesoveraardwarmte.nl/de-toekomst-van-aardwarmte-in-nederland/
Gerding, M. A. W., Karel, E. H. K., & de Vries, G. E. (2015). The history of the peat manufacturing industry in The Netherlands: Peat moss litter and active carbon. *Mires and Peat*, *16*(10).
Graham, K., & Rudolph, D. (2014). Geography, Communities and Energy Futures: Alternative Research Paths. *Scottish Geographical Journal*, *130*(3), 143–151. https://doi.org/10.1080/14702541.2014.927616
Gregory, D. (2004). *The colonial present*. Blackwell Publishers.
Hall, K. (1981). The economic nature of information. *The Information Society*, *1*(2), 143–166. https://doi.org/10.1080/01972243.1981.9959946
Hanke, F., Guyet, R., & Feenstra, M. (2021). Do renewable energy communities deliver energy justice? Exploring insights from 71 European cases. *Energy Research & Social Science*, *80*, 102244. https://doi.org/10.1016/j.erss.2021.102244
Hardy, J. T. (2003). *Climate change : causes, effects, and solutions*. J. Wiley.
Healey, J. (2014). *The climate change crisis*. Spinney Press.
Heffron, R. J. (2021). *The Challenge for Energy Justice: Correcting Human Rights Abuses*. Springer Nature.
Holmes, D., & Gagnon, M. (2017). Power, discourse, and resistance: Poststructuralist influences in nursing. *Nursing Philosophy*, *19*(1). https://doi.org/10.1111/nup.12200
Hurlbert, M., & Rayner, J. (2018). Reconciling power, relations, and processes: The role of recognition in the achievement of energy justice for Aboriginal people. *Applied Energy*, *228*, 1320–1327. https://doi.org/10.1016/j.apenergy.2018.06.054
Itten, A. V. (2018). *Overcoming Social Division*. Routledge.
IPCC. (2022). Summary for Policymakers. *Global Warming of 1.5°C*, 3–24. https://doi.org/10.1017/9781009157940.001
Jasanoff, S., & Kim, S.-H. (2015). *Dreamscapes of modernity : sociotechnical imaginaries and the fabrication of power*. The University Of Chicago Press.
Jenkins, K., McCauley, D., & Forman, A. (2017). Energy justice: A policy approach. *Energy Policy*, *105*, 631–634. https://doi.org/10.1016/j.enpol.2017.01.052
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
KIA. (2021, September 22). *Wet open overheid*. KIA. https://kia.pleio.nl/cms/view/3e519e46-904c-438a-a9bf-92f14f7dd869/wet-open-overheid-woo
Kothari, U., & Wilkinson, R. (2010). Colonial Imaginaries and Postcolonial Transformations: Exiles, bases and beaches. *Third World Quarterly*, *31*(8), 1395-1412. https://doi.org/DOI: 10.1080/01436597.2010.538239
Knights, D., & Willmott, H. (1985). Power and Identity in Theory and Practice. *Sociological Review*, *33*, 22–46.
Kraal, D. (2018, February 13). *Energy justice: What is it and why do we need it?* IMPACT: Monash Business School. https://impact.monash.edu/energy/energy-justice-what-is-it-and-why-do-we-need-it/

Krueger, R., Tuler, S., & Webler, T. (2001). What Is a Good Public Participation Process? Five Perspectives from the Public. *Environmental Management*, *27*(3), 435–450. https://doi.org/10.1007/s002670010160
Kuiken, D., & Slobben, R. J. (2021). AARDWARMTE EN BURGERPARTICIPATIE. In *ResearchGate*. https://www.researchgate.net/publication/356732624_Burgerparticipatie_Aardwarmte/link/61a953d3aade5b1bf5fdbbcd/download
Lammers, I., & Arentsen, M. (2017). Rethinking Participation in Smart Energy System Planning. *Energies*, *10*(11), 1711. https://doi.org/10.3390/en10111711
Levenda, A. M., Richter, J., Miller, T., & Fisher, E. (2019). Regional sociotechnical imaginaries and the governance of energy innovations. *Futures*, *109*, 181–191. https://doi.org/10.1016/j.futures.2018.03.001
LyotardJ.-F. (2007). *The differend : phrases in dispute*. University Of Minnesota Press.
Lysias Consulting Group. (2018). *Eindrapport raadsonderzoek Geothermie Groningen*.
Mason, M., & Clarke, M. (2010). Post-Structuralism and Education. *International Encyclopedia of Education*, 175–182. https://doi.org/10.1016/b978-0-08-044894-7.01730-9
McCauley, D., Heffron, R. J., Stephan, H., & Jenkins, K. (2013). Advancing energy justice: the triumvirate of tenets. *International Energy Law Review*, *3*, 107–110.
Ministerie van Volksgezondheid, Welzijn en Sport. (2022). Greenhouse gas emissions in the Netherlands 1990–2020 National Inventory Report 2022. In *RIVM*. https://www.rivm.nl/bibliotheek/rapporten/2022-0005.pdf
New Energy Coalition. (2022). *Energy Valley*. New Energy Coalition. https://www.newenergycoalition.org/energy-valley/
Owens, S., & Driffill, L. (2008). How to change attitudes and behaviours in the context of energy. *Energy Policy*, *36*(12), 4412–4418. https://doi.org/10.1016/j.enpol.2008.09.031
Palmgreen, P., & Clarke, P. (1977). Agenda-Setting With Local and National Issues. *Communication Research*, *4*(4), 435–452. https://doi.org/10.1177/009365027700400404
Pettigrew, A. M. (1972). Information Control as a Power Resource. *Sociology*, *6*(2), 187–204. https://doi.org/10.1177/003803857200600202
Raadgever, G. T., Mostert, E., & van de Giesen, N. C. (2008). Identification of stakeholder perspectives on future flood management in the Rhine basin using Q methodology. *Hydrology and Earth System Sciences*, *12*(4), 1097–1109. https://doi.org/10.5194/hess-12-1097-2008
Riemersma, B., Correljé, A. F., & Künneke, R. W. (2020). Historical developments in Dutch gas systems: Unravelling safety concerns in gas provision. *Safety Science*, *121*, 147–157. https://doi.org/10.1016/j.ssci.2019.08.040
Rijksdienst voor Ondernemend Nederland. (2019, April 15). *Beleid warmte en koude*. RVO.nl. https://www.rvo.nl/onderwerpen/verduurzaming-warmtevoorziening/beleid
Rijksoverheid. (2022). *Klimaatbeleid* . Rijksoverheid. https://www.rijksoverheid.nl/onderwerpen/klimaatverandering/klimaatbeleid#:~:text=De%20Klimaatwet%20moet%20burgers%20en

Robbins, P., & Krueger, R. (2000). Beyond Bias? The Promise and Limits of Q Method in Human Geography. *The Professional Geographer*, *52*(4), 636–648. https://doi.org/10.1111/0033-0124.00252

Russell, A. D. (2017). *Subjectivity of Solar Power: Using Q Methodology to Evaluate Perceptions of Solar Energy Projects in the San Luis Valley* [MSc Thesis].

Sandling, J. (2022, September 10). *Q Methodology: Complete Beginner's Guide | JONATHAN SANDLING*. Jonathansandling.com. https://jonathansandling.com/q-methodology-complete-beginners-guide/

Schelhas, J., Hitchner, S., & Brosius, J. P. (2018). Envisioning and implementing wood-based bioenergy systems in the southern United States: Imaginaries in everyday talk. *Energy Research & Social Science*, *35*, 182–192. https://doi.org/10.1016/j.erss.2017.10.042

Schlosberg, D. (2003). The Justice of Environmental Justice: Reconciling Equity, Recognition, and Participation in a Political Movementand political reasoning in environmental practice. In *Moral and Political Reasoning in Environmental Practice*. Mit Press.

Schmidt, V. A. (2011). Speaking of change: why discourse is key to the dynamics of policy transformation. *Critical Policy Studies*, *5*(2), 106–126. https://doi.org/10.1080/19460171.2011.576520

Schmidt, V. A., & Radaelli, C. M. (2004). Policy Change and Discourse in Europe: Conceptual and Methodological Issues. *West European Politics*, *27*(2), 183–210. https://doi.org/10.1080/0140238042000214874

Scott, A. C. (2018, June 1). *When Did Humans Discover Fire? The Answer Depends on What You Mean By "Discover."* Time; Time. https://time.com/5295907/discover-fire/

Sharp, J. P. (2009). *Geographies of postcolonialism : spaces of power and representation*. Sage.

Soja, E. W. (2010). *Seeking spatial justice*. Univ. Of Minnesota Press.

Sovacool, B. K., & Dworkin, M. H. (2014). *Global energy justice : problems, principles, and practices*. Cambridge University Press.

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

Spijkerboer, R. C., Turhan, E., Roos, A., Billi, M., Vargas-Payera, S., Opazo, J., & Armiero, M. (2022). Out of steam? A social science and humanities research agenda for geothermal energy. *Energy Research & Social Science*, *92*, 102801. https://doi.org/10.1016/j.erss.2022.102801

Stam, E. (2018, January 17). *Wingewest Groningen: een schandvlek op de kaart*. Sargasso. https://sargasso.nl/wingewest-groningen-schandvlek-op-kaart/

Steelman, T. A., & Maguire, L. A. (1999). Understanding participant perspectives: Q-methodology in national forest management. *Journal of Policy Analysis and Management*, *18*(3), 361–388. https://doi.org/10.1002/(sici)1520-6688(199922)18:3%3C361::aid-pam3%3E3.0.co;2-k

Tidwell, J. H., & Tidwell, A. S. D. (2018). Energy ideals, visions, narratives, and rhetoric: Examining sociotechnical imaginaries theory and methodology in energy research. *Energy Research & Social Science*, *39*, 103–107. https://doi.org/10.1016/j.erss.2017.11.005

Todd, H., & Zografos, C. (2005). Justice for the Environment: Developing a Set of Indicators of Environmental Justice for Scotland. *Environmental Values*, *14*(4), 483–501. https://doi.org/10.3197/096327105774462692
Townley, B. (1993a). Foucault, Power/Knowledge, and Its Relevance for Human Resource Management. *The Academy of Management Review*, *18*(3), 518. https://doi.org/10.2307/258907
Trencher, G., & van der Heijden, J. (2019). Contradictory but also complementary: National and local imaginaries in Japan and Fukushima around transitions to hydrogen and renewables. *Energy Research & Social Science*, *49*, 209–218. https://doi.org/10.1016/j.erss.2018.10.019
United Nations. (1988). *A/RES/43/53 Protection of Global Climate for Present and Future Generations of Mankind*.
van der Brugge, R., Rotmans, J., & Loorbach, D. (2005). The transition in Dutch water management. *Regional Environmental Change*, *5*(4), 164–176. https://doi.org/10.1007/s10113-004-0086-7
Venderbosch, M. (2021, September 10). *Warmtebron Utrecht ziet er toch vanaf: in Nieuwegein wordt niet naar aardwarmte geboord*. AD. https://www.ad.nl/utrecht/warmtebron-utrecht-ziet-er-toch-vanaf-in-nieuwegein-wordt-niet-naar-aardwarmte-geboord~a4a4393a/
Walker, G. (2009). Beyond Distribution and Proximity: Exploring the Multiple Spatialities of Environmental Justice. *Antipode*, *41*(4), 614–636. https://doi.org/10.1111/j.1467-8330.2009.00691.x
Walker, G. (2012). *Environmental justice : concepts, evidence and politics*. Routledge, Cop.
Walker, G., & Day, R. (2012). Fuel poverty as injustice: Integrating distribution, recognition and procedure in the struggle for affordable warmth. *Energy Policy*, *49*, 69–75. https://doi.org/10.1016/j.enpol.2012.01.044
Watkins, J. (2015). Spatial Imaginaries Research in Geography: Synergies, Tensions, and New Directions. *Geography Compass*, *9*(9), 508–522. https://doi.org/10.1111/gec3.12228
Watts, S., & Stenner, P. (2012). *Doing Q methodological research : theory, method and interpretation*. Sage.
Weart, S. R. (2008). *The discovery of global warming*. Harvard University Press.
Woodward, K., Dixon, D. P., & Jones, J. P. (2009). Poststructuralism/Poststructuralist Geographies. *International Encyclopedia of Human Geography*, 396–407. https://doi.org/10.1016/b978-008044910-4.00727-6
World Nuclear Association. (2021, May). *Carbon Dioxide Emissions From Electricity*. Www.world-Nuclear.org. https://www.world-nuclear.org/information-library/energy-and-the-environment/carbon-dioxide-emissions-from-electricity.aspx
Zabala, A., Sandbrook, C., & Mukherjee, N. (2018). When and how to use Q methodology to understand perspectives in conservation research. *Conservation Biology*, *32*(5), 1185–1194. https://doi.org/10.1111/cobi.13123