Navigating Value Controversies

A contribution to the professionalisation of Thermal Energy Communities in the Netherlands

MSc Thesis: CoSEM

Thijmen van den Ouweelen

Delft University of Technology

TU Delft

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by

Thijmen van den Ouweelen

Student Name	Student Number
Thijmen van den Ouweelen	5759137

First Supervisor:	Dr. B.J. Pearce
Second Supervisor:	Dr. A. Correljé
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Faculty:	Technology, Policy & Management

Cover: Construction Site for District Heating System Hysopt by Brian Vanheel (Modified)

TU Delft

Preface

Dear reader,

This thesis represents the conclusion of my master's program in Complex Systems Engineering and Management. I would like to begin by expressing my sincere gratitude to all the professors who have shared their knowledge and expertise, helping to shape this program into what it is today. Through CoSEM, I have gained a valuable skill set, from mastering Python and NetLogo to learning how to address complex problems as a systems engineer. These skills have given me a unique perspective on societal challenges, allowing me to analyze (socio-)technical systems, recognize the intricate moving parts, and identify opportunities to improve system functionality. I am confident that these competencies will serve me well in my future professional endeavours.

I would like to extend my heartfelt thanks to my first supervisor Dr. BinBin Pearce. Her frequent and detailed feedback, as well as prompt communication and responses, have been immensely helpful in this extensive project allowing for me to always see the see and take the next step. Similarly, I extend my gratitude to my second supervisor and graduation chairman, Dr. Aad Correljé, for both his insights into my thesis topic as well as guidance on the research process, helping me to stay critical of my work during the project.

In addition, thanks are given to Hans Otten, Partner at Fakton Energy and Ilonka Marselis, Strategic Advisor at EnergieSamen, for the discussions we had when I was still shaping the focus and scope of my research. Their perspective on the heat transition and knowledge of current developments have accelerated the conversion of ideas into a concrete research objective.

On a final note, I would like to express my appreciation for my friends and family, whose unwavering support throughout this project has been invaluable. Their understanding of my frequent absence from social gatherings, as well as their genuine interest in my research, not only enhanced the quality of my work but also increased my enjoyment of working on the project.

Thijmen van den Ouweelen
Amsterdam, October 2024

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Summary

Introduction

As a result of the Paris Agreement, the Netherlands committed to reducing greenhouse gas emissions by 49% compared to 1990 levels. A significant challenge in achieving this goal lies in the heating sector, which is heavily dependent on natural gas and must transition to sustainable alternatives. However, uncertainties around the viability of sustainable heat technologies, unprofitable business cases and low public trust in existing institutions pose challenges to this transition. A promising development is the rise of local communities establishing self-organized sustainable heat initiatives, known as Thermal Energy Communities (TECs), which emphasize community control. However, after a strong increase in the number of TEC-led projects in 2018, the number of projects has stagnated in 2021 and 2022 and declined since early 2023. Several factors contribute to this decline, including knowledge gaps within TECs regarding their professionalization, inexperience in civil-public collaborations between TECs and municipalities, and a misalignment between the current institutional set-up in the Netherlands and the desire for local ownership of collective heat systems.

Research Objective and Question

To fully integrate TECs in the Dutch heat transition, four preconditions including *knowledge*, *support*, *access to capital*, and *a license to operate* are to be developed. This thesis focuses on the *knowledge* and supports *preconditions*, aiming to understand how TECs manage the value controversies inherent to local energy projects by initiating social learning to overcome them. To guide

> *"How have value controversies in the professionalisation of TECs with complete control and ownership in the Netherlands initiated social learning?"*

Gaining a better understanding of this dynamic will contribute to the self-actualisation capacity of TECs, increasing the number that become operational and enabling further research into their development.

Research Approach and Methods

To guide the research a conceptual framework is constructed combining the Value Laden Institutional Analysis and Development (VLIAD) framework by Milchram et al. (2019) with Schram et al.'s (2024) value-based approach. The constructed conceptual model structures the analysis of the relation between value controversies and social learning while accounting for the context specificity inherent in energy projects. The research takes a qualitative comparative case study approach and starts with analyzing how exogenous variables influence decision-making processes, using document analysis of TEC reports and demographic data. Consequently, a taxonomy of values present in TEC projects is constructed and dynamics behind how value controversies triggering social learning are explored, drawing on media articles, community meetings, and surveys. The analysis uses Atlas.ti as an analysis tool. Finally,

expert interviews were conducted to validate and refine findings across the cases.

Key Findings and Conclusion

The study found that value controversies initiate social learning by highlighting mismatches between TEC decision-making structures and community expectations, as well as governmental regulations.

Single-loop learning occurs when TECs address immediate issues without challenging underlying assumptions, often due to regulatory constraints. Double-loop learning arises from community engagement and a flexible attitude towards the existing institutional framework by the project group. This was emphasised by Warm Heeg's ongoing community communication and responsiveness. Projects like Energiek Nagele, with limited community involvement, miss out on social learning opportunities, due to insufficient community support.

In conclusion, TECs that remain flexible and prioritise community engagement over fast project development leverage the opportunities for double-loop learning presented through value controversies, enhancing their adaptability and develop organisational resilience.

Recommendations

This thesis finds that during the development of TECs, they should focus on remaining flexible during the early project stages, avoiding establishing rigid rules and regulations. Additionally, TECs should prioritise frequent communication with residents, emphasizing broader environmental benefits at the start of the project while gradually shifting towards more personal benefits as the project progresses.

Further research should further investigate the relationships between energy poverty and social capital on the ability of TECs to adapt to encountered controversies. Additionally, further examining the impulses stemming from specific values of the population involved in the project, seems an interesting and important avenue as it impacts creating and maintaining support of the community which is identified as the most important factor for success in this thesis.

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Nomenclature

Abbreviations

Abbreviation	Definition
BEL	EVA-Lanxmeer Residents Association (Bewonersvereniging EVA-Lanxmeer)
DH	District Heating
HT	High Temperature
LT	Low Temperature
MT	Medium Temperature
NPLW	National Program Local Heat Transition (Nationaal Programma Lokale Warmtetransitie)
PAW	Natural Gas Free Neighbourhoods Programme (Programma Aardgasvrije Wijken)
PWE	Participatory Value Evaluation (Participatieve Waarde Evaluatie)
RFD	Research Flow Diagram
TEC	Thermal Energy Community
VLIAD	Value Laden Institutional Analysis & Development Framework
ZLT	Very Low Temperature

1

Introduction

In 2015, 196 parties signed the Paris Climate Agreement committing to limit global warming to less than two degrees Celsius above pre-industrial levels. One of these parties was the Netherlands, which in response, outlined a plan in the National Climate Agreement. This plan aims to reduce greenhouse gas emissions by 49% by 2030 compared to 1990 levels [40]. One of the sectors in the Netherlands that is required to transition to sustainable energy sources is the heating sector, where, as of 2022, 90% of buildings rely on natural gas for warmth [40]. A potential solution capable of enabling the heating sector to reduce emissions, recognised by the Dutch Ministry of Economic Affairs and Climate (EAC), is district heating (DH) connected to a sustainable heat or energy source such as geothermal, aquathermic or solar energy [40].

Being identified as an essential part of the heat transition the Ministry of EAC set the objective to realise 500.000 new connections on DH systems by 2030 [45]. However, recent studies have found that under the current speed of the transition, the set goal will not be achieved [55]. The barriers hampering the speed of the heat transition are diverse including low trust among citizens in both government and market parties, unprofitable business cases, and a lack of resources and capabilities at municipalities making them unable to support local initiatives [39]. In light of the mentioned challenges, the Ministry of EAC has pointed out the need for a new law to support the development of the heat transition in the built environment [45]. This new law, named the law for Collective Heat (Wcw), is currently under development and, amongst other facets encompasses an important role for Thermal Energy Communities (TECs). TECs have emerged from the desire of communities of citizens to take the lead in the heat transition forming self-organized heat initiatives making use of DH systems [21]. These communities are new players that offer alternatives to the usual public legal form (governments) and private legal forms (commercial market players). Although TECs are not public entities, their existence and development potentially serve a broader social interest as they prioritize community control and sustainability over profits [21, 45].

Like many energy projects, the development process of TECs is fraught with controversies stemming from perceived injustices and friction due to the absence of a proper legal framework and a misaligned formal assessment trajectory [20, 43, 52]. The impact of controversies is enforced in the case of TECs as they lack clear development guidelines and support due to their only recent emergence [21]. This

guidance and support, referred to as ”grow-up space” and ”professionalization,” involves creating a supportive environment for TECs and improving their operations [18]. To support TECs effectively in overcoming emerged controversies by developing grow-up space and aiding their professionalisation it’s essential to clarify the possible development paths of these initiatives and potential support roles for other stakeholders. However, as the exact desires and goals of TECs differ, due to their focus on multiple values purpose rather than profit it is difficult to design a one-size-fits-all solution for these projects in terms of support [18, 21].

EnergieSamen, a Dutch knowledge exchange institution, has identified the alignment between the initiatives institutional set-up and the norms & values held by the TEC as a potential driver for successful projects [9, 21, 44]. This statement is supported by scientific research on TECs and other local energy projects where a misalignment between institutions and the norms & values held by a community is defined as a value controversy [17, 41, 51, 52]. In the literature on energy projects, value controversies are not viewed as issues to be avoided but rather as challenges to be managed once they arise. While these disputes can have negative consequences, they also present opportunities for social learning.

This thesis investigates the role of values and controversies in the development of TECs, focusing on how these factors facilitate social learning through adaptive strategies employed by TECs and other stakeholders. The central hypothesis states that variations in the values underlying controversies have distinct impacts on social learning and necessitate different governance approaches to address them constructively. Chapter 2 reviews both academic literature and grey sources, such as company reports, government documents, and policies. After analyzing the literature, key concepts are discussed, leading to the identification of a knowledge gap that informs the main research question and sub-questions. Chapter 3 introduces the theoretical framework constructed for the analyses, while Chapter 4 outlines the methodology. The results are presented in Chapter 5, and their implications are discussed in Chapter 6. Chapter 7 aims to answer the research question and recommends further research. The thesis ends with a critical reflection of the researcher on the research in Chapter 8.

2

Literature Review

This section reviews academic literature to identify barriers, knowledge gaps and recommended research (Section 2.1.), which guides the analysis of company and government reports to pinpoint key concepts (Section 2.2.) and formulate a research objective (Section 2.3.5.). Consequently, the research objective is linked to existing theories (Section 2.4.) used for deriving the main research question of this thesis (Section 2.6.). The chapter concludes with a description of the research approach in (Section 2.7.) and the thesis' link to the study program of Complex System Engineering and Management in (Section 2.8.).

2.1. Literature Search

On March 11, 2024, a literature review was conducted to explore the barriers affecting the adoption and development of local collective heat systems in the Netherlands. The goal was to analyse and synthesize existing scholarly work and point out research gaps as per Wee & Bannister (2016) [60]. Due to their reliability and extensive coverage, Scopus and Web of Science were used as databases. Table 2.1 outlines the search queries applied on both platforms combining columns using the AND operator. The search was limited to English-language sources.

Keyword 1	Operator	Keyword 2	Operator	Keyword 3
District Heating Energy Communities Collective Heat	AND	Challenges Barriers Self-Governance	AND	the Netherlands

Table 2.1: Used Search Words and Operators.

Given the extensive literature available, the initial searches prioritized titles and abstracts. Subsequently, an orientation reading was conducted to understand the articles' content more thoroughly after which a snowballing approach was employed. Then, the articles retrieved from the preliminary searches on Scopus and Web of Science were merged and duplicate articles were removed. To ensure the selection

of suitable articles, specific inclusion criteria were applied during the screening process. These criteria comprised the following: the paper is sourced from a reputable publisher, focuses on the Netherlands, and comprehensively addresses various facets of the socio-technical system surrounding TECs, encompassing technical, institutional, and procedural dimensions. For a visual of the sequence used in the literature search and selection process, see Figure 2.1.

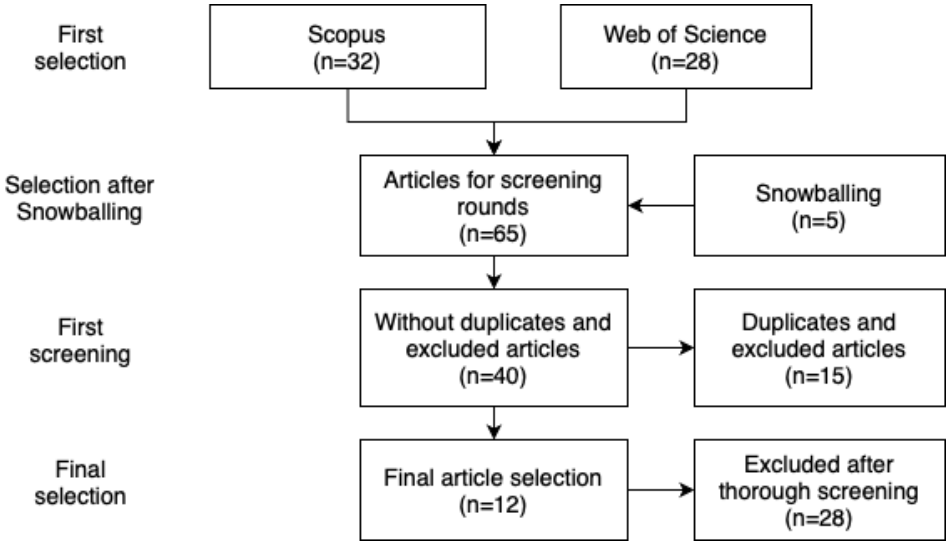

Figure 2.1: Literature Selection Process

The literature search resulted in the 12 articles presented in Figure 2.2. The selected articles are analyzed and serve as the foundation for reviewing grey literature. Both the academic and grey literature reviews inform the formulation of the main research question.

2.2. Identifying Gaps in The Academic Literature

In the literature, several barriers to the successful planning and development of collective heating systems by TECs were identified. First, there is **a lack of resources and capabilities among municipalities** to facilitate the development of local heat initiatives [32, 47]. This requires municipalities to outsource work concerning the development of collective heat systems which prolongs the knowledge and capabilities deficit as the information is not retained at the organization. Second, both **a lack of trust and conflicts** between different actors stagnate the development of local heat initiatives as citizens and public parties do not trust market parties to prioritise societal interests [32, 47]. Third, **a lack of transferable knowledge** for organizing local energy and heat initiatives forces all projects **to separately invent the wheel** [7, 8, 29]. This takes up unnecessary time and resources. Furthermore, this delay in development reduces trust and support among TECs at times when their development stagnates. Additionally, Gursan et al. (2024) identified a **conflict between policy goals on the national level of energy efficiency and energy security** delaying investments in energy infrastructure and efficiency measures in the built environment [28].

The reviewed articles also recommend further work, including how the behaviour of homeowners and tenants changes over time and what their role could be at the household level [36]. Another aspect that needs to be researched further is the **myriad of different approaches for self-organization to foster**

Reference	Title
[8]	Local civil society based renewable energy organizations in the Netherlands: Exploring the factors that stimulate their emergence and development
[29]	The transformative power of self-organization: Towards a conceptual framework for understanding local energy initiatives in The Netherlands
[36]	Kissing natural gas goodbye? Homeowner versus tenant perceptions of the transition towards sustainable heat in the Netherlands
[58]	Energy communities and their ecosystems: A comparison of France and the Netherlands
[17]	Cooperatives, incumbency, or market hybridity: New alliances in the Dutch energy provision
[31]	Renewable energy communities as 'socio-legal institutions': A normative frame for energy decentralization?
[7]	Energy citizenship in the Netherlands: The complexities of public engagement in a large-scale energy transition
[61]	Shaping an Inclusive Energy Transition:
[33]	Municipalities as key actors in the heat transition to decarbonise buildings: Experiences from local planning and implementation in a learning context
[32]	Why go public? Public configurations and the supportive and divergent views towards public district heating in the Netherlands
[47]	Social acceptance of district heating: evidence from the Netherlands
[28]	District heating with complexity: Anticipating unintended consequences in the transition towards a climate-neutral city in the Netherlands

Table 2.2: Reviewed Literature

the development of TECs [29]. Hasanov & Zuidema (2018) and C. Gursan et al. (2024) claim that the numerous internal and external processes at play in these initiatives need to be fleshed out further to explain how they shape the diversity of the observed institutional practices [28, 29]. Additionally, M. de Bakker et al. (2020), Heldeweg & Saintier (2020), and Weijnen (2021) emphasize the role values play in configuring the governance structure and the importance and difficulty of opening up to a more value-oriented perspective on decision-making and governance for these initiatives [17]. Furthermore, an analysis of how **municipalities engage with their communities** to identify opportunities for support and barriers in the collaboration is recommended [33]. Finally, Boon & Dieperink (2014), who identified factors affecting the emergence of TECs and other local renewable energy organisations (LREOs) recommend deepening their understanding of the founding and further development process by focusing more on organisational development [8].

Despite these discussed challenges and knowledge gaps identified in the articles presented in Figure 2.2, several initiatives have successfully navigated the aforementioned obstacles and realised or continue to realise their vision of establishing an operational TEC. This thesis highlights the need for research focused on understanding how TECs have been successful in overcoming the identified issues related to trust, limited resources, and capabilities, while also managing conflicting policy objectives. Thereby, this thesis can contribute to the existing body of academic literature while at the same time generating knowledge to support TECs and stakeholders to further develop their organisation, allowing for more

cases that can be used to study different approaches for successful self-organisation and to study ways in which municipalities can engage with them constructively. The next section leverages existing grey literature to further specify the scope of this thesis.

2.3. Deepening Understanding with Grey Literature

This section dives into the existing grey literature of TECs, including company reports, government reports and industry research, to further specify the scope and objective of this thesis. Consequently, this chapter moves on to exploring academic theory suited for guiding the research from which a main research question is formulated.

2.3.1. Stages of Development

In the grey literature, it was identified that the development of TECs passes four distinct stages. These stages are depicted in Figure 2.2 and include the initiation, development, realisation and exploitation stage [25].

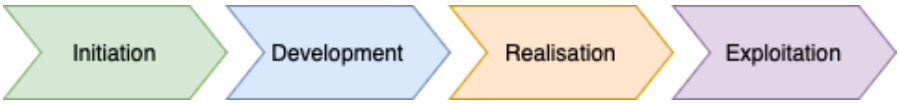

Figure 2.2: TEC Stages of Development

The initiation stage consists of exploring the option of a locally owned heat system. The focus of this stage is on the technical viability and financial feasibility of the project. In addition, residents and potential stakeholders are involved and the possibility of local ownership is discussed [22]. In the development stage, the goal is to create a technically viable and financially feasible proposal. The initiative is officially established, with a focus on community engagement and membership administration. The business case is finalised, permits are requested, and agreements are made with various stakeholders [22]. The realisation stage consists of the construction of the heating system. In this stage, the TEC is responsible for monitoring and overseeing the construction work [22]. In the final exploitation stage, maintenance and management begin. Membership administration and accounting are fully operational, and revenues have started coming in. Communication with members and customers is maintained while working on system optimisation and potential expansion [22]. Passing these stages until the exploitation stage has proven to be difficult for TECs due to the challenges discussed in (Section 2.1.). The next section dives into the roots of the identified challenges discussed in (Section 2.1.) that were found in grey literature.

2.3.2. Challenges From a New Market Configuration

Currently, the playing field of the Dutch heat transition is dominated by traditional players existing of either governmental organisations, market parties or hybrid organisations. TECs have emerged as a new type of player on this playing field representing a civil party, as opposed to the conventional traditional private and public parties.

A TEC characterises itself through three elements. First, the TEC occupies itself with at least one element from the heating system including the source, distribution, isolation, or cooling as well as offers

other energy services to its customers. Second, the decision-making authority and ownership rest with members or shareholders located near the heating system, including homeowners, rental cooperations, tenants, municipalities, and local businesses. Third, the TEC operates under self-established social governance principles, including a democratic structure with emphasis on inclusive decision-making, as well as a value-driven approach focused on purpose over profit [21].

The alteration of the market configuration in the heat sector due to the emergence of TECs is visualised by EnergieSamen in Figure 2.3 where the old configuration of government (*overheid*) and market (*markt*), is complemented by civil-led initiatives (*bewoners*).

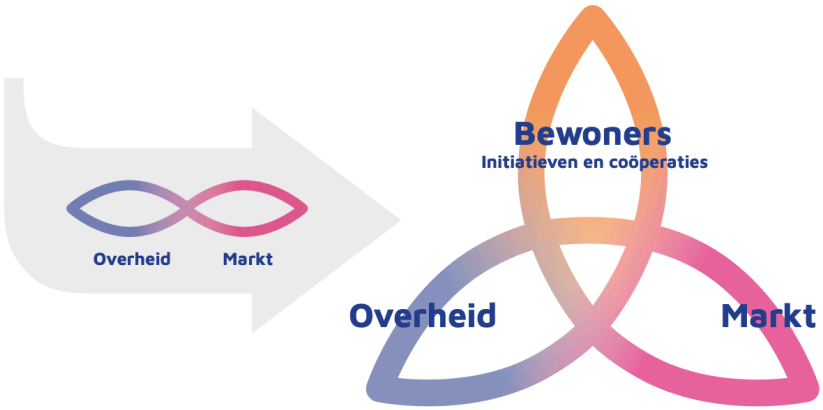

Figure 2.3: A new Market Configuration, adapted from [21]

Due to their status as a new market player TECs are not yet well integrated into the Dutch heat sector. As a result, existing formal and informal institutions in the industry are not designed to accommodate their presence, creating a misalignment between TECs and their environment. This misalignment hinders the development of TECs from initiation to exploitation and leads to challenges outlined in (Section 2.1.). Examples of these challenges, identified in grey literature, include difficulties in securing project funding or obtaining insurance, as banks and financial institutions are unable to accurately assess the associated risks and rewards [53]. Additionally, consultants and service providers lack experience with private-civil collaborations, making it unclear how to support TECs, while governmental bodies, such as municipalities, remain uncertain about the activities and services TECs are allowed to perform and provide. To organize the various developments necessary for fully embedding TECs in the Dutch heat transition, EnergieSamen has established four preconditions that must be met. The following section presents these preconditions along with their current status of development [9].

2.3.3. Preconditions for Embeddedness

EnergieSamen has identified four preconditions that must be met for TECs to become fully embedded in the Dutch heat sector, resolving their misalignment with the existing set of formal and informal institutions, and facilitating their development from initiation to operationalisation. These preconditions include the availability of *knowledge*, possession of a *license to operate*, *support* from stakeholders, and *access to capital*.

Knowledge refers to the collection of guidelines, standards and protocols TECs can use and follow to successfully pass each respective stage of development presented in Figure 2.2. Unfortunately, due to

the new nature of TECs and the limited number of projects under development in the Netherlands, the knowledge and available set of standards and protocols to guide TECs is limited. Only for the initiation stage, there is a relatively extensive collection of accessible literature and knowledge for TECs [18, 23]. For the development, realisation, and exploitation stage, on the other hand, this is not the case [9, 23].

A *license to operate* provides clarity regarding the construction, operations, and conditions under which a TEC can function, based on its recognition within the Dutch legal system and by stakeholders. This is also identified in the academic literature as an important prerequisite for energy communities to accommodate energy citizenship [31]. This precondition is currently under development, as TECs are most likely taken up in the Heat Act 2.0 as legal phenomena. The status of legal phenomena means for TECs that they can not register as a legal entity but may still receive certain rights and privileges [24]. The specifics of these rights and privileges are still being defined.

Support from stakeholders includes the ability of municipalities and other actors active in the heat transition to establish partnerships and collaborations with the TEC. This precondition is linked to the first two principles as knowledge of the development of TECs and a legal position are required to create other formal institutions such as regulations, contracts and protocols to follow for municipalities.

Currently, TECs have *access to capital* through national programs such as the PAW, existing subsidy schemes like SDE(+) and ISDE, and private funding from banks. However, these subsidy programs are not aligned with the organisational structure and specific characteristics of TECs, and banks perceive excessive risk during the early stages of TEC development [62]. As a result, securing funding remains a persistent challenge for TECs [53, 62]. Beyond the PAW, TECs rely on public officials who are willing to show flexibility in following formal protocols to access capital.

In light of these currently underdeveloped preconditions, partner organisations such as EnergieSamen, de ParticipatieCoalitie, and HIER have started to develop support for TECs in their development in the form of protocols, guidelines, and other tools. This work is aimed to support TECs in their development by aiding their *professionalisation* and supporting them in shaping a safe *grow-up space*. The next section discusses these two concepts and what their roles are in realising the preconditions of *knowledge*, *support*, *access to capital* and a *license to operate*.

2.3.4. Professionalisation and Grow-up Space

To develop the preconditions mentioned in the previous sections, EnergieSamen, HIER and the ParticipatieCoalitie work on two different tracks of development defined as *professionalisation* and *grow-up* space. After discussing both concepts their implications for this thesis are presented.

Professionalisation

Professionalisation is a term coined by de ParticipatieCoalitie and HIER and includes the process of formalising the internal processes of a TEC including governance principles and the formal and informal rules that shape the TECs' decision-making processes [18, 39]. Other grey literature also recommends this as Zuilhof et al. (2022) [63] claim preconditions and design principles for TECs will give space to pioneering and the accelerated professionalization of TECs. By contributing to the *knowledge* precondition through developing tools, guidelines and protocols to support the professionalisation of TECs, different initiatives are prevented from having to "reinvent the wheel".

Currently, there is still a lack of materials to support the professionalisation as the limited number

of TECs under development mostly have not yet passed the development stage. Therefore, materials around professionalisation are mostly focused on the initiation stage complemented with several worked-out materials for the development stage. Examples include pre-made starting documents for energy cooperations, pre-made mandates for energy cooperations, and neighbourhood scan methods for the initiation stage, as well as a layout for a heat roadmap that can be used in the development stage [22].

To develop supporting materials for the TECs in their realisation and operation stage, more initiatives need to reach these stages so they can be studied and their knowledge can be transferred to other initiatives in the form of tools and guidelines. However, it is important to note that there is no one-size-fits-all solution when it comes to the institutional setting of TECs as its success is, as EnergieSamen hypothesises, dependent on its alignment with the norms & values held by the TEC as a potential driver for successful projects [9, 21, 44]. This statement is supported by scientific research on TECs and other local energy projects [17, 41, 51, 52]. Therefore, generated knowledge must be focused on supporting TECs in navigating the challenges and controversies in their professionalisation rather than giving final solutions [21].

Grow-up space

The second concept, *grow-up space*, involves the process of continuous learning, mutual understanding, and the need for attention to institutions shaping relationship dynamics, clear agreements, and reflective practices between TEC and municipalities [18]. TECs operate based on different values than private parties. This shift from a more conventional public-private partnership, as illustrated in figure 2.3, forces the municipality to adopt new approaches and roles as a stakeholder. Given its novelty, this type of cooperation currently requires additional attention, especially since civil-public partnerships are likely to persist for decades once they are formed. Formalising such a new collaboration is a very exploratory process, laced with learning by trial and error in small steps. Challenges identified in this category include a lack of resources and capabilities among municipalities to facilitate the development of local heat initiatives, a lack of trust between market parties, citizens and governmental organisations, and a conflict between policy goals on the national level. Moreover, research on civil-public participation has been limited. The academic literature highlights a lack of knowledge and capabilities in the external environment of TECs, a gap further emphasized in grey literature [21, 46, 63].

Formalizing these collaboration types through standards and protocols can serve as guidance in times when the momentum of development decreases due to encountered challenges and emerging controversies in decision-making processes and contributes to the development of the precondition of *support* [39]. However, this also requires TECs to become operational so that their development and way of collaboration between municipalities can be studied.

The following section synthesizes insights from both academic and grey literature, establishing the research objective of this thesis. Subsequently, in (Section 2.4.) the thesis explores academic theory to guide the research and inform the formulation of the research question.

2.3.5. Research Objective

Summarizing the findings from the academic and grey literature, the development of TECs in the Netherlands is currently hampered by challenges including lack of trust between actors, inefficient available resources, knowledge and capabilities, and conflicting policy goals on the national level. At the same

time, knowledge gaps around self-organisation approaches for TECs and collaboration with municipalities form further bottlenecks. In the grey literature, these challenges were further emphasised as well as connected to a misalignment between the organisational characteristics of TECs and the current institutional set-up of the Dutch heat transition and sector in general as well as their community. This misalignment stems from the recent emergence of TECs in the traditional playing field occupied by government and market parties as depicted in Figure 2.3 and the unique set of values present in different initiatives.

To achieve full institutional embeddedness of TECs in the Dutch heat transition, four essential preconditions have been identified: *knowledge*, *support*, *access to funding*, and a *license to operate*. The development of a *license to operate* is currently progressing through the inclusion of TECs in the Heat Act 2.0. In the case of successful implementation of this new Heat Act with TECs receiving status as legal phenomena, the creation of formal regulations, procedures and standards will serve as the next step for shaping this precondition. At the same time, *access to capital* remains limited to government programs, such as the PAW, and existing subsidy schemes, as private financiers require more proof of the feasibility of potential investments. Given the current status of these preconditions, this thesis decided to focus on contributing to the preconditions of *knowledge* and *support*, as they are the areas deemed most suited to be addressed through scientific research and analysis.

To be more specific, the objective of this thesis is to gain a better understanding of how TECs that have reached the realization or exploitation stage have managed challenges arising from misalignment with their external environment and community during their professionalisation. If successfully generated, this improved understanding can be transferred to other TECs, aiding in their *professionalization* and helping these initiatives to create a supportive *grow-up space* in collaboration with stakeholders. This would enable more TECs to successfully realize their goal and become operational. As more TECs reach operational status, it would allow for further research on TECs in the Netherlands, leading to the development of essential knowledge and support systems, such as tools, protocols, and guidelines for TECs in the realization and exploitation stages. This process is illustrated in Figure 2.4.

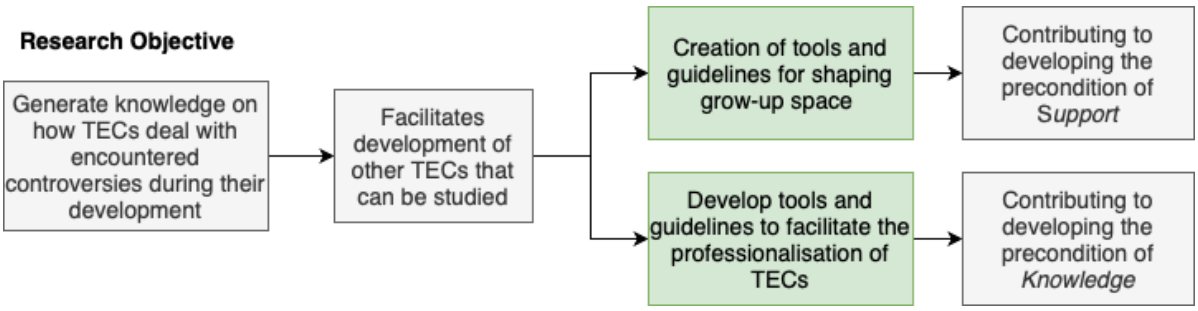

Figure 2.4: Research Objective

Indirectly, the process depicted in Figure 2.4 may also help prove the viability of such organizations, improving *access to capital* by providing financiers with a clearer assessment of risks and rewards. The discussed developments of the four preconditions have been visualized and presented in Figure 2.5. In this visualization, **green boxes** represent the current state of the preconditions, **orange boxes** highlight ongoing developments intended to complement the existing state, and **red boxes** indicate aspects of the preconditions that have yet to be developed. Additionally, studying the development of TECs answers the call for future work of the reviewed academic literature discussed in (Section 2.2.) on studying

approaches for self-organisation in existing TECs as well as identifying how municipalities engage with their communities. The next section moves back to academic literature used for structuring the research approach and informing the formulation of the main research question and associated sub-question.

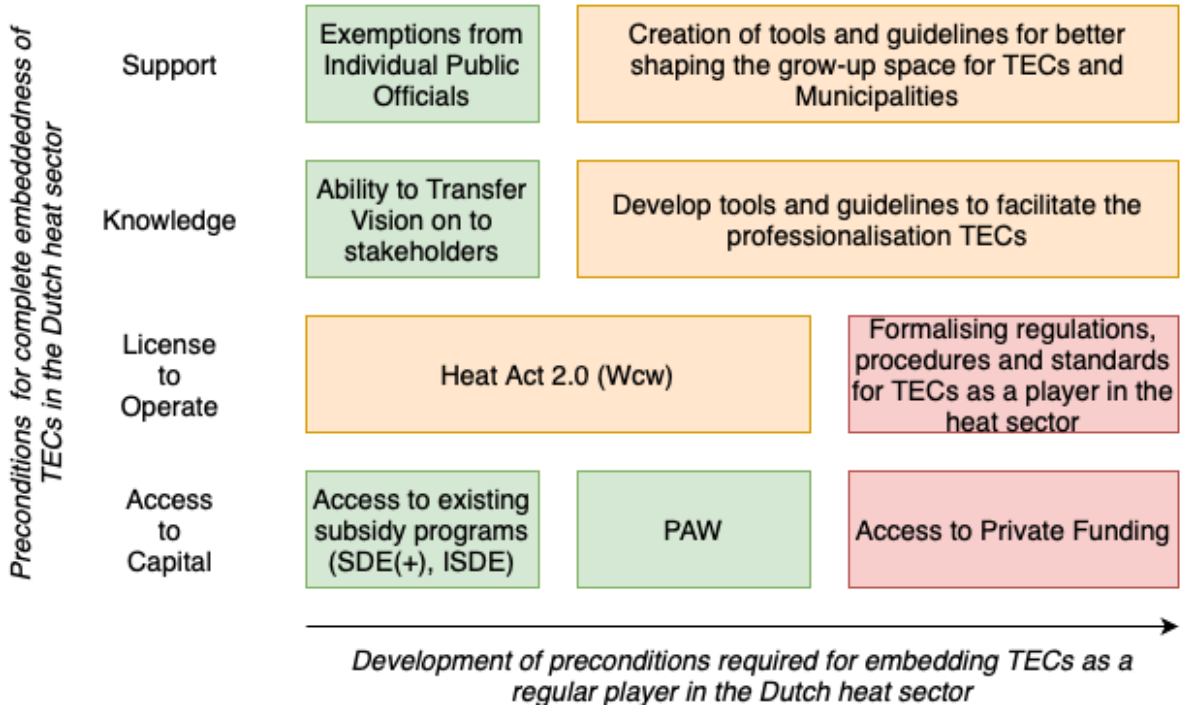

Figure 2.5: Preconditions and their role in realising the embeddedness of TECs in the Dutch heat sector

2.4. Turning Controversies into Opportunities for Growth

To facilitate the *professionalization* of TECs and shape their *grow-up space*, this thesis underscores the necessity of gaining a better understanding of how TECs that have reached the realization or exploitation stage have managed challenges arising from misalignment with their external environment. In academic literature challenges resulting from the misalignment between a community subject to an energy project and the prevalent set of formal and informal institutions structuring this process are called controversies. Following the academic literature on controversies and their inevitability in energy projects, the generated knowledge should aid TECs in navigating and governing the controversies inherent in professionalization, rather than seeking solutions to prevent them altogether. [21, 51]. Consequently, this thesis will focus on the nature of these controversies within TEC projects as they arise and how they are governed by the TEC and other stakeholders.

Controversies in energy projects are recognized by researchers as both an impediment and a catalyst for development. They can hinder the efficiency and effectiveness of collective decision-making while also initiating social learning and institutional change [15, 19, 41, 43, 51, 52]. Controversies in energy projects are linked to community perceptions of unfair distribution of risks and benefits, an inequitable division of responsibilities, and feelings of being excluded from the decision-making process [51].

Pesch et al. (2017) state that controversies are caused by the under-representation or absence of certain values in the project's decision-making process [51]. Schram et al. (2024) elaborate on this link between

values and controversies in energy projects by stating values should be considered as inherent normative qualities of these projects and that they are essential aspects that shape their direction [52]. Aside from academic literature EnergieSamen also identified the alignment between institutions and the norms & values held by the TEC as a potential driver for successful projects [9, 21, 44]. This implies that understanding the values at play in an energy project is crucial to comprehending why controversies arise.

Addressing these controversies by examining them and possibly broadening the set of present values in the decision-making process can lead to productive outcomes through higher level institutional change or social learning within the same policy process of an energy project [15, 41, 43, 51, 52]. The next section presents the identified variation between governance models for TECs before moving to the formulation of the research question.

2.5. Governance models for Thermal Energy Communities

In the reviewed grey literature a distinction was identified between the different available governance models of TECs. The governance models differ in terms of the allocation of ownership and control and include structures where (1) the TEC fully owns and controls the heating system; (2) ownership and control are shared with a private party; (3) ownership and control are shared with a public party; and (4) ownership and control are divided among civil, market, and public parties [21]. The governance modes are depicted in Figure 2.6. An elaborate discussion of the governance models on the characteristics of ownership, control, capacities, financing, and risk can be found in Appendix A.1.

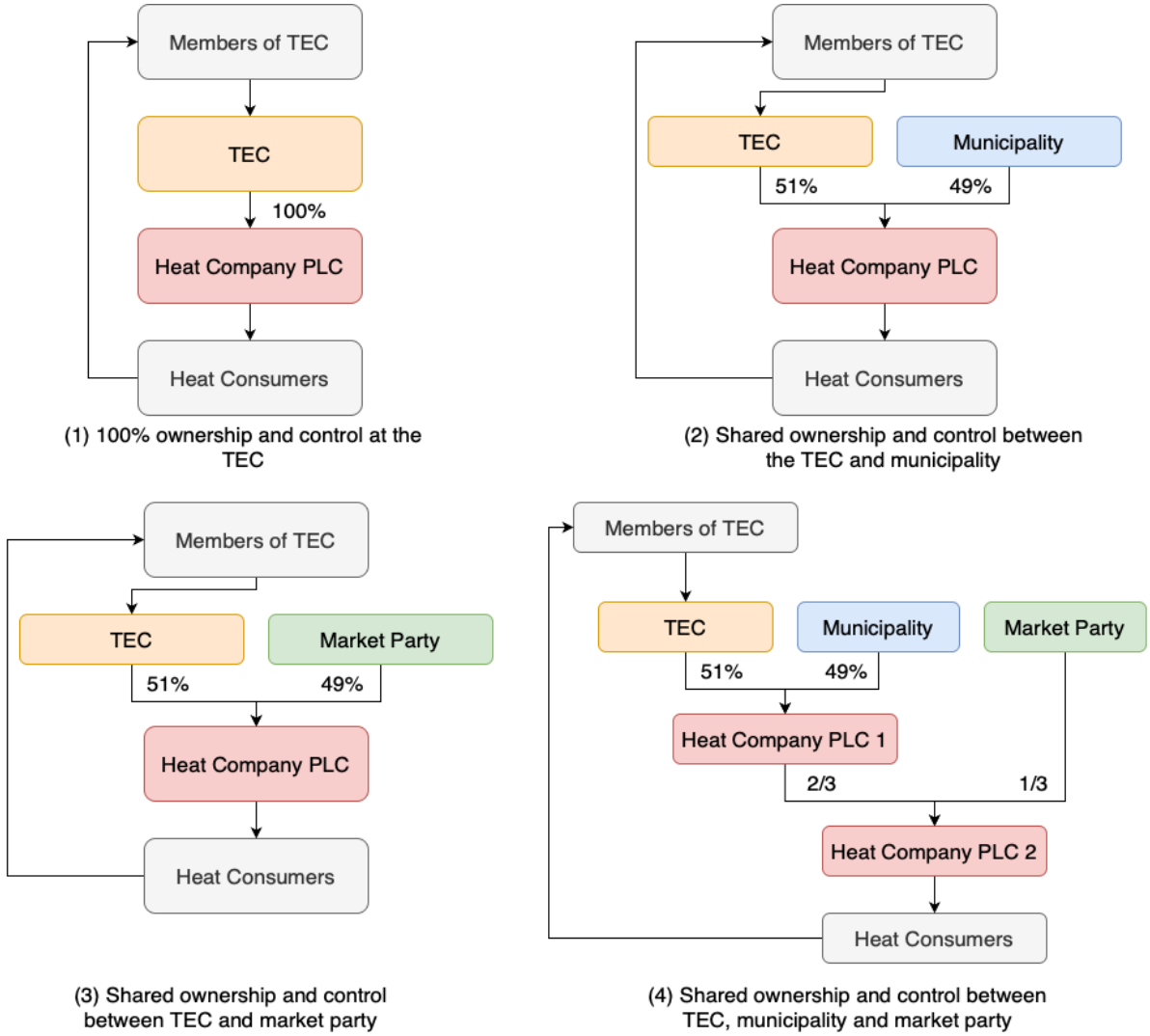

Figure 2.6: TEC Governance Models adapted from EnergieSamen [21]

2.6. Research Question

This chapter has set the research objective of generating knowledge on how TECs that have reached the realization or exploitation stage have managed controversies arising from misalignment with their external environment and community, to aid the development of other TECs. Existing theories on controversies in energy projects have emphasized the significance of addressing controversies in energy projects, understanding the values driving these controversies, and recognizing how they can enhance decision-making processes as a result of social learning. These insights have led to the formulation of the following research question:

> *"How have value controversies in the professionalisation of TECs with complete control and ownership in the Netherlands initiated social learning?"*

Answering this research question adds to the existing body of academic and grey literature by clarifying the nature of controversies in the professionalisation of TECs and how they have initiated social learning

allowing other TECs to use this knowledge in their development. Moreover, it tests the hypothesis of the relation between values & norms present in the community and corresponding governance approaches as a contributor to the success of TEC development. Additionally, the research contributes to the existing literature on energy controversies and the request of, amongst others, Milchram et al. (2019) to examine value controversies and social learning in energy projects over different times and geographies [43].

Furthermore, it introduces a new combination of two existing frameworks, the Value Laden Institutional Analysis and Development Framework (VLIAD) by Milchram et al. (2019) and the Value-based model by Schram et al. (2024), which will be elaborated on in Chapter 3.5. To guide the research towards answering the main research question, 3 sub-questions are formulated. The rationale for the sub-question and their associated research approach, as presented in Figure 2.3, is argued for in Chapter 4.

Table 2.3: Research Plan

#	**Research Question**	**Theoretical Framework**	**Data Collection Method**	**Data Source**
1	What are the exogenous variables influencing decision-making in the formal and informal trajectory of assessment of TEC development?	(Value Laden) IAD Framework	Desk Research	Company reports
2	What value controversies have emerged as a result of underrepresented values in the formal trajectory of assessment during the professionalization of TECs?	Value hierarchy and Formal and Informal Trajectory of Assessment	Media analysis & structured interviews	Nexis Uni, Policy Documents & members of TEC
3	How did value controversies lead to backflowing?	Formal and Informal Trajectory of Assessment	Media analysis, Desk Research & Structured interviews	Nexis Uni, Policy Documents & members of TEC

2.7. Research Approach

A comparative case study approach was adopted to guide this research. A comparative case study involves analyzing multiple cases of a certain project or activity to generate insights applicable to understanding the factors contributing to the success or failure of for example specific policies or programs [27]. Using a comparative case study approach, comparisons within and between the development of TECs over time can be made. This is useful when experimental designs are impractical or when understanding how context-specific factors influence policy or program effectiveness is imperative [27]. Comparative case studies are beneficial for uncovering underlying mechanisms in a certain context and for comparing findings between different contexts to identify overarching themes [38]. This thesis follows the steps of conducting a comparative case study as proposed by Kaarbo (1999). These steps include (1) formulating a specific research question for focused comparison, which was the focus of this chapter (2) selecting the desired variables to investigate in Chapter 3.5, (3) selecting comparable

cases across different contexts in Chapter 4, (4) operationalising the variables and constructing a case code book, (5) code write the cases, (6) and discuss patterns within and between cases in Chapter 5 and 6 [38].

Furthermore, this proposal utilizes qualitative analysis methods for several reasons. First, qualitative research methods allow for gaining insights beyond numerical data by considering context and complexity which is important when analysing socio-technical systems [6]. Second, the inductive approach of qualitative research allows for the recognition of patterns between different actor groups when examining the value controversies arising during the development of TECs [14]. Third, due to the limited number of TECs that can be used in the case study, more value is expected to come from in-depth analysis of the cases as statistical testing is not an option. However, the limitation of qualitative research lies in the reduced generalizability compared to quantitative analyses with statistical certainty, as qualitative results lack statistical significance testing [4]. To address this limitation the findings will be compared with existing literature in Chapter 6 while the 'limitations' section will include a thorough discussion of the potential implications and appropriate interpretation of the findings.

2.8. Link to Study Program

The proposed research aims to evaluate the socio-technical dimensions of TECs in the Netherlands. It involves navigating heating regulations like the 'Warmtewet', and tackling stakeholder conflicts among policymakers, municipalities, and building owners. Additionally, the study includes examining decision-making processes, governance structures, self-organisation approaches and the District Heating infrastructures. The complexity introduced by these factors forces the researcher to look beyond just the technical design of DH systems and makes this research fitting for a MSc CoSEM thesis. Furthermore, this proposal integrates tools, methods and concepts from CoSEM modules SEN113, SEN114, SEN115, SEN116 and SEN131b.

3

Theoretical Framework

This thesis explores the role of value controversies in the development of TECs with complete ownership and control of their collective heat system to identify their relation to occurrences of social learning using a constructed conceptual model consisting of two existing frameworks. This Chapter starts by presenting the Value Laden Institutional Analysis & Development framework from Milchram et al. (2019) and the Value-based model from Schram et al. (2024) in (Section 3.1) which are used for constructing the conceptual model presented in Figure 3.5. Then the two frameworks and their relevance to the research are individually discussed in (Section 3.2) and (Section 3.3) after which the rationale for their connection and integration is argued for in (Section 3.4).

3.1. Introducing the Combined Frameworks

The conceptual model constructed for this research consists of two components, the Value Laden IAD framework as proposed by Milchram et al. (2019), elaborating on the adapted version of the IAD model of Ostrom (2010) by Pahl-Wostl (2010) and the value-based model from Schram et al. (2024) which combines the value hierarchy of Van de Poel (2013) and the overflowing and backflowing model of Pesch et al. (2017). Figure 3.1 shows how the constructed conceptual model of this thesis is built up from the mentioned existing models.

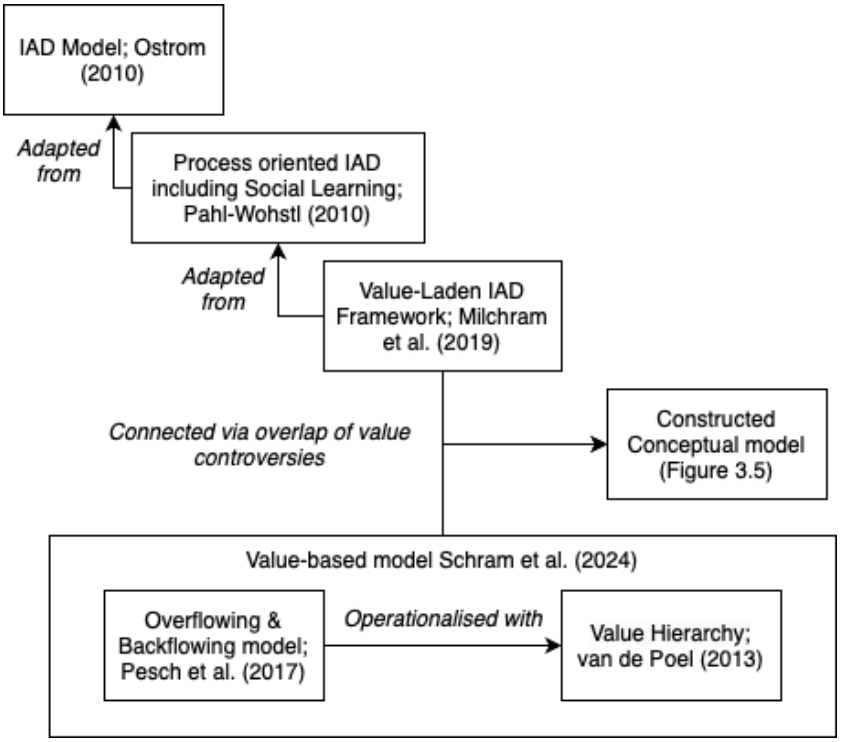

Figure 3.1: Schematic Model Representation

3.2. Value Laden IAD Framework

To identify opportunities for Social learning through examining value controversies in the professionalisation of TECs, the Value Laden Institutional Analysis and Development framework (VLIAD), as proposed by Milchram et al. (2019) is incorporated. The VLIAD is a meta-theoretical tool that can be used to structure the different components and actions within the complex system of a self-organising community [43]. The Value Laden IAD Framework is an enriched version of the IAD framework adapted from Ostrom (2010).

The framework uses a dynamic version of the IAD framework as proposed by Pahl-Wostl (2010) and includes the concept of social learning to make the framework process-oriented [50]. Social learning is a process through which individuals and groups acquire knowledge, skills, and attitudes by observing and interacting with others in a social environment [43]. Social learning cycles are triggered when value controversies arise, are noticed by the community, and actions are taken to improve the conditions in the action situation to better align with the evaluative criteria. This process can take place on multiple levels termed single-loop, double-loop, and triple-loop learning. The focus of this analysis is on single-loop and double-loop learning. Single-loop learning concerns the process leading to incremental adjustments of strategies and behaviour within the same policy process [19]. Double-loop learning encompasses detecting and correcting errors in the designs that underlie and shape the strategies and behaviour in single-loop learning [5]. This involves changing the institutions and the governance of the values, and policies that shape the actions in the action situation [5, 43]. The difference between single-loop learning and double-loop learning can be described as that between doing things right and doing the right things [43].

Second, the IAD framework is value-laden meaning the different components of the framework have a dedicated focus on specific value theory [43]. The role of values in the IAD framework was already stressed by Ostrom (2011) as she highlighted the importance of making sure institutions fit the values of those involved in their development [49]. These two additions to the IAD framework allow for process-oriented analysis of the professionalisation of TECs and specifically the role of values in social learning. Figure 3.2 displays the VLIAD framework and how value controversies are located in it as a misalignment between evaluative criteria set by a community and the actual interactions and outcomes within the action arena. Outcomes are divided by Pahl-Wostl (2010) into three distinct categories: (1) knowledge, (2) institutions, and (3) operational outcomes. Knowledge refers to meaningful information and experience for a specific situation [43, 50]. Second, operational outcomes refer to the improvement of existing technologies and the development and implementation of new technologies. Finally, Institutions refer to changes in formal and informal institutions. Formal institutions are laws, constitutions and police, whereas informal institutions include social norms and conventions that shape human behaviour [41].

The area of interest of the VLIAD framework for this thesis is the connection between value controversies and the formulation of new formal and informal institutions through single- and double-loop learning.

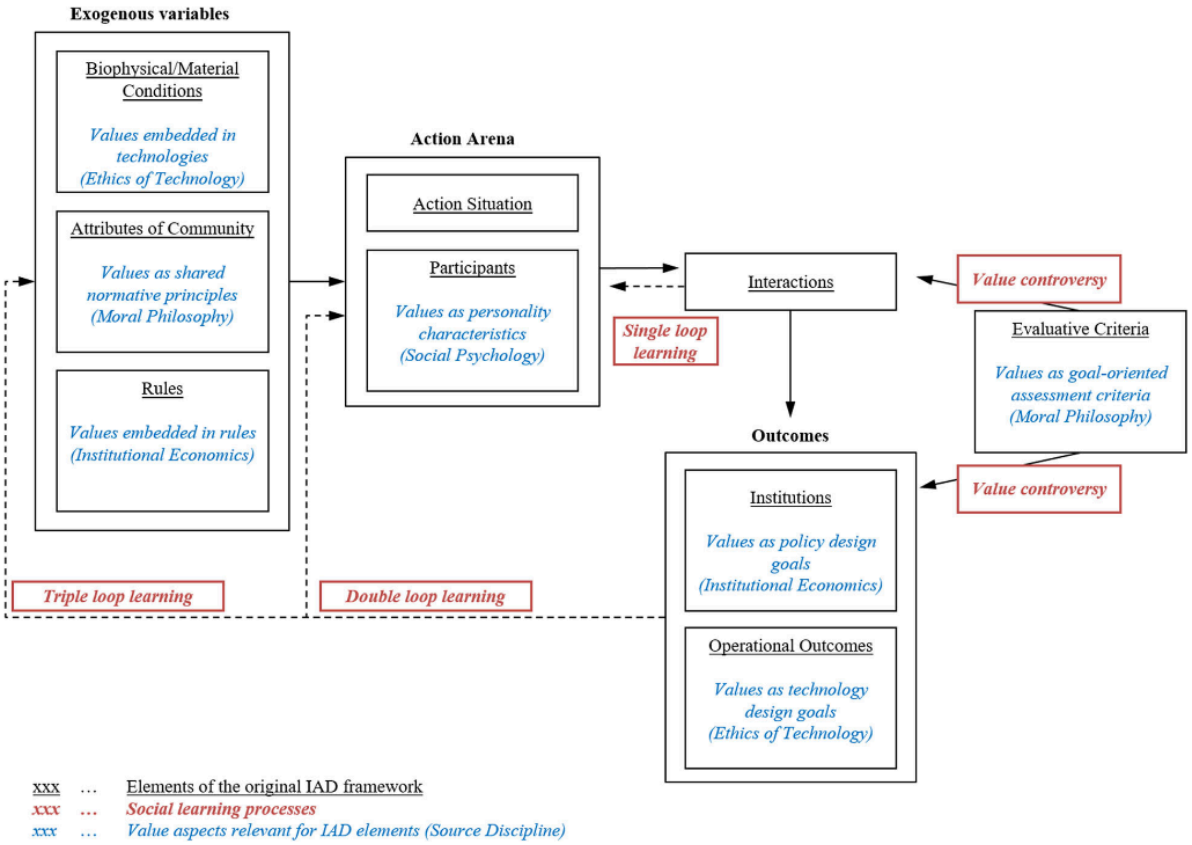

Figure 3.2: Value Laden IAD Framework [43]

3.2.1. Acknowledging the Context Specificity of Energy Projects

Emerging controversies during the professionalisation of a specific TEC are influenced by the given local (cultural) context, which involves a prevalent set of institutions and values [43]. This context specificity leads to variations in values embedded in the technical and institutional design and thereby the value controversies that emerge per project [43, 51]. This perception is reinforced by research into other types of energy projects, such as the development of solar farms in the Netherlands [52]. Additionally, the presence of specific demographic characteristics, as well as the formal and informal institutions practised by a community, is closely associated not only with value controversies but also with processes of social learning and the overcoming of social dilemmas [26, 48, 54]. Because of this notion of context-specificity, this research will start with a context analysis, mapping the exogenous variables of the IAD framework as they influence the decision-making and interactions in the action arena and therefore the professionalisation of TECs [43]. The definitions of the exogenous variables structuring the analysis are discussed below.

3.2.2. Exogenous Variables

This section presents the exogenous variables and what they encompass in the context of this thesis. The exogenous variables consist of the *Biophysical Conditions*, *Attributes of the Community*, and the *Rules-in-use*.

Biophysical Conditions

This variable includes the identification of the physical environment in which an action situation is located such as the building characteristics [48]. Additionally, the characteristics of the DH system are relevant including the heat source, distribution infrastructure, the number of grid connections and potentially other connected technologies such as storage.

Attributes of a Community

This variable includes three aspects. First, it encompasses the history of prior interactions among participants, which provides insights into trust levels, cooperation patterns, and conflict resolution mechanisms within the group. Second, it considers the internal homogeneity or heterogeneity of key attributes, such as goals, values, backgrounds, or interests. Homogeneity can facilitate easier coordination and understanding, while heterogeneity can bring diverse perspectives but may also lead to conflicts or misunderstandings. Lastly, it includes the knowledge and social capital of the participants, referring to the information, skills, and resources they possess, as well as the networks and relationships they can leverage [26]. High levels of knowledge and social capital can enhance the group's ability to effectively manage collective actions and address challenges [48]. By examining these components, a better understanding of the dynamics and potential outcomes of the interactions among participants can be gained [48].

Rules-in-use

These variables specify the common understanding of those involved related to who must, must not, or may take which actions affecting others subject to sanctions. During the development of the TEC, this is the variable that is most likely to change as a result of double-loop learning. This means the participants of the TEC, self-consciously change the rules in a collective choice or constitutional-choice

setting [48]. Heldeweg & Lammers (2015) demonstrated that the IAD framework could be useful in reducing complexity in local decision-making processes for smart grid implementation. All pertinent elements of the institutional context within an action situation are designated by rules currently in use [42]. Ostrom (2011) provides an in-depth specification of the effect of rules-in-use as external variables on the internal structure of the action situation, as illustrated in Figure 3. A description of working parts of an action situation that are affected by each rule is described in Table 3.1.

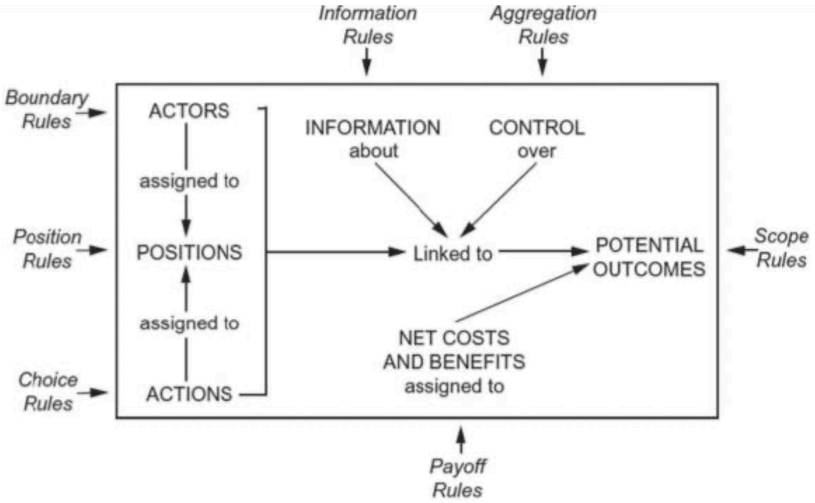

Figure 3.3: Rules-in-use located in the action situation, [48]

Rule	Affected working part of action situation
Boundary rules	How are actors choose to enter or leave positions
Position rules	What position can each actor hold
Choice rules	Which actions are assigned to an actor in a position
Information rules	What communication channels are used among actors and what information must, may, or must not be shared
Scope rules	What outcomes could be affected
Aggregation rules	How are decisions of actors at a node mapped to intermediate final outcomes
Payoff rules	How are benefits and costs distributed to actors in positions

Table 3.1: Rules-in-use, [48]

The goal of applying the VLIAD framework is to structure and support the analysis in identifying how the exogenous variables impact the decision-making processes in the development of TECs and how value controversies emerging during this development in turn change the interactions and rules-in-use in the action situation through social learning.

3.3. The Value-based Model

This section discusses the component of the constructed theoretical framework that is used for identifying value controversies and instances of social learning. The used framework is that of the formal

and informal trajectory of assessment, connected through the processes of overflowing and backflowing [51]. The theoretical framework is extended using the value hierarchy from van de Poel (2013). The combination of these frameworks and the link between values and controversies has in previous research been empirically proven by Schram et al. (2024).

3.3.1. Formal and Informal Trajectory of Assessment

The main framework used in this thesis is the overflowing and backflowing model from Pesch et al. (2017) induced with the value hierarchy of van de Poel (2013) as proposed by Schram et al. (2024). The framework is visualised in Figure 3.4.

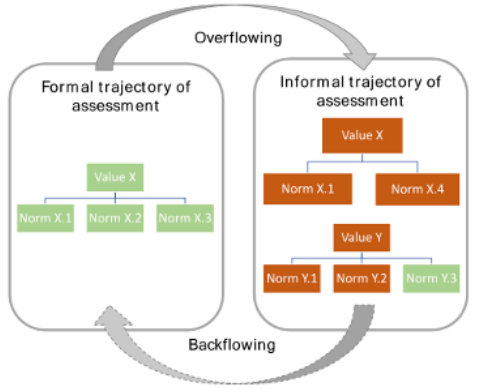

Figure 3.4: The Value-based model, [52]

The overflowing and backflowing model distinguishes two trajectories of assessment during decision-making processes of energy projects, a formal and an informal trajectory of assessment. The trajectory of formal assessment encompasses a set of procedures, standards, tools, and policy arrangements used to establish a collective value appraisal of the new technology or a project [51]. However, when societal concerns are not perceived to be sufficiently covered in the formal trajectory, overflowing occurs and gives rise to an informal trajectory of assessment. The trajectory of informal assessment is defined by advocacy for values that actors consider to be underrepresented in the formal trajectory and materialises in the formation of advocacy groups and media debates [16, 51]. This phenomenon can be seen as a sign that the space for arguments and values within an energy project needs to be examined and possibly complemented so that a productive exchange between formal and informal settings can take place. The informal trajectory can also result in changes or adaptations in the formal trajectory such as new standards, policy tools, procedures and participatory methods for the decision-making process of TECs. This process is referred to as ‘backflowing’.

As the goal of this thesis is an in-depth analysis of values present and underrepresented in the professionalisation of TECs, their role in the development of the projects and potentially in controversies the overflowing and backflowing model of Pesch et al. (2017) is combined with a value-based approach as per Schram et al. (2024). This model incorporates the value hierarchy of Van de Poel (2013). The value hierarchy consists of three elements: values, norms and design requirements and can be used in two ways, top-down and bottom-up. In this research, the bottom-up approach is used to identify underlying values based on observed expressed norms and design requirements [52]. Norms in the context of this thesis are defined as prescriptions for or restrictions on any kind of action [56]. In contrast to

values, norms are context-dependent. Norms can be further specified in design requirements. Design Requirements describe how a certain goal or action, defined as a norm, is attained [20, 56]. In the case of TECs such as value hierarchy could include *Financial Distributive Justice* (as value), *Affordable for all residents* (as a norm), and *Free installation and maintenance services for participants* (as design requirement).

3.4. The Conceptual Model

Combining the discussed frameworks gives the conceptual model depicted in Figure 3.5. Schram et al. (2024) state that research on value controversies in energy projects using their framework is context-specific which can serve as a weakness of their model [52]. This weakness is mitigated in two ways. First, by using the conceptual model in Figure 3.5 allows for starting with a context analysis to account for the context specificity of energy projects. This context analysis using the exogenous variables of the IAD framework allows for more nuanced comparisons as the findings of the value analysis are discussed within the context of their external environment. This supports creating an understanding of how context influences the development of the TECs as it gives an insight into the situation from which the values emerge as well as the influence of context on social learning. Second, context specificity can be accounted for by doing multiple studies on the same type of energy projects in different cultural and geographical contexts to gain a more complete understanding and come to generalizations [52]. The comparative case study approach follows this advice and partially mitigates this weakness.

For the analysis of value controversies, the model of van den Poel (2013) is connected to the VLIAD through the *value controversies* component. Value controversies within the VLIAD of Milchram et al. (2019) have already been linked to the processes of overflowing and backflowing (p.11, [51]). Operationalising the VLIAD with the value-based approach of Schram et al. (2024) allows for an examination of value controversies in the development of TECs through occurrences of overflowing and how this results in backflowing which takes the form in the VLIAD as social learning [52]. This overlap of value controversies serves as a bridge for connecting the two frameworks in the conceptual model. The dynamic characteristic of the VLIAD is compatible with the dynamic and ongoing nature of overflowing and backflowing processes of the model of Schram et al. (2024) making it suitable for analysing the development process of TECs and specifically the role of value controversies in social learning [52].

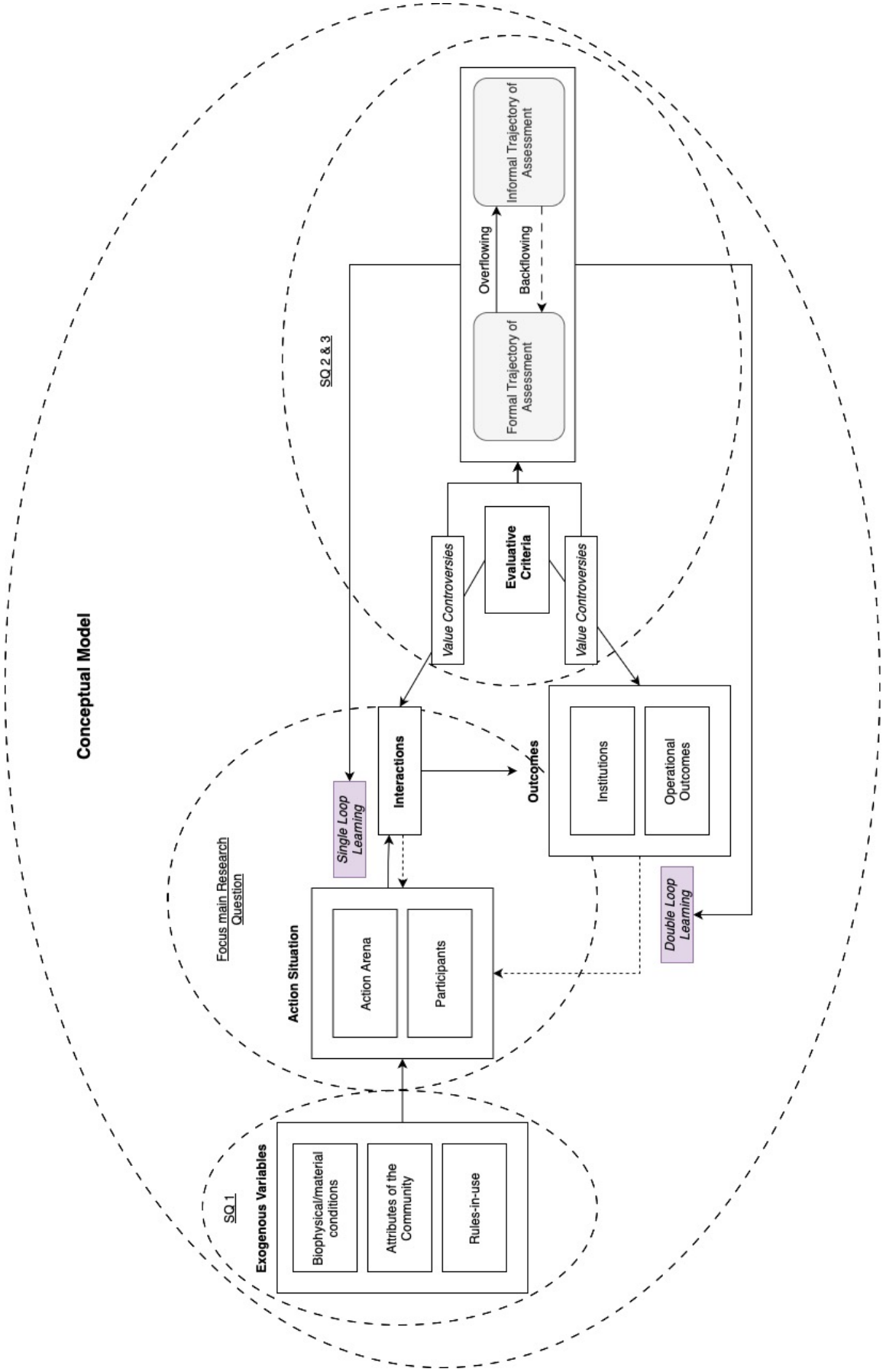

Figure 3.5: Conceptual Model

4

Methodology for the Comparative Case Study

This chapter starts with presenting the selected cases and case selection criteria in (Section 4.1). Then the formulated research approach per sub-questions is presented in (Section 4.2.) covering the rationale, expected output, data collection methods, data sources, and data analysis methods, along with the operated frameworks. The research process is visually represented in the Research Flow Diagram (RFD) in Appendix A.2.

4.1. Selected Cases

Three cases have been selected for the comparative case study. These include the cases of Thermo Bello, Energiek Nagele and Warm Heeg and were selected based on their compliance with the criteria presented in Table 4.1. (Sections 4.1.1, 4.1.2, and 4.1.3) provide an overview of the selected cases. In (Section 4.1.4) a comparison table including project start dates, (expected) finish dates, size, PAW status and Stage of Development is presented.

Selection Criteria	Focus
Governance model	Complete ownership and control at the TEC as opposed to shared ownership with a public or private party.
Organisational Characteristics	The case must be categorized as a thermal energy community (warmtegemeenschap) according to the standards of the European Union and EnergieSamen.
District Heating System	The technological system adopted by the community must be a type of collective heat system.
Available articles	There must be a solid database available on the TEC on Nexis Uni and other sources.
Stage of development	The TEC in this case must have made an initial decision on their governance model and technological system.
Location	The TEC must be located in the Netherlands.

Table 4.1: Case Selection Criteria

4.1.1. Thermo Bello

Case Description

Thermo Bello is located in Lanxmeer, a neighbourhood in Culemborg-oost. In the year 2000, the foundation for a scaled heating enterprise in the EVA Lanxmeer locality was established through the Lanxmeer Heat Supply Framework Agreement [59]. The aforementioned agreement was concluded with the local water utility company, the Municipality of Culemborg, and the EVA-Lanxmeer Residents Association (BEL). The agreement delineated the ecological objectives and conditions for the development and operation of a District heating system. In the initial phase, residential connections were made to a provisional system until the completion of the permanent installation in 2004. By 2006, Vitens, which had assumed control of the DH system, resolved to concentrate exclusively on its principal function of water extraction and supply. This decision resulted in the divestiture of non-core activities, including the heating network [59]. The initial proposal to assume control of the heating network was presented to the Municipality of Culemborg, which declined on the grounds of a lack of alignment with its strategic objectives. Subsequently, an offer was extended to BEL, the subsequent partner in the framework agreement. This enabled the residents of Culemborg, EVA Lanxmeer, to adopt the water pump station of Vitens and utilise it as their heat station. This water pump station supplies tap water to the Culemborg region at a constant temperature of approximately 12°C, which is suitable for low-temperature heating (LTH) [59]. In 2024 Thermo Bello is still the only operational TEC in the Netherlands.

Database

In the case study of Thermo Bello, 66 documents were coded and analysed. Of these documents 55 were published by the media and 11 consisted of newsletters published by the TEC, policy documents of the TEC and transcribed council meetings. Additionally, an interview was conducted with the director of Thermo Bello in function at the time of development.

4.1.2. Energiek Nagele

Case Description

Energiek Nagele is located in the municipality of Nagele. The city consists of 3 areas: a village area, an industrial area and a wider rural area. The TEC is located in the village area. In 2016, the 'Dorpsbelang' Association conducted an exploratory study that concluded that Nagele offered potential as an experimental space for the generation and utilisation of sustainable energy. A competition held in 2017 resulted in the selection of the "Nagele in Balance" concept in early 2018 [35]. The objective of this concept is to optimise the generation and storage of energy within Nagele during the summer months for utilisation in the winter and other seasons, thereby maintaining a balanced energy supply on an annual basis. This approach permits the discontinuation of natural gas distribution by the network operator Liander without the necessity for substantial enhancements to the existing electricity grid. The project was designated a pilot under the national Gas-Free Neighbourhoods program (PAW), with €4.2 million in funding allocated to it [35]. It was decided, due to the innovative nature of the project, that a pilot project should be initiated, and implemented on a small scale. This resulted in the establishment of a collective heating system based on solar thermal energy, encompassing seasonal and daily storage for eight residential units and a former educational facility renovated as a community hub. The heating system was operational by early December 2021; however, sub-optimal technical performance and concerns raised by the local population regarding the project's development format have led to its shut-down in 2023 [35]. Currently, the TEC is exploring possibilities for project re-initiation, as €3 million of the PAW subsidies remain unallocated.

Database

In the case study of Energiek Nagele, 44 documents were coded and analysed. Of these documents 41 were published by the media and 3 consisted of a report and news magazine published by the TEC. Additionally, an interview is conducted with a member of the direction group.

4.1.3. Warm Heeg

Case Description

In 2012, the village of Heeg, situated within the province of Súdwest-Fryslân, set itself the objective of phasing out the use of natural gas by 2025, which has recently been postponed to 2030. Motivated by a desire to proactively shape their energy future rather than have decisions imposed by governmental authorities, the villagers initiated efforts to develop a collective heating system. Since 2012, the project has progressed from the initiation stage to the development stage and is now standing on the verge of the realisation stage [30]. However, difficulties in obtaining project financing have hindered the TECs' progress, resulting in the project being halted on four occasions for six months each time. Fortunately, the TEC became part of the national PAW program and received €4 million in funding, which enabled it to continue its activities. The objective of the TEC is to facilitate the decarbonization of residential heating in 864 households in a cost-effective manner that does not impose undue burdens on the local population [30].

Database

In the case study of Warm Heeg, 56 documents were coded and analysed. Of these documents, 24 were published by the media and 32 consisted of documents, such as reports, white papers and blogs published by the TEC. Additionally, an interview is conducted with a member of the direction group.

4.1.4. Comparison Table of Cases

Table 4.2 includes information on the selected TECs, additional specifications on the technology and infrastructure can be found in Appendix B.1.

Case	**Thermo Bello**	**Energiek Nagele**	**Warm Heeg**
Start Date	2006	2018	2012
Finish Date	2008	Project Frozen	2030
Properties	229	496	1170
PAW participant	No	Yes	Yes
Stage of Development	Operational	Execution	Development/ Realisation

Table 4.2: Comparison Table TECs

4.2. Research Approach

The rationale behind each research question and the desired outcomes are outlined in this section followed by an overview of the data collection and analysis methods used to address them. Each method is briefly described and justified in terms of its relevance to the study. These selected methods will serve as the foundation and input for applying the conceptual model shown in Figure 3.5, which is designed to provide an answer to the main research question.

4.2.1. Sub-question 1: Identifying the Impact of Exogenous Variables

The rationale for answering Sub-question 1 is twofold. First, the Exogenous variables affect the patterns of interaction in an action situation, as outlined by Ostrom (2010). Answering this question allows for establishing a robust understanding of the context in which the TEC is located, accounting for the context specificity of energy projects discussed in Chapter 3. Second, it helps to answer the main research question by allowing for cross-comparison of the exogenous variables and their influence on decision-making processes and single- and double-loop learning.

Data Collection

The data analysis method employed in this analysis is document analysis, collected through desk research. The data sources comprise documents published by the TECs and company reports, such as the Local Energy Monitor published by HIER [34]. Furthermore, data about the built environment and the demographic characteristics of the residents are collected.

Data Analysis

The Analysis is structured using the Exogenous Variables of the (VL)IAD framework depicted in Figure 3.2. These variables include the Biophysical Conditions, Attributes of the Community, and the Rules-in-use. As a large amount of information is available including irrelevant information for answering the research question, stringent research discretion was applied when determining the exact information that was to be collected for this research question.

For the biophysical conditions, the focus lies on characteristics of the environment that might influence technical performance and requirements, such as energy labels of the connected buildings, and the chosen technical system. Mapping Attributes of the Community, encompassed collecting data on the population involved in the project that might affect their willingness and capacity to participate in the project. For the rules-in-use the rules in Table 3.1 formed the structure of the analysis. After the data collection, the similarities and differences between the cases are discussed to create an understanding of what exogenous variables influence the decision-making in the development of the TECs. The findings are then validated, corrected and complemented through expert interviews from which the process is discussed in (Section 4.2.3).

The output of this sub-question is an overview of the exogenous variables that influence the decision-making process in both the formal and informal assessment trajectories of TEC development. Chapter 5 will present only those exogenous variables found to have a direct impact on the decision-making process of the formal and informal trajectory of assessment. For transparency, an overview of all exogenous variables, despite not being recognised as having impacted the decision-making process of the formal and informal trajectory, that were covered in the analysis process is placed in Appendix B.1-3.

4.2.2. Sub-question 2 & 3: Values, Value Controversies & Social Learning in Local Heat Initiatives

The deliverable of sub-question 2 is a taxonomy of the values that are present in the analysed cases and the value controversies that emerged due to a misalignment between the needs and wants of the population and the set of institutions present in the governance approach of the TEC, manifesting as overflowing. The third research question examines how the underrepresentation of certain values in the formal trajectory of assessment has triggered social learning through backflowing. Answering this question, along with sub-question 2, enables a comparative analysis of the values, emerging value controversies, and resulting social learning in individual cases. This approach helps identify general patterns in how value controversies arise and how they lead to social learning through backflowing.

Data Collection

The collected data sources included Nexis Uni for media articles gathered through customized search queries adjusting keywords, and timelines, and removing duplicates, resulting in a database of 40 to 70 articles per case. Additionally, the websites of TECs and local governments were consulted for transcripts of community meetings, consultations, development reports, and neighbourhood surveys.

Data Analysis

The analysis incorporates the value-based model of Schram et al. (2024). The main analysis tool used is Atlas.ti. Atlas.ti is a tool that supports the qualitative analysis of larger bodies of unstructured textual,

audio and graphical data. To determine the values present in the development of TECs a bottom-up approach using the value-based hierarchy from Van de Poel (2013) depicted in Figure 4.1is used.

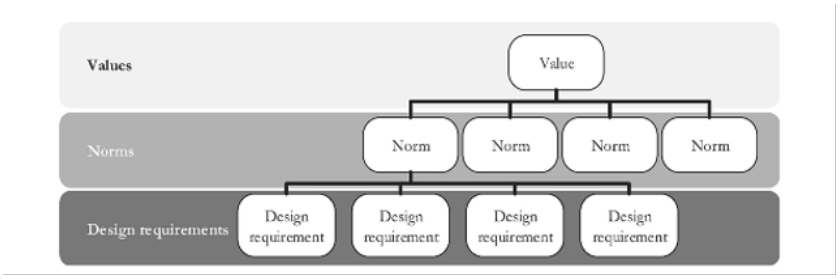

Figure 4.1: Value Hierarchy, [56]

This research adopts an inductive approach to examine various articles published during the development of the TECs, intending to construct a taxonomy of values present within the community. As values are not argued explicitly the analysis focuses on arguments in favour or against decisions and developments addressing norms and design requirements within the analysed articles [52]. This is also the rationale for why data is drawn from sources, such as media articles, council meetings, and neighbourhood surveys, as these documents tend to contain these lines of argument. As discussed in Chapter 3.5, norms are context-dependent prescriptions for or restrictions on types of action [56]. Norms can be further specified in design requirements which describe how a certain goal or action, defined as a norm, is achieved [20, 56]. When encountered these arguments addressing norms and or design requirements are classified and coded in Atlas.ti. After all documents were coded the identified arguments for or against design requirements are categorised and grouped under overarching norms which are in turn categorised under overarching values.

An example of this process is illustrated in Figure 4.2, using the value of Community Sense from the Warm Heeg case. In the analyzed documents, arguments for and against specific design requirements (represented by Dark Blue Boxes) were identified. For instance, one article highlighted the project group's proposal to offer free energy advice as a way to engage the community and dispel misconceptions about gas-free heating. The design requirement derived from this, along with others, was categorized under the norms (Red Boxes) these requirements support. For example, the design requirements of achieving a 70% participation rate in the neighbourhood and ensuring high attendance at informational and community meetings collectively uphold the norm of active community participation. It is worth noting that in some cases, arguments were directly linked to norms without an associated design requirement. These arguments were also coded, allowing norms to be derived directly from them. The identified norms were then grouped to derive a value (Purple Boxes). A value hierarchy like in Figure 4.2 has been created in Atlas.ti for every value presented in Chapter 5. These value hierarchies can be delivered upon request by the lead researcher and first supervisor for transparency reasons or in case of interest.

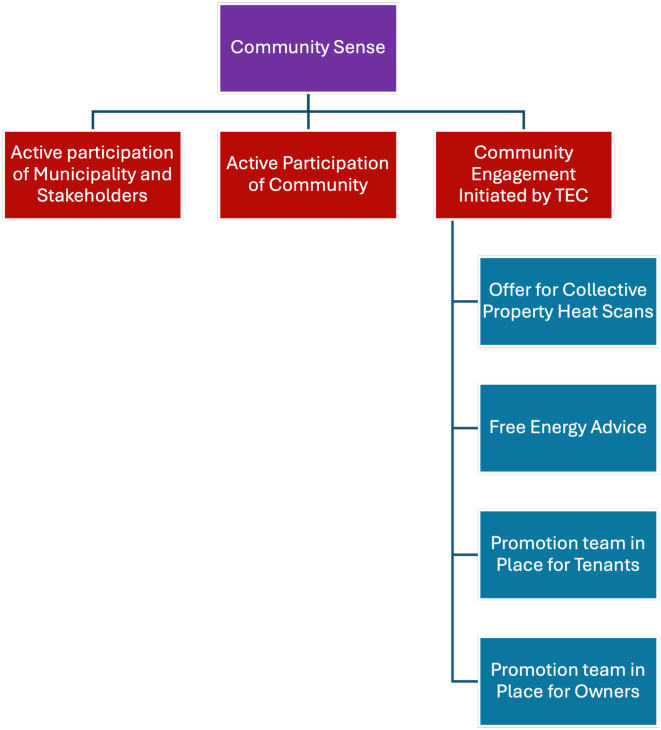

Figure 4.2: Example Value Hierarchy Application Community Sense, Warm Heeg

After the first round of inductive analysis, a second round of deductive analysis is performed. The goal of this second round of analysis is to examine the presence of overflowing and backflowing in the form of single- and double-loop learning. This approach involves distinguishing the arguments for and against norms and design requirements identified in the articles into the formal or informal trajectory based on their attributes. Figure 4.3 shows the division between attributes of the formal and informal trajectory of assessment. However, special attention here is given to the role of the project group of the TEC as they can both be identified as formal or informal trajectory depending on the collaboration agreement with citizens and other stakeholders. Both controversies expressed by the participants about the development of the project as well as the TEC about institutionalised actors are noted as overflowing as they point out an under-representation of values in the project important to the residents. Additionally, discretion in distinguishing between the formal and informal trajectory in the case of participants of the TEC has been applied by determining the role of the actor in the moment of expressing the argument. This means the role of the person who expressed the argument is assessed to fit either in the formal or informal trajectory.

	Formal trajectory of assessment	Informal trajectory of assessment
Logic of value expression	Judicial rationality (Embedded in predetermined procedures, recurring practices/routines)	Narrative rationality (continuity, based on shared origin and common future + emotional attachment)
Justice tenet starting point	Procedural justice (Universal and general principles. Assumes equality.)	Justice as recognition (adding attention for specific practices and circumstances. Requires explicit recognition local sphere)
Democratic principle	Delegative authority	Community-based authority
Main actors	Institutionalized actors (e.g., governmental authorities, firms, expert organizations)	Residents, citizens, NGOs, sometimes ad hoc civil society organizations
Opinions about other	Self-interest, opportunism, nimbyism, emotional	Technocratic, elitist, ignoring rights, impose suffering
Group identity	Detached disposition	Common identity of a(n emerging) societal collective

Figure 4.3: Formal and Informal Trajectory [52]

Once overflowing was encountered, adaptations in behaviour and decision-making in later published documents or mentioned in policy documents and reports were sought. Backflowing is denoted if changes are made to collaboration strategies with stakeholders, the organisational structure, or other processes or procedures in the project. If these changes in behaviour within the same policy process are identified this is marked as instances of single-loop learning. If the underlying evaluative criteria, objectives or rules-in-use shaping the behavior and strategies in the action situation are adjusted double-loop learning is noted. The output of this analysis is an overview of emerged value controversies per case and whether and how they led to backflowing. The results of this analysis are validated, corrected and complemented through expert interviews described in (Section 4.2.3.).

4.2.3. Semi-structured Interviews

To validate, correct and complement the findings retrieved from the described analyses interviews were held with project group members of the selected TECs. This is done in the following format. The identified values, value controversies, and instances of social learning are presented to participants of the TEC in question for feedback in a semi-structured interview with open-ended questions as this allows for adapting to the responses of the interviewees and minimizes the chance of the interviewer influencing the answers [37]. By presenting the gained insights and findings from the research to the interviewee, rather than asking for values and instances of social learning, the interviewees' opinion is captured. This interview format offers multiple benefits. First, it enables the identification of values through participants' reactions to the presented findings [52]. Second, it allows participants to provide feedback on the findings, helping to identify blind spots and reduce the biases that can occur in single-researcher research such as 'Anchor', 'Confirmation', and 'Sunk Cost' biases [37]. Microsoft Teams and Zoom are used as the main tools for conducting and recording the interviews. From each case, 1 participant is selected for the interview, with an interview duration of approximately 45 minutes. The

findings from the interviews are integrated in Chapter 5, correcting, validating and complementing the results. Summaries of the findings from the interview are placed in Appendix C. The interview documents are not placed in the Appendix as this was agreed upon when the interviewees signed the consent forms.

4.2.4. Main Research Question

After answering the sub-question the insights from the sub-questions and interviews were combined and discussed in Chapter 6 to identify main themes and formulate generalizations that served to answer the main research question:

> *"How have value controversies in the professionalisation of TECs with complete control and ownership in the Netherlands initiated social learning?"*

Answering this research question by using knowledge of the impact of exogenous variables on decision-making processes during TEC development, as well as the emerging value controversies and their relationship to social learning, enables TECs to more effectively guide their professionalization.

5

Results

This chapter presents the results from the research methods presented in Chapter 4. Each section starts by mentioning what research question it is related to and the methods that were performed to generate the results. (Section 5.1) presents the exogenous variables affecting the decision-making process of the formal and informal trajectory of the TEC projects. (Section 5.2) presents a taxonomy of the values identified in the cases, and the occurrences of overflowing & backflowing revolving around them. The findings from the interviews are integrated in this chapter and explicitly mentioned. An overview of the interview protocol and key findings per interview can be found in Appendix C.

5.1. Identifying the Impact of the Exogenous Variables

This section compares the findings of the analysis described in (Section 4.2.1) focused on answering Sub-question 1:*"What are the exogenous variables influencing decision-making in the formal and informal trajectory of assessment of TEC development?"* This section contains the variables that were identified as being relevant to answering the research question, however, more exogenous variables were taken up in the analysis initially. An overview of all exogenous variables examined in the context analysis can be consulted in Appendix B.1-B.3.

5.1.1. Comparing the Biophysical Conditions

The biophysical conditions of the cases presented and compared include specifications of the built environment in which the TEC is located, as well as the technical specifications of the DH system.

The Built Environment

Table 5.1 presents the data collected regarding the built environment in which the TECs are located. In Lanxmeer, there is a markedly higher proportion of owner-occupied homes (78%) compared to the rest of the Netherlands, where the figure stands at 57%. In the village area of Nagele, the majority of properties are privately owned. However, of the properties selected for the pilot project, the majority are owned by a housing corporation named Mercatus. In Heeg, the majority of properties are privately owned, but 23% are in the possession of rental corporations. Previous research has indicated that owner-

occupied homes are more favourable for transitioning to DH systems, as there is no split incentive between renter and owner in the transition [47]. Of the three cases, the DH system in Heeg is required

Case	Lanxmeer	Nagele Village	Heeg
Surface area	0,63km²	0,72km²	1,13km²
Population	1.420	1.130	2.080
Owners/Renters	78%/14%	68%/22%	68%/23%
Single-/Multi-Family Homes	72%/28%	99%/1%	87%/13%
Construction year before 2000	49%	92%	81%

Table 5.1: Biophysical Conditions: The Built Environment; [11, 12, 13]

to span the largest area, given the intention of the TEC to connect almost half of the population to the DH system. The majority of houses in Lanxmeer were constructed between 1925 and 1970, with a following construction period between 2000 and 2010. A precise delineation of the construction years is illustrated in Figure 5.1. The houses in Lanxmeer are relatively modern, with 51% constructed after 2000, in comparison to the national average of 19%.

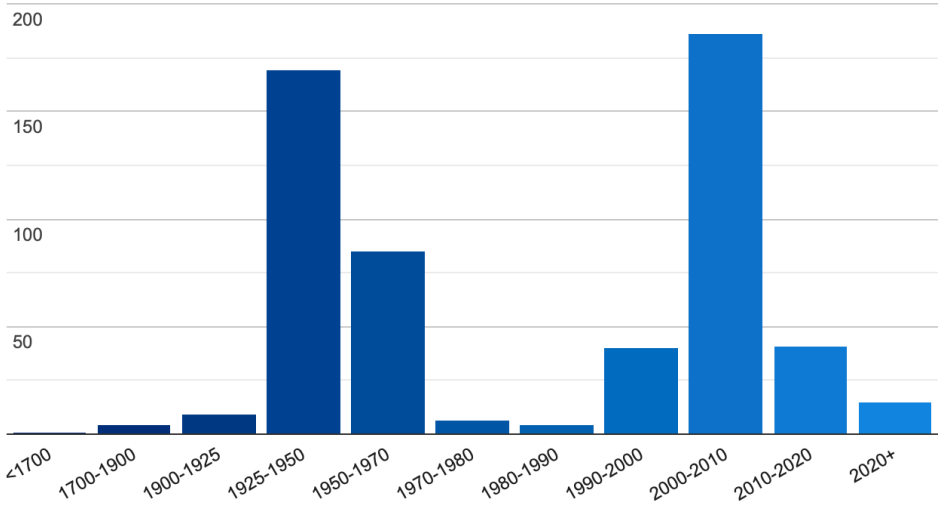

Figure 5.1: Number of houses build (Y-axis) by period (X-axis) in Lanxmeer, [1]

The newness of the properties is visible in the distribution of energy labels in the area. Figure 5.2 shows that 45.1% of the labels are A, being the majority in the area. The rest of the houses are fragmented in terms of energy labels.

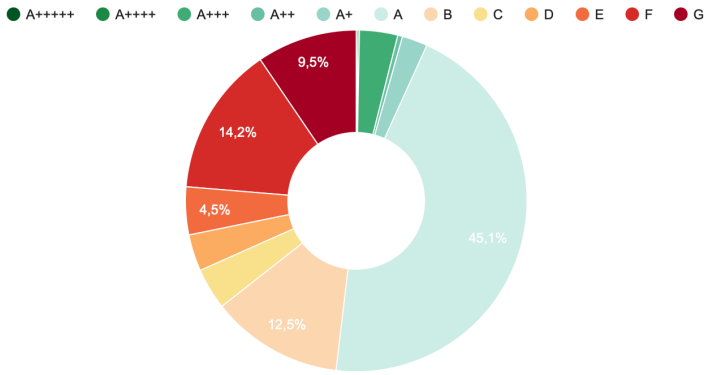

Figure 5.2: Energy Labels houses Lanxmeer, [1]

Nagele is a relatively new municipality as well with all houses being built after 1950. The largest share of the buildings stem from 1950-1970. Figure 5.3 shows the exact segmentation of build years for the houses.

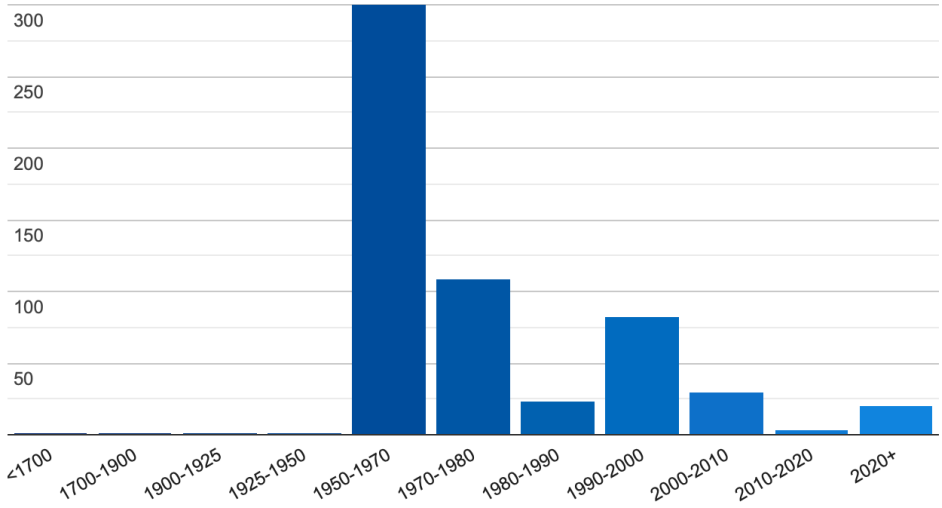

Figure 5.3: Number of houses build (Y-axis) by period (X-axis) in Nagele, [3]

However, even though Nagele is a relatively new municipality, the energy labels of the houses are lower than in the other cases. Only 35% of the houses have an energy label of A or higher. Most houses fall in the B, C, or D category with 61.5%. The segmentation of the energy labels for the buildings in Nagele is depicted in Figure5.4.

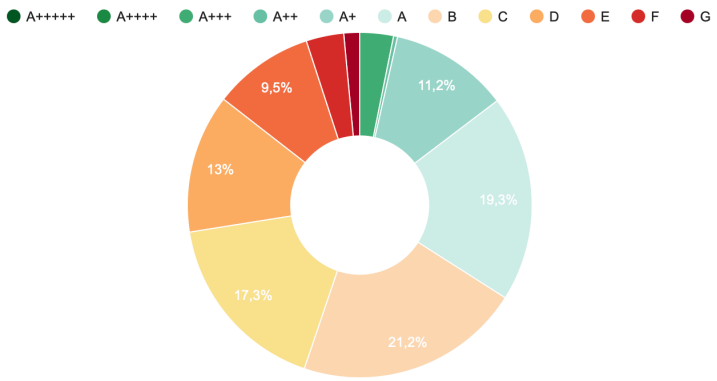

Figure 5.4: Energy Labels Nagele, [3]

The buildings in Heeg are relatively new and are mostly built between 1990-2010 as can be seen in Figure 5.5. In comparison to the other cases, the construction dates of the properties in Heeg are distributed more evenly.

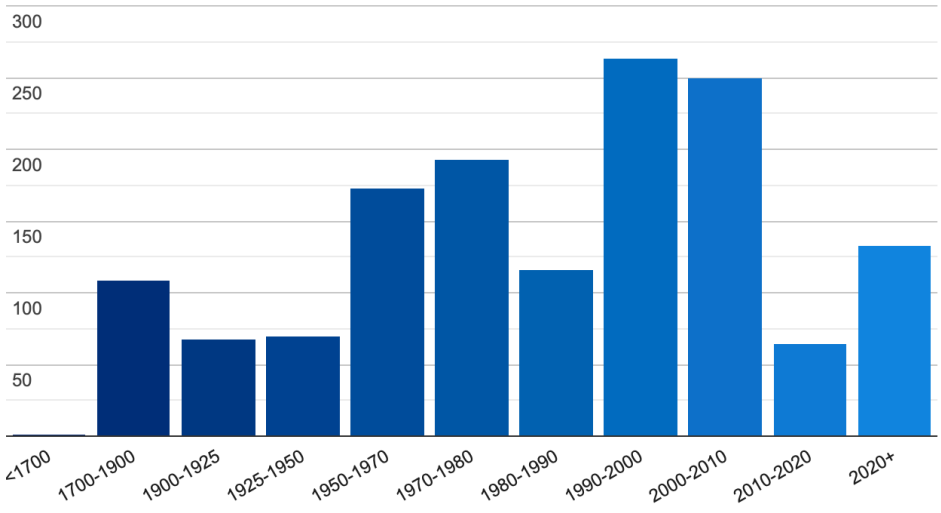

Figure 5.5: Number of houses build (Y-axis) by period (X-axis) in Heeg, [2]

The majority of the buildings in Heeg possess energy label A (30%), followed by those with B (22.6%) and C labels (14.6%). The exact division of energy labels for the buildings is given in Figure 5.6.

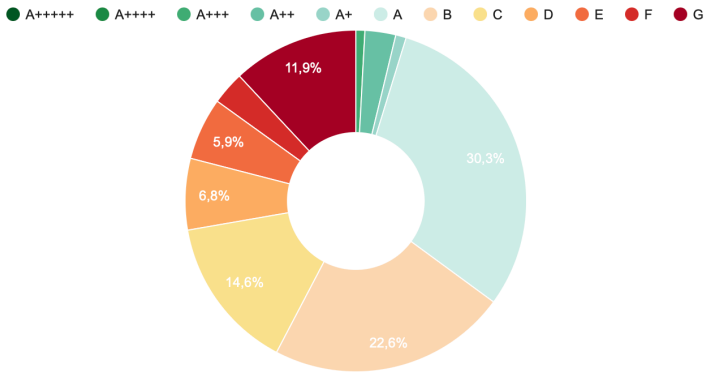

Figure 5.6: Energy Labels Heeg, [2]

The Technical System

Table 5.2 displays the technical characteristics of the DH systems developed or under development with each respective TEC. An elaborate description and visualisation of the DH systems per TEC can be found in Appendix B.1.

Specifications	**Thermo bello**	**Energiek Nagele**	**Warm Heeg**
Connected Properties	*229*	*497/(9)*	*1170*
Technology	*LT-Network (50°C)*	*MT-network*	*MT/LT-network*
Source	*ZLT-Aquathermic source*	*Solar MT*	*ZLT-aquathermic source*
Development Stage	*Operational*	*Execution/Operational*	*Development/Execution*
Start date	*2007*	*2018*	*2012*
Finish date	*2009*	*2030*	*2030*

Table 5.2: Technical Specifications DH system of TECs, [30, 35, 59]

Impact on decision-making processes

The biophysical conditions described above were identified to have an impact on the decision-making processes of the TECs. However, the exact cause of the impact differed per project. In the case of Thermo Bello the DH system was available at a near-operational state to the TEC as it was operated by Vitens for the previous years. The availability of an almost-ready heating system resulted in a quick development of the TEC, starting in 2007 and becoming operational 2 years later (Interviewee #1). It lowered the required amount of financing and accelerated the development of the DH system keeping residents engaged. The system of Energiek Nagele and Warm Heeg in contrast had to be built from scratch. In the case of Energiek Nagele the biophysical conditions were not as favourable to the development of the TEC. This resulted from their decision to opt for a new DH technology, before unseen in the Netherlands, using solar energy for heating the properties and an underground storage system, used in the winters. The innovative nature of their design made the TEC decide to start with a pilot project connecting 9 properties instead of a village-wide roll-out. In the end, the technical complexity of the project was one of the major factors in the project shutting down (Interviewee #2). Additionally, a renovation project by the housing corporation Mercatus, improving the isolation from the properties of a share of the participants, created a split in heat demand among residents. The variation in heat demand caused by differences in energy labels, resulting from the renovation, led to a divide in incentives

for participating in the project. This heterogeneity in heat demand was described by Interviewee #2 as affecting the decision-making process of the TEC as fewer people were interested in participating in it. Additionally, the innovative design of Energiek Nagele also caused challenges, resulting in sub-optimal technical performance. In the case of Warm Heeg, their biophysical conditions had less impact on the development of the system, even though they planned to connect most households to their system, with 1170 connections (Interviewee #3).

5.1.2. Comparing the Attributes of the Community

This section discusses the attributes of the community per case. Only demographics that were identified as influencing the development of the project are discussed in this section. For a more elaborate description of the Attributes of the Community please consult Appendix B.2.

Demographics of the Lanxmeer, Nagele & Heeg

Table 5.3 shows the demographics of the population the TECs are embedded in. Interesting findings were the percentage of higher level of education in Lanxmeer, where 52% has some form of higher education, compared to only 32% on average in the Netherlands. All the populations the TECs are

Demographics	**Thermo bello**	**Energiek Nagele**	**Warm Heeg**
Average Income	*€29.500*	*€19.000*	*€27.098*
Nationality	*95% Dutch*	*78% Dutch/15% European*	*96% Dutch*
Higher Education	*51.8%*	*24.4%*	*24.1%*
Secondary Education	*31.3%*	*51.3%*	*48.3%*
Elementary Education	*17%*	*24.4%*	*27.6%*

Table 5.3: Demographics TECs

located in are predominantly Dutch. However, the amount of people with a migration background is twice as high in Nagele (22%) as the average in the Netherlands (11%). Regarding average income, Nagele is below the Dutch average which is also reflected in the rate of people in Nagele receiving government support which is 3 times higher (3%) than in the rest of the Netherlands (1%).

Level of Education

The level of education was identified as having a significant impact on the decision-making processes of the formal and informal trajectories. In the case of Thermo Bello a high level of education was deemed an important factor due to the need for adaptive capacity and problem-solving capabilities within the TEC as well as the benefits from having access to lawyers, engineers and other areas of expertise required for the development of the project (Interviewee #1). In the case of Energiek Nagele, this was less the case forcing the TEC to seek external partners for expertise. In the case of Warm Heeg, the level of higher education was the same as that in Energiek Nagele, however, this was identified as less of an obstacle in the analysis as the required skills and expertise were accessible for the TEC (Interviewee #3). Additionally, prior experience with locally-led initiatives resulted in an easier initiation of the project according to the interviewee. The three interviewed individuals considered this variable pivotal in the progression of their initiative because of the numerous intricate challenges encountered. Thus, having access to individuals who are accustomed to addressing challenges of a high degree of complexity enhances the likelihood of successfully resolving them (Interviewee #1; Interviewee #2; Interviewee

#3).

Level of Income

Level of income is also seen as affecting the decision-making process of the TECs according to the findings. This comes from the fact that the development of TECs takes a lot of effort and time, around 2000 man-hours for Thermo Bello in two years (Interviewee #1). This requires the project group to work on the initiative on an almost full-time basis, meaning they will not have other active sources of income. The project group of Thermo Bello was able to do this on a completely voluntary basis with the support of locals in different working groups, however, in Nagele people were less eager to participate (Interviewee #2). The reason for this, as pointed out by Interviewee #2, was partially due to the low income in the area reducing the capacity for people to participate as well as increasing worries about the uncertainty around the change in cost for heat when transitioning to a DH system. This not only meant less support from the community but also less frequent communication as the residents were not as involved in the decision-making process. Later in the project, the project group of Energiek Nagele moved to full-time contracts for the project group. In the case of Warm Heeg, this was done immediately at the start of the project as it was deemed too complex for voluntary work.

Role of the Municpality

Regarding the presence of the Municipality as a partner or facilitator there were clear differences in the cases, becoming mostly clear during the interviews. As Thermo Bello was the first TEC in the Netherlands the governmental support on a national and local level was minimal. Even the municipality, as opposed to what was found in reports and the media, played no role at all in the development of the TEC (Interviewee #1). The municipality was only involved at the start during the acquisition of the heating system as a formality. The national government also withdrew from aiding the project and discarded, during and after the development of the TEC, the appeal of altering and loosening regulations for civil-led heat initiatives (Interviewee #1). In contrast, the interviewee of Energiek Nagele stated that their municipality contributed a lot to the development of the project and was closely involved along the way. This is possibly because the municipality of Noord-oost Polder is among the richest in the Netherlands making them capable of offering support and resources (Interviewee #2). When Energiek Nagele had financial problems, due to a later-than-expected received share of the PAW subsidies, the municipality was able to give an advancement on this payment, not delaying the project development. In the case of Warm Heeg, the municipality was involved in the decision-making process but performed a rather passive and observing role (Interviewee #3). Additionally, the interviewee expressed the ongoing struggle resulting from the fast churn rate of employees at the municipality. This led to delays as new employees needed to be on-boarded on the project without any existing protocols from the municipality to guide them. Additionally, not all employees were as enthusiastic about the project, making the degree of communication and collaboration inconsistent (Interviewee #3).

Heterogeneity in the Community

The interviewee of Energiek Nagele mentioned that besides the challenges resulting from a split in heat demand between homeowners and renters, there was also a split in the attitude towards local initiatives in the community. Some residents wanted to be involved in all activities while others had communicated to be left undisturbed during the project as they had bad experiences with previous local initiatives or were influenced by negative stories about DH projects from elsewhere (Interviewee #2). Housing corporation Mercatus was able to take over all participatory responsibilities of their tenants while homeowners had

to represent themselves, again creating an unequal distribution of burdens and benefits among residents. Finally, the community in Nagele consisted of immigrants with a limited understanding of Dutch making communication difficult according to Interviewee #2. These struggles coming from heterogeneity in the population also occurred in Heeg according to the Interviewee. Warm Heeg had a larger community than the other TECs therefore there was also greater diversity within the community in education, income, an political orientation, making communication difficult as not everyone gets an impulse to participate from the same incentives (Interviewee #3).

5.1.3. Comparing the Rules-in-use

This section compares the rules-in-use that were identified as having the strongest impact on the project. A description of all rules-in-use per case can be consulted in Appendix B.3.

Information & Aggregation Rules

When it comes to the rules in use the three cases had different approaches. In the case of Thermo Bello, there was already an initial format for the project, formulated during previous local initiatives (Interviewee #1). This significantly sped up the project as all the rules-in-use were clear to the participants. An additional benefit from this was that the community was already familiar with people in the project groups mitigating trust issues (Interviewee #1). This was a phenomenon that was also present in the Warm Heeg case as the interviewee mentioned that they purposely picked well-known people in the community with a good reputation to participate in the project group. The Warm Heeg interviewee stated that even though it has nothing to do with the quality of the project it helps with keeping momentum and winning the trust of residents (Interviewee #3). Additionally, Thermo Bello tried to create a clear organisational structure and decision-making rules at the start of the project together with all residents, both participating and non-participating. Moreover, agreements were made regarding the goals and objectives of the project in the short- and long-term. The spread of information happened through weekly meetings with the participating residents, where non-participating residents were also invited, allowing them to give criticism on the project. The decision to start with the project was only made after everyone in the neighbourhood had expressed their support.

In the case of Energiek Nagele, there was a different approach to creating rules-in-use for the project. Less emphasis was placed on collaborating with the community as there was only 1 meeting with the participants every 6 months (Interviewee #2). However, this was also due to the desire of the residents to not be involved and disturbed too much by the project (Interviewee #2). In contrast, with the communication style of Thermo Bello and Warm Heeg, the interviewee of Energiek Nagele stated that from the start they decided that if there was no progress or 'relevant' news to share they would not communicate with the community as they feared disturbing and bothering them (Interviewee #2). This low frequency of communication has led to challenges regarding maintaining support from the community now since the project was shut down as it is difficult to (re)build this (Interviewee #2).

A complaint about the rules-in-us in the Energiek Nagele case referred to the fact that the form of the TEC both technical and organisational was determined too early in the project and further left unaltered. As one participant noted, "The solution was deemed as the Egg of Columbus too early in the project and seen as the perfect fit for the area". Additionally, in the analysed documents the project process of Energiek Nagele has been described as Kafkaesque and rigid by both the project group and residents. Warm Heeg took a more modular approach changing the organisational structure as the project pro-

gressed. A notary was approached for this way of working. This came forth from the philosophy that rules and statutes do not create trust, but strong communication and engagement with participants do (Interviewee #3). Therefore, on many occasions, there was a 1-on-1 approach to communicating with participants and residents. Additionally, before decisions are made on any matter by the TEC, there must be anonymity among participants.

5.2. Values, Value Controversies & Social Learning in Local Heat Initiatives

This section discusses the results of the analysis described in (Section 4.2.2) aimed at answering the research questions: *"What value controversies have emerged as a result of underrepresented values in the formal trajectory of assessment during the professionalization of TECs?*" and *"How did value controversies lead to backflowing?"* The section starts with presenting and comparing the results of the coding rounds including the values in (Section 5.2.1) followed by occurrences of overflowing and backflowing identified in the cases in (Section 5.2.2). Finally, a distinction within the cases of backflowing is made between single- and double-loop learning in (Section 5.2.3).

5.2.1. A Taxonomy of Values

A list of the identified values per case is presented in Table 5.4. This does not imply these are the only values present in the projects, however, they were the topics of discussion in the analysed documents derived from arguments about the norms and design requirements of the TECs. For definitions of the values identified specific to the cases of Thermo Bello, Energiek Nagele, and Warm Heeg see Appenix B.4-6. An overview of the value hierarchies of each value including norms, design requirements and the exact quotations they were extracted from can be delivered on request by contacting the lead researcher and first supervisor.

Values	Thermo bello	Energiek Nagele	Warm Heeg
Aesthetics	*x*		
Altruism	*x*		
Authenticity	*x*		
Autonomy	*x*	*x*	*x*
Community Sense	*x*		*x*
Environmentalism			*x*
Financial Distributive Justice	*x*	*x*	*x*
Quality of Life		x	
Recognition		*x*	
Trust		*x*	*x*

Table 5.4: Values Identified in the Development of Thermo Bello, Energiek Nagele & Warm Heeg

Thermo Bello

In the case study of Thermo Bello, 6 overarching values were identified resulting from 17 identified norms and 11 design requirements that were derived from 61 quotations. Additionally, 6 occurrences

of overflowing were identified in the second round of coding divided over 2 values. For definitions of the value identified in the case of Energiek Nagele see Appenix B. The findings described above are visualised in Table5.7. Even though Thermo Bello included the broadest set of values, this case involved the least variety in value controversies. Only the value of *Autonomy* and *Financial Distributive Justice* involved value controversies. For a description of the values identified in the case of Thermo Bello see Appenix B.4.

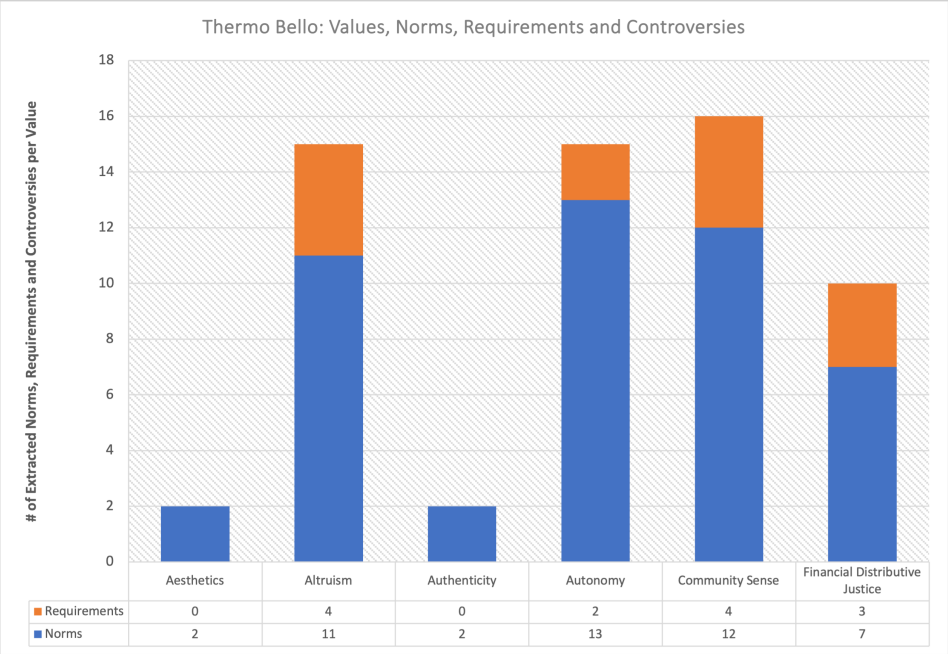

Figure 5.7: Values, Norms & Design Requirements, Thermo Bello

The values most at play at the start of the project were *Altruism* and *Autonomy*. Later in the project *Autonomy*, *Community Sense* and *Financial Distributive Justice* were identified more frequently.

Energiek Nagele

In the case study of Energiek Nagele, 5 overarching values were identified resulting from 17 identified norms and 12 design requirements that were derived from 121 quotations. In the analysis, 8 controversies were identified. The findings described above are visualised in Table5.8. For definitions of the value identified in the case of Energiek Nagele see Appenix B. The values most frequently identified at the start of the project were *Financial Distributive Justice*, *Recognition* and *Autonomy*. Later in the project, this switched to *Autonomy*, *Quality of Life* and *Transparency*.

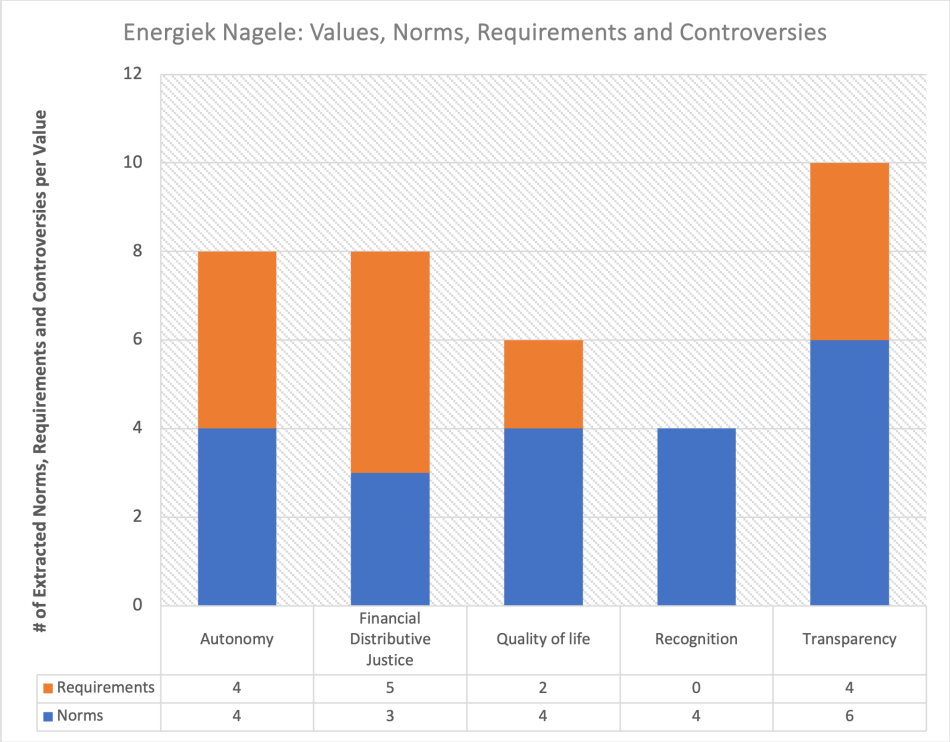

Figure 5.8: Values, Norms & Design Requirements, Energiek Nagele

Warm Heeg

In the case study of Warm Heeg, 5 overarching values were identified resulting from 16 identified norms and 15 design requirements that were derived from 123 quotations. This case included the most identified controversies of all cases with a total of 16 controversies. The findings described above are visualised in Table5.9. For a description of the value identified in the case of Warm Heeg see Appendix B. The values strongest at play at the start of the project were *Autonomy*, *Community Sense*, and *Trust*. Later in the project, *Financial Distributive Justice* was added to this list.

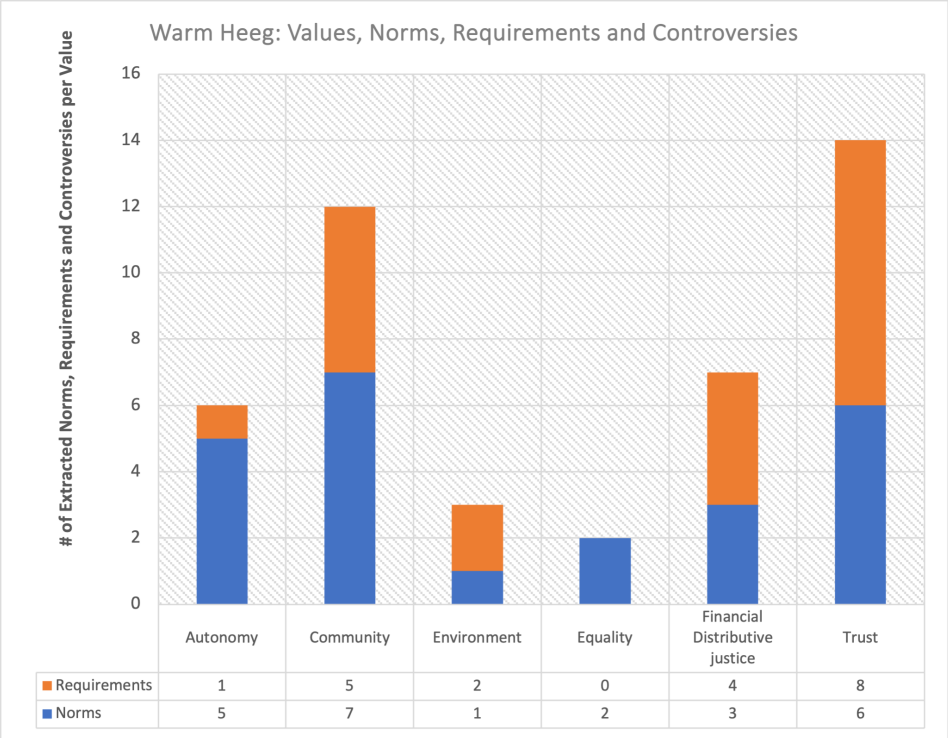

Figure 5.9: Values, Norms & Design Requirements, Warm Heeg

Comparing the values

Present values in all three cases were *Autonomy* and *Financial Distributive Justice*. *Autonomy* in the case of Thermo Bello and Warm Heeg was mostly expressed through arguments for keeping ownership and control of the heating system at the municipality. In the case of Energiek Nagele a controversy around *Autonomy* took the form of the community not wanting to participate in the projects' ongoing development. This was also stated as the most important value in the development of the Thermo Bello during the interview (Interviewee #1). The interviewee of Warm Heeg agreed with the identified values and noted *autonomy* as the most important driver for the development of the TEC. However, the interviewee explained that it started with a group of people who care about sustainability, even though this is not the value that eventually plays a role when the larger mass is convinced to join. This according to the interviewee has more to do with the experienced benefits when the project is completed which for most of the participants of Warm Heeg is energy independence from Russian natural gas (Interviewee #3). *Financial Distributive Justice* had overlapping definitions in the cases. Especially the burden of acquiring financing and the misalignment between application requirements and procedures and the TEC reoccurred in the cases, making the TEC dependable on public officials who wanted to bend standard procedures a bit and work around challenges.

Additionally, the values discussed appear deeply rooted in each community's culture. Thermo Bello emphasized the sustainable character of Lanxmeer visible through the strong presence of the value of *Altruism* in Figure B.4, Energiek Nagele takes pride in its innovative heritage and mainly brings up bad experiences with (energy) poverty visible in the presence of *Recognition* and *Financial Distributive Justice* as a value in Figure B.5, while Warm Heeg highlighted its independence and commitment to the Mienskip, resembled through the presence of *Trust* and *Community Sense* in B.6.

5.2.2. Occurrences of Overflowing & Backflowing

This section describes the results of the second round of coding including occurrences of backflowing connected to the values identified in the cases of Thermo Bello, Energiek Nagele and Warm Heeg. All instances of overflowing and backflowing are written out for each case and can be consulted in Appendix B.7.

Thermo Bello

The results of the second round of coding in the Thermo Bello case are visualised in Figure 5.10. Cases of overflowing were observed connected to the values of *Autonomy* and *Financial Distributive Justice* and related to 6 different value controversies. In the case of Thermo Bello 11 arguments were attributed to the formal trajectory of assessment and 46 to the informal trajectory of assessment. This unbalance between activity in formal and informal trajectory comes from the fact that Thermo Bello mostly showed attributes of the informal trajectory rather than the formal trajectory. The logic of value expression of the TEC resembled that of a narrative rationality pointing out how the government speaks about the self-realisation power of citizens but does not follow with actions, ignoring the needs and wants of the population in Lanxmeer. In terms of justice, the TEC seemed to promote both justice as recognition as well as procedural justice, involving the community in the creation of the evaluative framework as early as possible as well as emphasizing the desire to be independent from government institutions and become more sustainable. Finally, the TEC frequently used personal communication channels, required unanimity in decision-making processes and had a director group working on a volunteer basis. All these factors build trust by communicating the message 'we are in this together' indicating more of a community-based authority than a delegative authority.

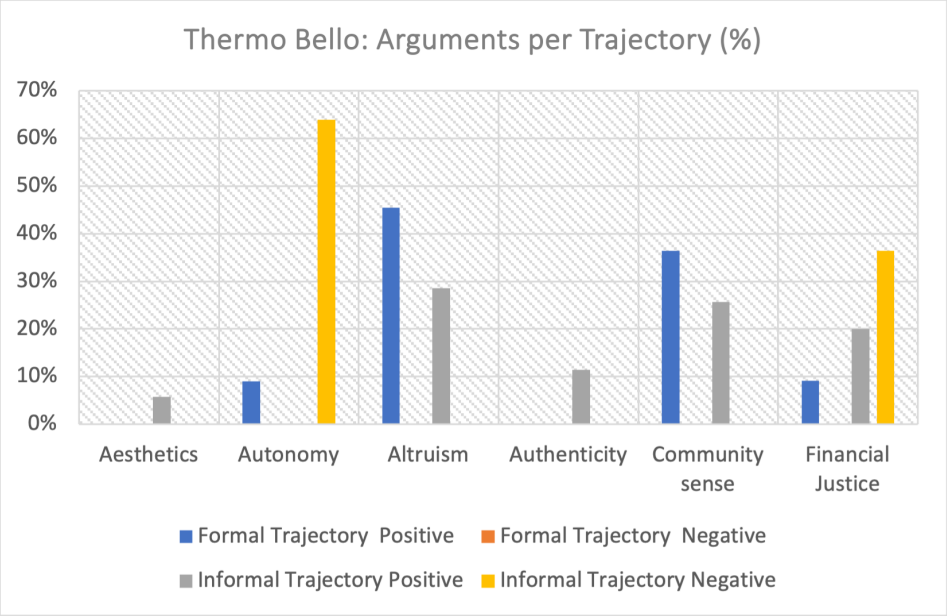

Figure 5.10: Distribution of attention to values in Formal and Informal Trajectory of Assessment, Thermo Bello

The identified value controversies through occurrences of overflowing are connected to the values of *Autonomy* and *Financial Distributive Justice*. As a result of the overflowing 5 occurrences of backflowing, two in the form of double-loop learning and 3 as single-loop learning. A description of the value

controversies and occurrences of backflowing written out in detail can be found in Appendix B.7.1.

Their most hampering value controversy according to the interviewee had the form of working with the existing set of regulations of large heat companies as the administrative burden was hard to comply with for a company based on volunteers. The interviewee also expressed little trust in municipalities as they were unwilling to participate in or support the project. This mainly resulted from the fact that Thermo Bello was the first TEC in the Netherlands, making it difficult for the local and national governments to offer support. Additionally, the TEC accused government officials of being mentally inflexible, stating their biggest challenge was making other parties understand what they envisioned Thermo Bello could be. This is visible in the spike of negative argument in the informal trajectory under *Autonomy* in Figure 5.10. The interviewee even sat with the Ministry of EAC at one point but they discarded the TECs' appeal for a change in regulations to unburden TECs from administrative and regulatory responsibilities (Interviewee #1). This led to backflowing as the TEC countered this challenge by founding a working group solely focused on the legal organization structure of the organisation and hiring a notary to guide this process.

During the interview as well as in the examined documents, little controversies internally were mentioned as the main focus was on the inability of municipalities and the government to work with TECs. Thermo Bello mitigated value controversies from the start by extending the initiation phase and making decisions unanimously. This created trust among participants which was a great driver for the project when facing challenges (Interviewee #1). This approach is also visible in the spikes in positive arguments and lack of negative arguments in both the formal and informal trajectory around the value of *Community Sense* in Figure 5.10.

Energiek Nagele

The results of the second round of coding in the Energiek Nagele case are visualised in Figure 5.11. In the case of Energiek Nagele 22 arguments were attributed to the formal trajectory of assessment and 58 to the informal trajectory of assessment. Occurrences of overflowing took place around the values of *autonomy*, *financial distributive justice* and *Transparency*. With *autonomy*, *quality of life* and *transparency* receiving more negative attention in the informal trajectory of assessment than in the formal trajectory. A description of the value controversies and occurrences of backflowing written out in detail can be found in Appendix B.7.1.2. The focus of the informal trajectory around the value of *Recognition* in Figure 5.11 displays the value Nagele places on being a pioneer and for the rest of the Netherlands. The desire to be recognised and experiment with innovative new technologies and methods is a strong drive throughout the project.

The collaboration between TEC and the population differed in the case of Energiek Nagele from that of Thermo Bello as there was more distance between the TEC and the participants. The TEC was more in contact with the municipality and other partner organisations having more similarities to the formal trajectory. This finding was underscored when Interviewee #2 made a distinction during the interview about their two tracks of development. The first track concerns the alignment between TEC and the community. This concerns the organisational structure of the TEC and the way of working with the heat consumers. The second track concerns aligning with the municipality, private parties and other stakeholders (Interviewee #2).

Energiek Nagele showed attributes similar to the formal trajectory of assessment visible in the presence of negative arguments in the formal and informal trajectory around *Autonomy*. This can be traced back

to the document where the TEC expressed frustration over the residents' unwillingness to participate, while residents sought to avoid disruption from the TECs' operations, reflecting a judicial rationality on the part of the TEC. In terms of Justice, the TEC and citizens were aligned in their promotion of justice as recognition, referring to the fear of energy poverty and the inability to comply with government programs when it comes to the energy transition. Finally, the TEC acted more as a delegative authority. Only meeting with the local community twice per year and communicating when necessary due to the fear of being burdensome towards the community. This resulted in a loss of support once the TEC encountered technical challenges as ignored problems were then voiced by the population.

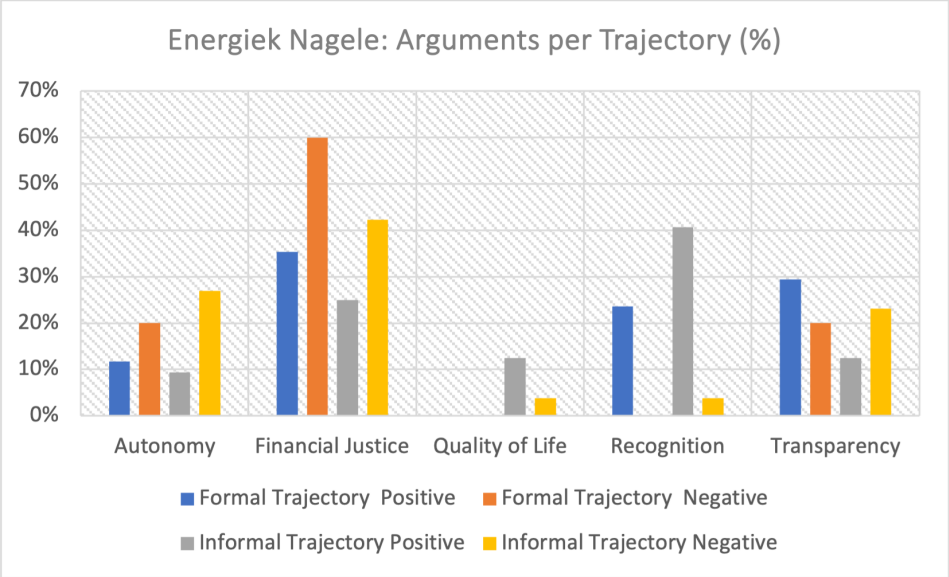

Figure 5.11: Distribution of attention to values in Formal and Informal Trajectory of Assessment, Energiek Nagele

The controversies around *Financial Distributive Justice* were especially a pain point for both the TEC as well as the population receiving the most attention throughout the project as is visible in Figure 5.11. The term energy poverty as something that had to be prevented at all costs was mentioned multiple times during the interview (Interviewee #2). Additionally, the interviewee of Energiek Nagele expressed particular frustration with working with existing protocols and regulations from both government bodies as well as market parties. Examples of this were completing 'seemingly' simple tasks such as applying for insurance and applying for SDE+ subsidies to cover the cost of the required solar panels. These subsidies are property-bound, forcing the community to apply for individual subsidies and require a surface of at least 200 square meters per property which none of the properties met. This created two main challenges: first, the limited number of eligible rooftops, and second, the need to complete administrative work and gain approval for each property. The TEC still moved forward with the application as they argued that their project was similar to large wind farms, where energy generated across different parcels is collectively treated as one system. After nearly nine months, a supportive government official helped the TEC find a way to qualify for the subsidy as this official recognised the project's innovative nature. As in the case of Thermo Bello, the interviewee expressed frustrations with the inability of public officials to think in solutions rather than in existing protocols.

Interesting is the presence of negative arguments in the formal and informal trajectory, which is a contrast with the case of Thermo Bello. Of the 8 value controversies identified in the analysis, 3 have

resulted in backflowing, all single-loop learning. However, 2 plans have been expressed involving, altering the organisational structure and actor composition indicating signs of double-loop learning processes. These come from the mismatch between the requirements of the residents to participate in the TEC and the willingness of the residents to do so. However, at the same time the residents, contradictory, wanted to be informed more on decisions that were made leaving the TEC in a difficult situation. This desire only entered the decision-making process of the TEC when the project shut down due to technical challenges. As a result, for the next project phase, the residents of Nagele and the TEC agreed to include an independent observer in the project group. This person would serve as a gatekeeper, ensuring the objectives and behaviours of both the client and the contractor are aligned. Additionally, this leader would be responsible for objectively communicating information about decisions and developments to the residents, ensuring transparency throughout the project. Also, shared ownership with the municipality is sought, moving to governance model 2 from Figure 2.6 unburdening the citizens from some of the tasks. However, currently, the implementation of these changes is dependent on whether the TEC can regain momentum. According to the interviewee, this is far from certain as their first unsuccessful attempt is now used as an argument against the continuation of the project by residents.

Finally, In the case of Energiek Nagele the values of *recognition* and *quality of life*. *Recognition* is a value embedded in the population from the past, as Nagele had the official title of being the most modern village in Europe. The value of recognition returned in value controversies through the desire of the project group and the population to be put on the map again by using new technologies for the heating system that were unknown in the Netherlands thus far. The value *quality-of-life* was identified through the desire to maintain the quality of living during as well as after the project. This translated into citizens explaining they wanted minimal adjustments to the built environment both in the time of the adjustment as well as the aesthetics.

Warm Heeg

The results of the second round of coding in the Warm Heeg case are visualised in Figure 5.12. In this case, the TEC tried to form a collective with the residents as much as possible. Trying to position itself with the informal trajectory. However, due to the large size of the project, and the involvement of more than 1000 residents, this was not always reflected in the responses of the community. In the case of Warm Heeg 28 arguments were attributed to the formal trajectory of assessment and 52 to the informal trajectory of assessment.

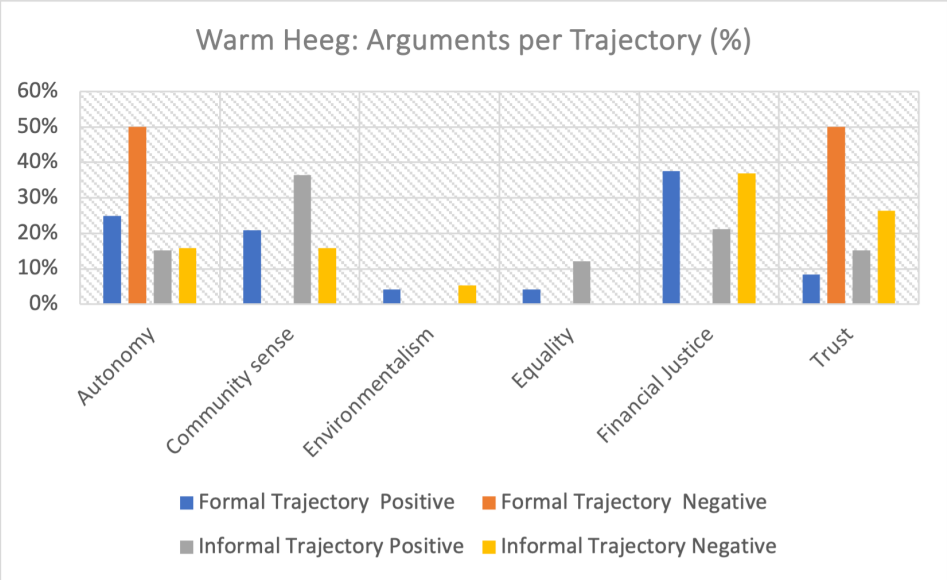

Figure 5.12: Distribution of attention to values in Formal and Informal Trajectory of Assessment, Warm Heeg

In the case of Warm Heeg, 16 occurrences of overflowing were identified with the values, of *autonomy*, *Financial distributive Justice*, *Community Sense* and *Trust*. From these value controversies, 4 instances of single-loop learning and 2 instances of double-loop learning were identified. A description of the value controversies and occurrences of backflowing written out in detail can be found in Appendix B. During the interview with Warm Heeg, the distinction between the 'two tracks', as in the Energiek Nagele case, was also mentioned by mentioning the two-sided struggle of working with the government and creating support among residents (Interviewee #3). Additionally, friction with regulations was expressed as a main challenge by the interviewee of Warm Heeg. Furthermore, Warm Heeg had to stop developments 4 times because of the inability to acquire project financing, requiring a financial guarantee from the municipality to continue. These struggles are visible in the presence of the many negative arguments expressed around *Financial Distributive Justice* by the informal trajectory in Figure 5.12.

Moreover, the inconsistency of support from the municipality was a problem according to the interviewee of Warm Heeg. This was due to the fast change of public officials resulting in situations where sometimes new officials were less willing to work with the TEC than others. In the case of Warm Heeg controversies around *Autonomy* came from a critical stance of local people to change their old ways, visible in Figure 5.12, in the activity of negative arguments in both the formal as informal trajectory around norms and design requirements related to the value of *Trust*.

Warm Heeg although having the largest community and therefore the biggest challenge in reaching everyone, still opted for close collaboration with the community and overlapped more in attributes with the informal trajectory of assessment. This was, amongst other things, identified in the framing of the project as an opportunity to be independent from the government and Russian natural gas indicating the logic of the project through narrative rationality rather than judicial rationality. This is visible in Figure 5.12 through the presence of negative arguments from both the formal (TEC) as well as informal (population) trajectory related to the value of *Trust* in the vision and strategy of the government on the energy transition. When it comes to the starting point of justice the TEC took a very balanced approach

both showing characteristics of procedural justice as well as justice as recognition. This was exercised by emphasising the local wants and needs of the population of Heeg as well as exercising a highly democratic and personal approach to decision-making, involving the community from day one in the creation of the project evaluative framework.

In terms of democratic principles, the TEC expressed itself as a community-based authority, mainly focusing on building trust. This was exercised by raising different promotion teams for owners and renters and communicating weekly through multiple channels. During the interview, the interviewee stated that the key to creating awareness lies in the repetition of information without bothering the residents. The success of this approach is evident in Figure 5.12, where positive arguments related to Community Sense from the informal trajectory make up the largest share of the total arguments expressed by this trajectory. Additionally, no strict rules-in-use were made as they were believed to decrease trust among citizens and this allowed the TEC to be flexible and adapt itself to what the community desired at that specific point in time. Warm Heeg was the only TEC with this flexible project structure. Ultimately, the project team sought to establish trust by incorporating individuals with strong reputations within the community. The interviewee specifically highlighted the need to steer clear of controversial figures in the project development. While this may not directly affect the project's financial or technical feasibility, the composition of the project team significantly impacts the project's crucial element: community support (Interviewee #3).

This investment in building trust at the start of the project, involving placing yourself as a TEC in the same boat, as residents seems to have paid dividends for the case of Thermo Bello and Warm Heeg as they allow for constructive dealing with value controversies. However, it is important to say that this approach came with a price in the form of slower progression as can be seen in the development time of Warm Heeg, taking over 12 years to reach the realisation stage.

5.2.3. Social Learning

The capacity to overcome challenges through the initiation of social learning has been tracked and is illustrated in Figure 5.13. A distinction is made between single-loop and double-loop learning. If a controversy was identified but no evidence of social learning was found in either the documents or interviews, it is represented in the graph as an 'Unconverted Controversy'.

It is visible that Thermo Bello has encountered the fewest controversies, followed by Energiek Nagele and then Warm Heeg. A quick calculation shows that Thermo Bello has a conversion rate of (83%), Energiek Nagele of (63%), and Warm Heeg of (63%).

The limited number of value controversies in the Thermo Bello case stems from the fact that there were already protocols and working group structures in place from earlier local projects. Additionally, the availability of an almost ready heating system reduced challenges around technical complexity and acquiring funding that was experienced by the other cases.

In the case of Energiek Nagele, the absence of double-loop learning came from the little interaction between the TEC and the community. For double-loop learning it is required that errors or unsatisfactory results are identified so changes to existing institutions and processes can be made. However, if there is no or limited interaction between the parties, the feedback on these unsatisfactory results is not able to reach the project group, leaving potential improvements undiscovered. In the case of Warm Heeg, there were many controversies due to the high heterogeneity in the population which made it difficult

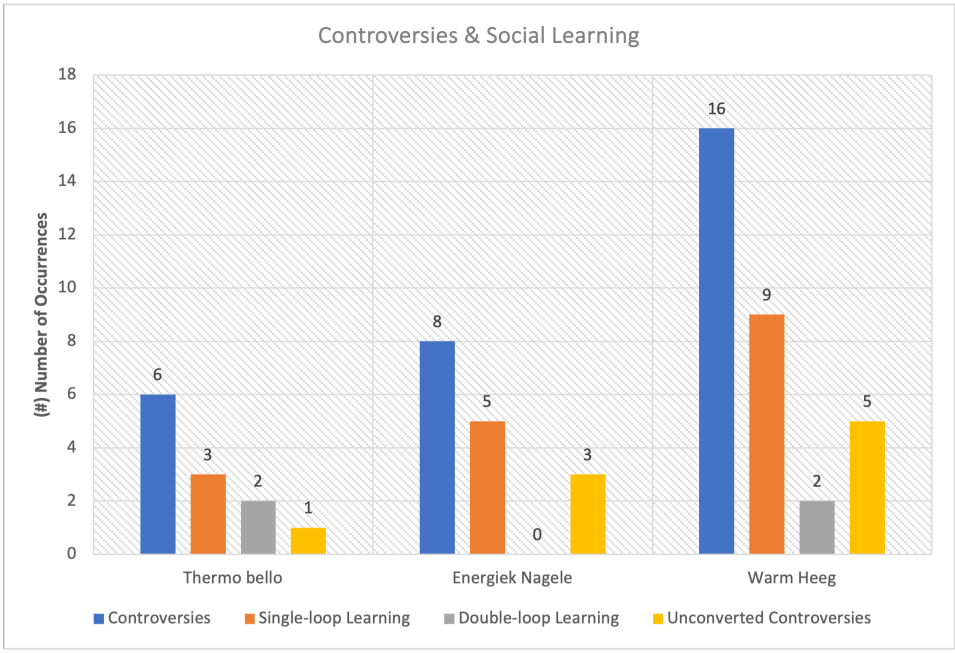

Figure 5.13: Conversion of Value Controversies in Instances of Social Learning

for the TEC to make decisions satisfactory to all. However, due to the highly democratic approach of Warm Heeg, most controversies were still overcome through either single- or double-loop learning. Additionally, the refusal to make strict rules and policies of the project group left the team flexible allowing them to easily adapt and form themselves to what the community desired.

6

Discussion

In this chapter, the results from Chapter 5 are discussed, focusing on the exogenous variables impacting decision-making processes of the formal and informal trajectories (Section 6.1.1), causes for overflowing due to underrepresented values in the formal trajectory of assessment (Section 6.1.2) and connections between value controversies and backflowing (Section 6.1.3). In (Section 6.2) the findings of the research are compared to existing literature. Finally, the chapter concludes by addressing the research limitations (Section 6.3), divided into limitations on the constructed theoretical model (6.3.1), the research methods (6.3.2), and input data (6.3.3).

6.1. Discussion of Results

6.1.1. Exogenous Variables Impacting the Decision-Making Process

This section discusses the findings related to answering sub-question 1 from Table 2.3. The context analysis of exogenous variables and semi-structured interviews with the TECs identified the communities' income level, education level, population and built environment heterogeneity, and technical complexity of the DH system as factors influencing the decision-making processes of both the formal and informal trajectories in the examined TEC initiatives. This section presents how this thesis interprets these results and discusses their implications for TECs and academics. For reference in this section a summary of the results on how the examined exogenous variables influenced the cases individually has been visualised in Table 6.1.

Variables	Thermo bello	Energiek Nagele	Warm Heeg
Level of Income	A high average income allows participants to join the project on a voluntary basis	Low income increases fear of energy poverty, lowering the participation rate	Average income but no mention of energy poverty, a select group willing to work full time
Level of Education	High level of education and experience with local initiatives accelerated the initiation stage	Required expertise from external parties	Both relevant experience and expertise in the group as well as individuals with a higher level of education
Technical Complexity	Ready to use DH system decrease need for capital	Highly innovative DH system caused unsatisfactory performance during pilot	Regular system, with little experienced challenges
Homogeneity in Population	Relatively homogeneous population and built environment	Homogeneous population but split into property owners and renters	High heterogeneity in the population and the built environment caused increased number of value controversies

Table 6.1: Exogenous Variables Affecting the Analysed Cases

level of income and participation

The results of the context analysis suggest that higher average income levels enhance the capacity for community participation in TEC decision-making as was identified in (Section 5.1.2: *Level of Income*). In wealthier communities such as Thermo Bello and Warm Heeg, residents were not only more willing but also more capable of contributing the time and resources needed for complex, volunteer-driven projects. Greater participation enabled more inclusive and transparent decision-making, reducing opposition and fostering more constructive dealing with value controversies benefiting social learning. Conversely, in the lower-income area where Energiek Nagele is located, residents were less engaged, expressing to be left alone as noted by the interviewer. In Energiek Nagele this was partially attributed to the low level of income as residents have other worries and require full-time jobs to cover their costs. The result was less engagement with the population and therefore receiving less input from them in decision-making processes, which resulted in overflowing later in the project, particularly when disagreements emerged regarding the level of complexity of the technical system as well as the lack of an independent overseer in the organisational structure.

The effect this has on participation in decision-making processes is relevant for the project because it enables the informal trajectory of assessment to influence key decisions. As a result, decisions made by the formal trajectory of assessment better reflect the needs and desires of the population, while reducing opposition, as both decision-makers and the public are aware of the rationale behind each decision. Notably, higher average income levels in a community facilitate this process by fostering greater participation from the informal trajectory, as people are not bound to a full-time job, allowing more feedback on the values that should inform the project's evaluative criteria. However, increased participation,

often tied to higher income levels, can lengthen decision-making processes, as more individuals seek to contribute to discussions. This is visible in the 12-year project duration of Warm Heeg, only just reaching the realisation stage.

As TECs cannot influence the level of income of their population, this finding should be taken into account when the TEC opts for a governance model at the start of the project. In the case of Energiek Nagele, the low level of income in the population could have been a good reason to consider a different governance model, sharing control, and ownership model with the municipality or private party, as the benefits attributed to a model with complete ownership around were not experienced due to the low participation capacity among residents. A shared model could have lessened the burden on the community as tasks and responsibilities would have been covered by the partner organisation. Currently, the TEC is looking to move towards such a governance model; however, due to the challenges witnessed by stakeholders, potential partners, including the municipality, are hesitant to collaborate.

level of education and problem-solving capacity

In (Section 5.1.2.: *Level of Education*), a higher level of education was described to accelerate decision-making by improving problem-solving capacities within TECs. The reason for this is two-fold. First, having access to individuals in working groups who are accustomed to handling complex problems, due to their professional or academic background, helps address challenges where existing solutions cannot simply be replicated. This is particularly relevant for TECs in the Netherlands, as they have only recently emerged, with few examples available, and even fewer that are fully operational. The cases examined in this study faced numerous challenges that required unique solutions, even for seemingly simple tasks like applying for insurance.

The level of education also benefits the decision-making processes as certain skill sets that are required for TECs to develop and professionalise are already present in the population including legal knowledge, experience with project management, and engineering skills as being a few mentioned in the interviews. This not only speeds up the decision process as decisions can be made without consulting external parties for expertise, but also improves the level of trust in the made decisions as people know the decision-makers on a personal level. This advantage was specifically targeted in the case of Warm Heeg, where the TEC purposely included people in the project group with a high profile in the neighbourhood as explained in (Section 5.2.2: *Warm Heeg*). In summary, both the formal and informal trajectory of assessment benefits from a higher level of education through faster solving of encountered challenges, as well as the benefits from increased trust in the made decisions in the long-term.

The findings from the examined cases suggest that an early assessment of the community's educational profile and their willingness to participate can help TECs select appropriate governance models and structure their decision-making processes. Where a high level of education and expertise in the neighbourhood indicates smoother decision-making, a lower level of education or lack of expertise could be a sign to pick shared ownership models or start approaching external parties for missing expertise early.

Heterogeneity and complexity in decision-making

Heterogeneity in the community is identified in this thesis as unfavourable for the decision-making processes of the examined TEC, except for heterogeneity in expertise and occupation from which the merits are discussed above. This is due to multiple factors.

First, heterogeneity in the community creates a split in the needs and wants of the population that makes

it more difficult to come to a single satisfactory decision. An example is the split in renters and owners in the community of Nagele discussed in (Section 5.1.2.: *heterogeneity in the community*). A renovation improving the isolation of the properties owned by Mercatus created a split in the financial desirability due to a difference in heat demand and therefore expected cost between the tenants of Mercatus and the homeowners who were not able to afford such a renovation. Second, effectively proven approaches such as one-on-one visits and tailored communication become more time-consuming, leading to slow progress development, making it in turn more difficult to maintain the support of the community. An example comes from the Warm Heeg project, where the group aimed for a democratic decision-making process. However, the high heterogeneity in income, age, education, and property types, as noted by the interviewee, brought challenges when trying to secure the required 70% approval from the population. As a result, the decision-making process became lengthy, contributing to a project duration of over 10 years. It is no surprise that Warm Heeg had the highest number of identified value controversies in the three cases, as is visible in Figure 5.13.

The main conclusion drawn from this observation is that the increased heterogeneity requires a more comprehensive evaluative framework for the project to ensure the satisfaction of the participants. This complexity leads to prolonged decision-making as a more diverse set of values in the informal trajectory of assessment must be considered, requiring the formal trajectory of assessment to expand the evaluative framework. However, judging from the case of Energiek Nagele, when choosing a governance model with complete ownership and control of the collective heat system, this delay in making a decision should be accepted as the costs of speeding these burdensome but crucial decision-making processes at the start of the project are outweighed by the delay due to emerging controversies caused by opposition later in the project.

Degree of Technical Complexity

The degree of technical complexity influences the trajectory of formal and informal assessment in decision-making processes as a higher degree of complexity results in a longer project duration due to the emergence of potential technical challenges. The case of Thermo Bello illustrates how the availability of a near-operational DH system facilitated the accelerated development of the project. In contrast, both Energiek Nagele and Warm Heeg faced the challenge of constructing their systems from the ground up. Energiek Nagele, in particular, opted for a system of high technical complexity including a solar heating system combined with underground storage. This high complexity was ultimately a significant factor contributing to its shutdown.

A high degree of technical complexity influences the decision-making process of the informal trajectory as they are, when informed, wearier of things that can go wrong and less likely to move away from their current situation. The formal trajectory of assessment on the other hand requires more capital to cover any emerging malfunctions and risks to lose community support if too many obstacles of the technology are 'perceived' by them as was described in (Section 5.2.2:*Warm Heeg*.

Unstudied Exogenous Variables

Factors that influenced the decision-making process of the formal and informal trajectory that were not included in the context analysis were the level of connectivity between residents and the presence of spill-overs from other projects. In the interview with Energiek Nagele as well as Warm Heeg, the interviewee indicated that social approval works as a strong driver for convincing people. In the case of Warm Heeg, this occurred in the form of people converting to voting in favour of the TEC after having

called with family and friends who were part of a developing TEC themselves. This phenomenon shows similarities with the findings from Oncecan et al. (2024) where bringing tenants into contact with tenants who were part of other heat projects, leads to more trust in favourable outcomes [47]. In the case of Energiek Nagele, several failed heat projects gave DH and local ownership a bad reputation slowing the development in the initiation stage and raising concerns after the project was indefinitely, shut down as explained in (Section 5.2.2:*Enegiek Nagele*).

This insight derived from the interviews creates an additional dimension for the development of TECs. This thesis sees possibilities for further research revolving around the effects of these spill-overs on TEC projects, from which the specifics are presented in (Section 7.3.3).

6.1.2. Emerging Value Controversies as a Result of Underrepresented Values

This section discusses the findings from applying the value hierarchy of van de Poel (2013) as described in (Section 4.2.2) including the identified values and cases of overflowing related to answering sub-question 2. Additionally, an emerging insight is discussed revolving around the difference in impulse in the community stemming from specific value controversies.

The Identified Value Controversies

In the examined cases of Thermo Bello, Energiek Nagele, and Warm Heeg a total of 30 controversies were identified, revolving around the values of *Autonomy*, *Community Sense*, *Environmentalism*, *Financial Distributive Justice*, *Quality of Life*, *Recognition*, *Transparency*, and *Trust*. Values are paired on similarities made to form the structure of the discussion and their implications according to this research for the professionalisation and grow-up space of TECs. An overview of these value controversies written-out in detail can be consulted in Appendix B.7.

Autonomy & Financial Distributive Justice

The value controversies around *Autonomy* and *Financial Distributive Justice* demonstrate how dependencies on the TECs' external environment hinder TECs' ability to realise their projects. The difficulty in obtaining subsidies or other types of financial resources, along with bureaucratic hurdles, has affected all cases.

The difficulty with acquiring subsidies and other sources of project financing plays a major role in all three cases. The struggle stems from the heavy administrative burden of applying for subsidies and the misalignment between the requirements to apply for subsidy programs and the capacities TECs possess as an organisation. As noted in (Section 5.2.2), TECs face challenges such as being unable to apply for collective subsidies across multiple properties or solar systems on different roofs powering a single DH system. These value controversies highlight the underdevelopment of the precondition *access to capital*.

Within the decision-making processes of TECs controversies around *Financial Distributive Justice* decrease the participation rate of residents because losing momentum and community support due to (temporary) shut-downs is difficult to regain, as experienced by Warm Heeg and Energiek Nagele (Section 5.2.2:Energiek Nagele; Warm Heeg). Additionally, limited financial resources constrain the project's ability to attract external advisors, which is especially critical in lower-income communities as explained

in (Section 6.1.1: *Level of income and participation*).

Controversies around *Autonomy* mainly emerged from friction between the TEC and the set protocols and evaluation criteria in the formal trajectory often intertwined with controversies around *Financial Distributive Justice* as they were frequently experienced when applying for subsidy programs. Controversies identified around Autonomy highlighted the underdevelopment of the precondition of *a license to operate*, resulting in overflowing as TECs expressed dissatisfaction with the inability of municipalities and other government bodies to think in solutions rather than in existing protocols as encountered in the cases of Thermo Bello and Energiek Nagele (Section 5.2.2:*Thermo Bello; Energiek Nagele*).

These *Autonomy* issues constrain TEC decision-making, as they often have to rely on public officials willing to make exemptions. Even with the implementation of the Heat Act 2.0, new contracts, regulations, and formal institutions will still need to be developed to fully embed TECs within the legal framework.

The interviewees of Warm Heeg and Thermo Bello indicated that the challenges around *Financial Distributive Justice* and *Autonomy* can only be addressed through government intervention. While this falls under triple-loop learning, making it beyond the scope of this thesis, this thesis acknowledges that TECs have limited options to address financial challenges within the current state of development.

Community Sense, Trust & Transparency

The overlap between the value controversies of *Community Sense*, *Trust*, and *Transparency* is that they primarily took place due to misalignments between the TEC and the population, where the TEC acted as the formal trajectory of assessment and the population as the informal trajectory.

Controversies around these values, although initially causing delays, appeared to benefit the projects by fostering social learning and enabling the TECs to adapt their structures to better align with community values but required to be monitored by the TEC. For example, as discussed in (Section 5.2.2: *Energiek Nagele*) the residents of Nagele expressed a desire to include an independent observer in the project group. This observer would have the authority to flag questionable decisions regarding technology and organizational structure and communicate these concerns to the community. Additionally, the population was not aware of the high technical complexity of the project as well as what was expected from them in terms of participation. This led to dissatisfaction with resulting outcomes such as high electricity prices and frequent approaches of members of the project group. These instances of overflowing were noted by the project group after the project was shut down due to poor technical performance in the realisation stage as residents were interviewed about their views on the project. In this situation dealing with both the technical problem and the expressed dissatisfaction of the population did not do well for momentum as the decision-making process gets more rigid when trust and transparency are low.

In Warm Heeg, although these types of controversies also arose, their effects were felt less than in the Energiek Nagele case. The interviewee attributed this to their project approach and structure with little focus on creating strict rules and more on building trust and frequent communication as described in (Section 5.1.3.: *Information & Aggregation Rules*).

The key takeaway from this is that while controversies taking place between the TEC and the community, such as those involving *community sense*, *trust*, and *transparency*, may have less short-term impact than *autonomy* and *financial distributive justice*, they require immediate attention. If not addressed, these

issues can complicate decision-making processes and undermine the TEC's ability to engage residents meaningfully, widening the gap between TEC and the community, and leading to further dissatisfaction and project setbacks.

Recognition & Quality of life

In the case of Energiek Nagele, the values of *recognition* and *quality of life* were notably present in the documents examined as explained in (Section 5.2.2.: *Warm Heeg*). The value of *recognition*, rooted in Nagele's past as Europe's most modern village, emerged through the public's desire to use innovative heating technologies and be put on the map again. The value of quality of life emerged in the community's desire to minimize disruptions to both the built environment and its aesthetics during and after the project.

The presence of these values might have been an early predictor that the complete ownership and control governance model was not the right fit for the population in question, as well as the high degree of technical complexity of the project. Currently, Energiek Nagele is trying to convince the Noord-oost Polder municipality to join them and form a civil-public model (Model 2 in Figure 2.6). This thesis acknowledges the importance of beginning with full ownership and control since any concessions made by a TEC at the start are difficult to reverse. However, postponing essential modifications for a prolonged duration, as demonstrated in the Energiek Nagele case, may lead to unfavourable outcomes and harm both the project's reputation and that of the project group in the community. A reputation that should be nurtured and preserved at all costs.

Impulses from Values

As an emergent finding during the analysis, this thesis recognises a difference in the type of impulse stemming from specific values that are at play for the TEC and participants.

Values such as *altruism*, *environmentalism*, *autonomy* and *community sense* have been expressed by the interviews as being effective initiators of the project as expressed in (Section 5.2.1: *Comparing the vlues*). For instance, in the case of Thermo Bello, the project group aimed to contribute to Lanxmeer's vision of remaining the most eco-conscious neighbourhood in the Netherlands, while Warm Heeg's project was motivated by the desire to reduce reliance on fossil fuels and halt natural gas extraction in the Netherlands (Interviewee #1; Interviewee #3). These values generate interest in the possibility of a locally owned heat system and initiate conversations among residents, often expressed as arguments supporting choices that benefit the greater good.

However, these values seem to lack an impulse that calls to action for the majority of the population as was for example expressed in the interview with Warm Heeg, where the interviewee emphasised not everyone felt the same incentive from the outlook of owning sustainable heat system and the environmental merits it brings. This difference in incentive is visible in Figure 5.12 where positive arguments for the values of autonomy and environmentalism are for the majority being expressed by the formal trajectory of assessment, which in this case were the project group leading the TEC.

Values that directly impact individuals tend to create a stronger impulse for action as was identified in (Section 5.2.2: *Thermo Bello; Energiek Nagele; Warm Heeg*). In the examined cases, values like *Financial Distributive Justice* and *Quality of Life* were significant drivers of backflowing. The substantial influence of these values on project trajectories likely stems from the fact that their effects are

experienced in the short term. For example, in Warm Heeg, insufficient project financing caused development to pause four times, necessitating immediate solutions from the TEC. Similarly, in Energiek Nagele, residents felt their quality of life was disrupted due to excessive interference from the project, which demanded a prompt response. In both cases, the TECs adapted swiftly to these controversies. In the case of Warm Heeg, backflowing occurred through single-loop learning by securing a municipal financial guarantee, while Energiek Nagele minimized communication and construction times to reduce the experienced inconvenience by residents. These immediate adaptations underline the impact of these types of values, as they require quick solutions to maintain project momentum and community support.

Given these insights, placing a stronger emphasis on personal benefits in communications between the TEC and the community could be an effective strategy for maintaining resident support, especially in the later stages of the project. Highlighting aspects such as financial benefits, independence from geopolitical conflicts, or addressing energy poverty could generate more sustained support compared to focusing solely on sustainability and community values, as seen in the examined cases. The implication for decision-making processes in the projects' development is that a more involved community fosters increased interaction between the TEC and its members. This interaction facilitates the identification and correction of misalignments between the formal trajectory of the TEC and the informal trajectories of its members. Such alignment is crucial for enabling constructive social learning, as it requires the communication and resolution of these discrepancies. Additionally, creating a narrative that fits the community smoothens the decision-making process as all heads are pointed in the same direction.

6.1.3. Value Controversies Leading to Backflowing

This section discusses identified differences in dynamics in backflowing and the types of value controversies that trigger it, differentiating between single-loop and double-loop learning in the examined cases. The section is related to answering the sub-question 3. Moreover, strategies or factors contributing to whether value controversies lead to backflowing identified in the cases are discussed including what their implications are for TECs. The thesis also suggests a relationship between the two types of learning, as double-loop learning can indirectly contribute to single-loop learning by enhancing residents' support and willingness to participate in decision-making processes. This enhanced participation strengthens the TECs' ability to maintain high morale and leverage community resources more effectively. The discussion begins with an exploration of the single- and double-loop learning processes separately, followed by an analysis of the strategies and factors that contribute to double-loop learning. For convenient referencing, Table 6.1 has been retrieved from the results section for reference purposes and is placed in this section.

Single-loop learning

Single-loop learning took the majority share of the total instances of backflowing in all cases as depicted in Figure 6.1. The cases included two forms of single-loop learning. First, it occurs when there is a misalignment between the TEC (formal trajectory) and the community (informal trajectory). Second, it happens when the TEC itself acts as the informal trajectory, with external stakeholders like municipalities and government bodies serving as the formal trajectory of assessment. Single-loop learning can be realized in different ways, examples identified in the cases are the willingness to work around the rules by public officials at the municipality, the presence of relevant knowledge and experience in the TEC, and enough financial resources to hire external expertise. Single-loop learning was identified mostly around the values of *Autonomy*, and *Financial Distributive Justice*.

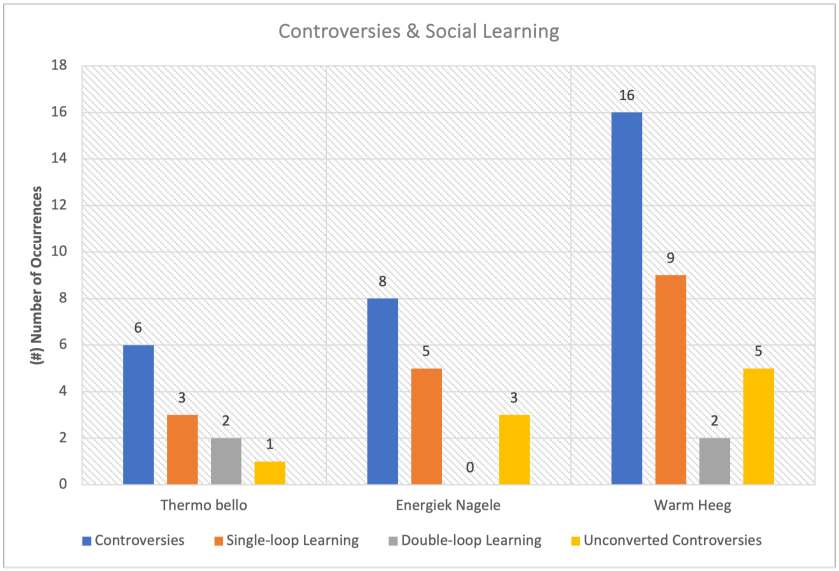

Figure 6.1: Conversion of Value Controversies in Instances of Social Learning

The instance of Single loop learning discussed in (Section 5.3.3.:*Single loop learning*) surrounding Thermo Bello and Energiek Nagele highlights challenges faced by the TECs in navigating regulatory and subsidy frameworks. In the Thermo Bello case, the project group expressed dissatisfaction with the lack of government support for self-actualization initiatives, as they faced similar regulatory requirements as large corporations. Likewise, Energiek Nagele struggled with SDE+ subsidies for solar panels due to constraints requiring individual applications for properties. After extensive efforts, the project eventually gained eligibility with assistance from a supportive official who was willing to be flexible in following existing protocols.

This thesis was not able to find direct connections between the identified value controversies and single-loop as there are a plethora of spaces where a TEC can leverage capacities, resources, or willing stakeholders. Additionally, most challenges where single-loop learning was required have been successfully overcome, as long as the TEC was able to maintain the support of its citizens. An example is the TEC of Warm Heeg, where 4 times the project fell still for over 6 months due to unavailability of willing financiers. All four times the TEC overcame this struggle through sheer perseverance, as became clear during the interviews. This implies that, according to the cases examined, to allow single-loop learning to take place the TEC should foster and nurture the support and willingness to participate in its community. Effective strategies for this identified are taking on attributes of the informal trajectory of assessment as an organisation, and coordinating double-loop learning which is discussed in the next sections.

Coordinated Double-loop Learning

Regarding double-loop learning the results indicate that this type of social learning is a result of value controversies emerging from a misalignment between the values present in the evaluative framework of the TEC and the values present in the population as it is described in existing literature [43].

The degree to which there was a constructive way of dealing with value controversies indicating the need for double-loop learning differed with a strong contrast between Energiek Nagele and the other cases as is visible in the difference of double-loop learning instances depicted in Figure 6.1. In the case

of Energiek Nagele both the organisation structure and technical system were chosen rather quickly with minimal involvement of the community resulting in a governance structure that, when already entering the execution stage, was disapproved by consensus. As a response several plans, embodying double-loop learning have been proposed, however, the TECs' current stalemate, resulting from technical and financial underperformance, as described in (Section 5.2.2:*Energiek Nagele*), raises doubts about whether the TEC will get the opportunity to implement these strategies (Interviewee #2).

In contrast in the Warm Heeg case, little focus was placed on creating strict rules and set agreements from the start (Interviewee #3). Instead, they kept their options open by hiring a notary to guide their iterative development as described in (Section 5.1.3:*Information & Aggregation Rules*), deliberately refraining from establishing strict rules and regulations between the TEC and the community. This approach allowed for greater flexibility in addressing the participants' desires and needs, as demonstrated by Warm Heeg. In addition, one-on-one meetings with participants allowed for more open conversations allowing people to criticise the project and point out concerns without fear of being judged for it. Additionally, all decisions required full anonymity to be made. The success of this approach has also been found in Schram et al. (2024) when analysing the development of solar projects. Solar projects that involve opposition from the start to create the evaluative framework have a higher social acceptance and local support [52].

In light of this insight, this thesis proposes that TECs not fixate on creating rules immediately, but rather stay flexible and focus mainly on building trust and communication. There is no one-size-fits-all solution due to significantly differing contexts therefore focus on building trust and support to overcome controversies. Also, the results suggest that rushing the project at the start to be able to communicate progress, does not benefit the project in the long-term, rather patience and community building in the initiation and development stage fosters the basis to successfully move on to later projects stages.

Positioning of the TEC in the Formal vs Informal Trajectory of Assessment

From the results in Chapter 5 this research identified a difference in the ability of the TECs to constructively deal with value controversies depending on the resemblance of the TEC with the participating community. Table 6.2 shows the alignment of the TECs with the formal and informal trajectory based on the attributes of *logic of value expression*, *justice tenet starting point*, and *democratic principle* of the main actor as they were presented in (Section 5.2.2.).

Attributes	**Thermo Bello**	**Energiek nagele**	**Warm Heeg**
Logic of Value Expressions	*Narrative Rationality*	*Judicial Rationality*	*Narrative Rationality*
Justice Tenet Starting Point	*Justice as recognition/ Procedural Justice*	*Justice as recognition*	*Justice as recognition/ Procedural Justice*
Democratic Principle	*Community-based authority*	*Delegative authority*	*Community-based authority*

Table 6.2: Characteristics of cases resembling either the formal or informal trajectory of assessment

More constructive dealing with controversies was identified if the TEC contained more characteristics of the informal trajectory. It also affected the type of values controversies that emerged. Where logically

more intensive overflowing occurs between the TEC and the local community take place if the TEC moves more to the formal trajectory of assessment. Although this approach seemed to benefit the project in an initially quicker pace of development the friction of unresolved controversies remains, emerging when other challenges decrease the momentum of the project. This was visible in the Energiek Nagele case which developed much quicker, moving from the initiation to development, realisation and even pilot stage in five years. This is beneficial during the start of the project as progression and visible results keep people excited about the project however it also caused the aforementioned misalignments between the organisational structure of the TEC and the community to be left unresolved as there is little iteration on these matters.

The positive effect of sharing characteristics with the Informal Trajectory became clear in the case of Warm Heeg, even though more value controversies occurred, the TEC was able to build and maintain the support of its community. This is especially impressive considering the large community of Warm Heeg and the high degree of heterogeneity in the population and built environment identified in the context analysis. It is important to note that as the population grows, the proposed strategy of positioning oneself along the informal trajectory becomes more challenging. This is because the increased diversity requires a greater variety of perspectives that need to be considered. As a result, Warm Heeg has begun to exhibit certain traits of *procedural justice* as a foundational aspect of justice. This is attributed to the challenges that arise in crafting a narrative that accommodates specific practices and contexts, which become more diverse with a growing and heterogeneous population.

Where Thermo Bello and Warm Heeg resembled more characteristics of the informal trajectory, Energiek Nagele had more overlap with the formal trajectory. The perceived positioning of the TECs in the studied cases has been visualised in Figure 6.2. In the figure the position the TEC has indicates the perceived closeness of resemblance it had with either the formal or informal trajectory, meaning that Thermo Bello showed the most resemblance with the informal trajectory of assessment and Energiek Nagele with the formal trajectory of assessment. This section discusses the implications of this finding for the development of the TECs.

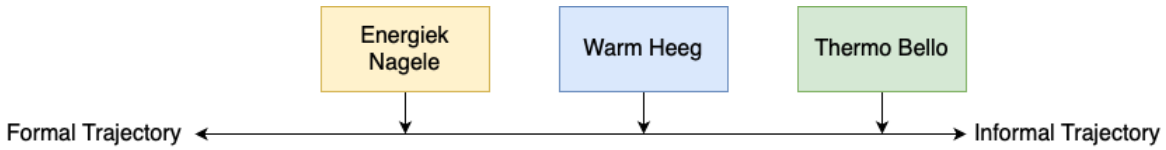

Figure 6.2: Positioning of the TEC between the Formal and Informal Trajectory of Assessment

The outcomes of the different approaches are shown in the initiation of double-loop learning depicted in Figure 6.1.

For TECs, this finding indicates that they can create a better environment for double-loop learning to emerge from value controversies by improving participation and engagement with their community. To do this they can create a narrative around their project based on their shared origin, and common future to create an emotional attachment with the population. Additionally, this can be realised by bringing attention to specific practices or circumstances, like the distrust in the government in Warm Heeg or the desirability to not be dependent on Russian gas. Finally, they should act as a community-based authority, empowering citizens to take part in decision-making processes by communicating their opinion matters, through for example a unanimous voting standard like in Thermo Bello and Warm Heeg.

Furthermore, emphasizing certain values in the TECs narrative that align closely with residents' interests may eliminate the need for backflowing after controversies altogether, as observed in some instances in Warm Heeg. In this case, 16 controversies were identified, but only 11 instances of backflowing were reported as is shown in Figure 5.13. Nonetheless, the TEC was able to leverage, maintain and extend the support of the population for 12 years, including 4 shut-downs due to insufficient available capital.

6.2. Comparing the findings to Existing Literature

This section compares the findings of this thesis with those of the existing literature reviewed in Chapter 2. This comparison reflects a commitment to best practices in academic research. By aligning the results of this thesis with previous research, the aim is to challenge the interpretation of the researcher, explore alternative explanations, or strengthen the findings. This in turn enhances the validity and reliability of the findings, ensuring that the contributions of this thesis are well-grounded within the existing body of academic literature.

6.2.1. Values in Energy Projects

The difference in impulse resulting from distinct values described in (Section 6.1.2) has been identified in earlier work on the role of values in energy projects where more altruistic and biospherical values such as altruism and environmentalism, result in interest in sustainability as well as some participation, and hedonic and egoistic values lead to the acceptation or rejection of participation in the project [57]. The effect of biophysical values on the project development was also identified by Boon & Dieperink (2014) when they analysed factors that affect the emergence from which local renewable energy organisations (LREO) are established [8]. The findings of this research align with existing literature in that benefits for the greater good, such as environmental care and increased sustainability, were the initial drivers of the project, sparking discussions about a locally owned heat system. However, concerns at the individual level, such as the fear of energy poverty, the preservation of quality of life, and independence from Russian gas, proved to be more compelling motivators for action.

Another finding by Boon & Dieperink (2014) was that they identified that the presence of an unequal playing field for LREOs can sometimes work as a motivation rather than a barrier for the establishment of local energy initiatives [8]. A similar dynamic was identified in the Thermo Bello case where value controversies around autonomy, involving regulatory burdens for the TEC were translated into a narrative, positioning the TEC with its community which seemed to enhance support. However, where Boon & Dieperink focused on LREOs in general and only successful cases, this thesis has isolated TECs as specific LREOs of interest and also included less successful cases such as Energiek Nagele. Including these less fortunate cases helps with highlighting how certain practices present in successful and absent in unsuccessful cases contribute to making a difference. The merits of the democratic approach deployed by Thermo Bello and Warm Heeg were accentuated in this thesis due to the opposite approach of Energiek Nagele and the consequences this had for their development.

Additionally, this thesis corroborates with the findings of Heldeweg & Saintier (2020) that a proper link between the purpose and values of a community and the organisation is key to ensuring their goals and that a participatory form of organisation that empowers individuals by emphasising collective ownership is important in the long run of a project [31]. The democratic approach identified in the Warm Heeg case, allowing individuals in the community to weigh in on decisions regarding technology, distribution and

consumption, was of significant influence on their ability to leverage such a heterogeneous community.

6.2.2. Creating a Narrative Rationality

Hasanov & Zuidema (2018), Jansma et al. (2020) and Beauchampet & Walsh (2021) found that communities follow a local norm-driven motivation and rely on logic targeting community development. Therefore initiators of the project must raise awareness of what the direct benefits are for the community and create a single narrative that embodies a shared vision [7, 29, 36]. This was identified in this thesis as well in the form of the success of TECs that show attributes of the informal trajectory as well as the effect of leveraging more hedonic and egotistic values later in the project. However, a conflict between the findings of this thesis and the work of Hasanov & Zuidema (2018) is the claim that self-organisation happens in a distributed process where all group members contribute to the project, while none of them are in control [29]. In all three cases examined in this thesis, a clear project group consisting of a handful of people were identified as the leaders of the project. While best practices were marked by governance principles resembling a democracy, this group seemed to primarily shape the project for the majority of its development. An explanation for this conflicting finding might be the difference in the scales of projects, where Hanaov & Zuidema (2018) focused on projects ranging from 10 to 100 participants the cases examined in this thesis included initiatives involving communities of 200 to 1100 participants.

6.2.3. Heterogeneity vs Homogeneity in the Community

Jansma et al (2020) stated in their work that homeowners and tenants although slightly different in their intensity, have similar incentives and motivations for local energy initiatives projects [36]. This was however not experienced in the same way in this thesis. As in the case of Energiek Nagele the owner-renter split, increasing heterogeneity in the community, caused challenges that were experienced similarly in the case of Warm Heeg. This potential conflict might be explained by the fact that Jansma et al (2020) only measured the attitude towards becoming gas-free rather than the actual observed behaviour during the project development[36]. This conflict highlights a potential intention-action gap which might prove an interesting topic for further research on the development of TECs and specifically on processes or actions on how the gap can be bridged.

6.2.4. Civil-Public Collaborations

Unfortunately, this thesis was not able to come up with generalizations for the collaboration between municipalities and the TECs due to the minimal and inconsistent type of identified interactions in the cases. This is above all unfortunate as in 2021, Beaucamphet & Walsh (2021), also identified this struggle [7]. It is possible that a thesis focused on specifically these TEC-municipality interactions would have created better and more conclusive findings. This leaves a thesis purely focused on the formal and informal strategies of municipalities in TEC projects an urgent and interesting avenue for future research. Additionally, this thesis aligns with the policy implication expressed by Herrerra Martinez et al. (2022) and C. Gürsan et al (2024) that increasing municipal competencies and capacity must be a priority development due to the role they could play in effective decentralised heat planning, crucial for realising the heat transition as a result from the findings in (Section 5.1.2: *Role of the Municipality*) [33]. The lack of support from the municipality in the Thermo Bello case was a significant frustration

for the TEc according to the interviewee. In the Warm Heeg case, the municipality's inconsistent support, driven by a high turnover rate, created an uncertain environment for the TEC. This uncertainty made planning difficult, as the TEC could not rely on consistent access to resources and expertise.

6.2.5. The Importance of Social Capital

The enhanced ability to participate in the decision-making processes of the TEC, identified in this thesis, resulting from a higher level of income, shared values and norms due to homogeneity in the population and the access to resources available in a network have been described by Fien & Skoien (2000) as sources of Social Capital [26]. Social Capital refers to the networks, relationships, and social ties that individuals or groups have, which provide them with resources, support, and opportunities [26]. In turn, social capital is seen as a predictor for social learning as it promotes productive, purposeful and collaborative communities, which are good conditions for social learning. To be more specific social capital facilitates social learning through the purposeful leveraging of skill and knowledge in a population [26]. Other research deems social capital as more relevant for the resilience of a collective, meaning when the population is disrupted by an external shock [10]. This might explain why Energiek Nagele was less able to cope with the experienced controversies, while Warm Heeg was able to navigate the many controversies it encountered.

6.3. Research Limitations

This section discusses the limitations of the research to help the reader with the interpretation of the findings by placing them in the research context, increasing the validity of this research.

6.3.1. The Constructed Conceptual Model

This thesis operationalised a newly constructed conceptual model consisting of the VLIAD from Milcheram et al. (2019) and the value-based model from Schram et al. (2024) to structure the analysis and guide the research in answering the main research question. Although a thorough methodology section was constructed aimed at limiting the weaknesses that come from the constructed framework, some limitations still exist and were experienced during the research.

First, the role of exogenous variables in research was to account for the context specificity of value controversies. Looking back on the research and the results this research seems to have partially met this goal, however, certain important factors identified in the interviews were difficult to frame in the current set-up of the framework. One of these factors revolves around the fact that value controversies and TECs can not be completely examined without accounting for the wider international context exceeding the boundaries of the examined communities. In the interviews, this became clear due to the occasional reference to a spill-over from other TECs and controversies before the establishment of the TEC. An example of this is the short-experienced inversion of the effect of an average low-income in the case of Energiek Nagele when gas prices rocketed in 2022. For a brief moment, the sight of a new heat source decreasing the gas bill and creating independence from Russian gas evoked positive responses in the community as the fear of energy poverty grew. This means that the boundaries to which a TEC can be affected by other things are not as clearly defined as portrayed in the constructed conceptual model. For a more accurate analysis of all factors affecting decision-making processes in the development of TECs,

multiple scopes of the community embodying the 'affected public' need to be taken into account.

Second, this thesis excluded triple-loop learning from the analyses, as this required adding an extra dimension to the research that was deemed to exceed the time constraints of a MSc Thesis. However, in the existing theory on social learning, and especially in projects where national governments are actively involved, single-, double- and triple-loop learning are intertwined and evolve, partially, as a result of the interactions between them [19, 43]. This implies that the thesis might have missed the potential direct or indirect impacts of value conflicts on triple-loop learning, as well as how triple-loop learning might affect single- and double-loop learning, and vice versa.

Future research could account for the 2 discussed limitations by increasing the scope to a national scale including government dynamics over time and include the effect of spill-overs from other projects. However, the practicality and desirability of such a wide scope should be thought through as well as the potential loss of context specificity of the individual cases.

6.3.2. Limitations of Methodology

Although qualitative research is deemed the most appropriate research approach for achieving the research objective it comes with several limitations that need to be addressed. As the approach to the research is qualitative and lacks statistical testing, it is important to clarify that the thesis does not intend to claim the findings are universally applicable. This is because the findings must be considered in the specific context of the TECs. Variations in the combination of present value controversies, the specific composition of actors and their degree of participation, and the level of social capital within a community can all influence the dynamics observed in the studied cases. Instead, the research aimed to identify patterns and draw insights from the dynamics and interplay observed between exogenous variables, value controversies, and social learning in the examined cases. These insights are meant to provide perspectives for fostering discussion and guiding discussions within the decision-making processes of TECs. By reflecting on the decisions and actions of the TECs in the examined cases, other TECs can develop a better understanding of how value controversies arise and how social learning can be fostered to navigate them. This reflection can help TECs anticipate potential challenges and make more informed decisions when navigating the complex relationships between residents, stakeholders, and influences from the exogenous variables affecting their development.

In terms of the methodology, certain factors might have impacted the validity of the research. First, the overflowing and backflowing analysis included a degree of ambiguity in allocating norms and design requirements to values making the research susceptible to researcher bias. Especially due to the relatively unprofessional nature of TECs, the discussion in the analysed articles was mainly focused on norms rather than concrete design requirements making them sometimes more difficult to place. This challenge was also experienced by Schram et al. (2024) using the value hierarchy of van de Poel (2013) [52]. Second, in the second round of coding when arguments had to be attributed to the formal or informal trajectory of assessment there was another threat of researcher bias due to the interpretation of the finding.

This limitation was in the research approach accounted for by the interviews as the results from all cases were presented to a member of the project group of the respective TEC who was offered the opportunity to complement and correct the findings.

6.3.3. Data Input

The main limitation of the data collection revolved around the limited availability of interviewees for the research. The goal at the start of the project was to conduct 3 interviewees per TEC however this soon proved to be unattainable. The cause for this lies in the fact that the emergence of TECs in the Netherlands, moving from a centralised set-up to a more decentralised system, is a popular topic among researchers and students writing their thesis both from the Netherlands and abroad. This made making contact with the TECs difficult as well as converting contact into an interview as they are spammed with requests to participate in research. Especially the case of Warm Heeg presented difficulties when it came to arranging the interview as the initial two responses of the TEC were that they no longer engage in any research activities. A total of 3 months of persistent weekly emails and calls were required to arrange this interview. That being said, the interviews that were conducted brought relevant insights to this thesis, leading to the belief that potential other interesting findings have been kept out of the reach of this thesis.

Finally, the reporting standards of the TECs differed between the cases. Where Thermo Bello published detailed reported summaries of almost every community meeting, participant survey and more, Energiek Nagele and Warm Heeg published significantly less. This led to occasions during the interview where instances of social learning were mentioned by the interviewee that were not identified in any of the analysed documents. An example is the focus of Warm Heeg on approaching well-connected people in the neighbourhood to occupy positions in their project group. Additionally, for those instances of social learning to emerge in interviews, the interviewee must still be aware of all those instances of social learning which is not guaranteed especially in the case of Warm Heeg which has spanned over 12 years as of today.

Future research could focus on similar research purely reliant on interviewees to see if different findings come to light. However, due to the experienced struggles with getting interviews, it is possible this research must wait until either more TECs have reached the realisation or operation stage or when the hype around these organisations has decreased a little among researchers.

7

Conclusion & Recommendations

This chapter addresses the main research question: *"How have value controversies in the professionalisation of TECs with complete control and ownership in the Netherlands initiated social learning?"* Additionally, the section explains how this process has helped bridge the identified knowledge gaps and responds to the recommendations for further research outlined in Chapter 2. The chapter starts by presenting the conclusions to the different sub-questions in (Section 7.1) derived from the discussion in Chapter 6. (Section 7.2) explains the thesis' contribution to academic literature. Finally, (Section 7.3) offers recommendations for various stakeholders and academia.

7.1. Conclusion

Before moving to answering the main research question this section aims to provide answers to the sub-questions individually.

> ***SQ.1**: What are the exogenous variables influencing decision-making in the formal and informal trajectory of assessment of TEC development?*

The identified exogenous variables that influenced the decision-making processes of the formal and informal trajectory of assessment in the examined are the *level of income*, *education*, *heterogeneity* in the *population* and *built environment*, and the *degree of technical complexity* of the DH system.

The level of income positively influenced the informal trajectories ability to take part in the decision-making process benefiting the formal trajectory through more communication and engagement with the community, enhancing the TECs' ability of double-loop learning.

The level of education benefited both the formal and informal trajectory in the same way, as it was linked to a higher problem-solving capacity within the population. This allowed for better dealing with emerging controversies and complex situations while requiring less external expertise, thereby speeding up decision-making processes.

High *heterogeneity* in the population made it more difficult and time-consuming for the formal trajectory to create a narrative that appeals to all members of the community and motivates individuals to

participate equally. Additionally, it requires a more extensive evaluative framework for the project development, necessitating more instances of double-loop learning, and extending the duration of decision-making processes. For the informal trajectory, it means their needs and wants are represented to a lesser extent in the decision-making process as many other voices have to be taken into consideration as well. This makes it more difficult to make decisions that result in a sufficient level of satisfaction for all participants.

A higher *degree of technical complexity* negatively impacted the decision-making process. It forced the formal trajectory in the examined cases to deal with more complications during the project while the informal trajectory loses trust in the successful completion of the project when results are below expected. This decline in trust diminishes community support, which, in turn, affects the formal trajectory by reducing communication and engagement with the community.

> ***SQ.2****: What value controversies have emerged as a result of underrepresented values in the formal trajectory of assessment during the professionalization of TECs?*

Value controversies in the examined case resulted from two different misalignments. First, the value controversies around *Autonomy & Financial Distributive Justice* highlighted a misalignment between the TEC and its stakeholder environment. In these instances, the TEC acted as the informal trajectory and felt unable to realise its vision under the current set of rules and regulations endorsed by the municipalities, subsidy programs and other organisations which resemble the formal trajectory of assessment.

Value controversies around *Community Sense*, *Quality of life*, *Recognition*, *Transparency*, and *Trust* took place between the TEC, as the formal trajectory, and the population, being the informal trajectory, where the population felt their needs and wants were not endorsed by the project group and the project structure. These values were significantly influenced by the context of the TEC or the history of the community involved.

Where the value controversies between TEC and its environment required immediate action to maintain the development of the project, the misalignments between the TEC and its population were sometimes not as imminent in their impact. However, these values have proven crucial to attend to in the examined cases as they lead to friction, emerging later in the project when the TEC loses momentum.

> ***SQ.3****:How did value controversies lead to backflowing?*

This thesis identified differences in how value controversies led to backflowing differing between the forms of single- and double-loop learning.

When it comes to single-loop learning this thesis did not identify any direct explanations for how it resulted from value controversies. Single-loop learning can take many shapes and forms including public officials' rule-bending, leveraging social capital from the community, and consulting external expertise. In cases like Thermo Bello and Energiek Nagele, the TECs faced challenges with regulatory and subsidy frameworks. However, this thesis did recognise that an environment can be created under which single-loop is more easily triggered. A TEC that managed to do this was Warm Heeg, as they successfully navigated obstacles through perseverance investing in community support. Fostering community support is crucial for single-loop learning as it increases the ability of TECs to leverage the resources and expertise that are available to the population.

Where single-loop learning can take place between both the TEC and its community as well as the TEC and its environment, consisting of municipalities and other governmental bodies, double-loop learning solely stems from misalignments between the TEC and its community. Double-loop learning has been identified in the examined cases as more easily influenced by the TEC than single-loop learning. controversies led to backflowing when the TEC was able to detect misalignments between the needs and wants of the population and the structure they used in approaching the development of the TEC. As it is difficult to assess where and how these misalignments take place it requires the TEC to be continually engaged with its population, deriving the values important to them from feedback on the ongoing processes of the project as well as the form in which decision-making takes place. In the Energiek Nagele case, rapid decision-making without community involvement led to governance disapproval and a loss of community support, hindering project execution and making them unable to initiate double-loop learning. In contrast, Warm Heeg adopted a flexible development strategy, emphasizing open communication and trust-building, resulting in higher social acceptance and three instances of double-loop learning.

Moreover, the research identified differences in the development of TECs based on their alignment with the formal or informal trajectory of assessment. Thermo Bello and Warm Heeg exhibited more characteristics of the informal trajectory, while Energiek Nagele showed overlaps with the formal trajectory. These differences influenced how controversies were managed and the type of value conflicts that emerged, impacting the relationship between TECs and the communities involved. Informal trajectory alignment, as seen in Warm Heeg, was more effective for creating community support in turn allowing the TEC to be better able to navigate controversies once they arose as there were stronger feedback loops between the TEC and the community. In contrast, the formal trajectory alignment of Energiek Nagele led to rapid initial development, but unresolved controversies emerged over time, indicating misalignments with community needs and missing opportunities for double-loop learning. The study suggests that TECs benefit from promoting double-loop learning and enhancing community engagement. Recommended strategies for this are building a shared narrative around the project, giving one-on-one attention to participants and incorporating democratic decision-making practices.

These findings highlight the importance of a flexible mindset, building trust, and preserving community engagement over rigid rule-making to foster double-loop learning leading to long-term success.

> ***RQ**: How have value controversies in the professionalisation of TECs with complete control and ownership in the Netherlands initiated social learning?"*

Before answering the main research question this section starts with repeating the research objective as described in 2. This thesis started with the hypothesis from EnergieSamen in Chapter 1 that the alignment between the TECs' institutional set-up and the norms & values held by the TEC could be a potential driver for the success of these projects [9, 21, 44]. This led to the research objective in Chapter 2 of creating a better understanding of how TECs manage value controversies resulting from misalignments with their environment or community. A better understanding of this dynamic could be shared with other TECs to assist them in gaining traction and establishing a supportive collaboration with stakeholders, thus facilitating more TECs to reach the operation stage. As more TECs become operational, it would present more cases for further research, leading to the creation of essential knowledge and support systems, including protocols and guidelines for the realisation and operation stages that are now lacking these tools.

In the development of the examined cases value controversies have led to social learning by revealing misalignments between the decision-making structures of the TECs and the informal expectations of the community as well as the organisational capacity and the set of regulations and protocols on a governmental and municipal level. Some controversies require solutions without the need for structural change to the organisational structure or evaluative framework of the project, known as single-loop learning. However, other controversies led to double-loop learning, which facilitated the adaptation of TECs to emerging challenges and fostered a more collaborative decision-making process and the ability to professionalise as an organisation.

Value controversies initiated single-loop learning when TECs responded to immediate challenges without revisiting the project's underlying assumptions. This was especially relevant in cases where regulatory barriers, such as subsidy requirements, imposed constraints on the TEC's operations. Although these controversies did not always result in profound changes to the TEC's decision-making framework, they did foster learning by compelling TECs to leverage community support, seek external expertise, or adapt within the given regulatory frameworks.

How value controversies initiated double-loop learning depended on the degree of community engagement in decision-making processes, the degree of overlap with the informal trajectory of assessment as well as the flexibility of the project group with regards to the existing institutional framework. Warm Heeg, which engaged with their community through ongoing communication, acting more as the informal trajectory, was better able to manage value controversies and foster double-loop learning. This allowed for constructive social learning, where the project was continually refined in response to community feedback. Conversely, projects like Energiek Nagele, which followed a more formal trajectory with limited community involvement, missed out on opportunities for deeper social learning, ultimately facing a loss of community support and momentum.

In conclusion, value controversies initiated social learning by forcing TECs to reassess their alignment with both community values and external pressures. TECs that prioritize flexibility, and community building were able to harness controversies as opportunities for double-loop learning, resulting in more adaptive and resilient development processes.

7.2. Contribution to academic literature

Chapter 2 identified several barriers to the successful planning and development of collective heating systems by TECs. Key challenges included the lack of knowledge and resources at municipalities; distrust between stakeholders hindering collaboration; and the need for each initiative to separately invent the wheel. Areas of recommendation for further research involved, amongst other things, an analysis of the internal and external processes active during the development of TECs by Hasanov, M., & Zuidema, C. (2018), and the roles values play in configuring the governance structure by M. de Bakker et al. (2020), Heldeweg & Saintier (2020), and Weijnen (2021).

This thesis aimed to aid these calls for research by examining the development of three TECs in depth with a focus on how values play a role in shaping their organisational structure throughout the project. The results have improved the understanding of the role values play in shaping these projects by exploring the relationship between value controversies and social learning. By doing this, this research contributes to laying the foundations for further research into how local initiatives can open up to a more value-oriented perspective in their decision-making process.

Finally, the insights and findings discussed in the previous sections of this chapter resulting from the case analyses have contributed to the creation of transferable knowledge for organising TECs, improving the understanding of these organisations and the challenges they encounter limiting their need to completely reinvent the wheel as they can build upon a more extensive existing knowledge base.

7.3. Recommendations

This section utilizes the research findings to provide practical recommendations for the advancement of TECs in enhancing their navigation of controversies encountered during their development. Furthermore, it offers guidance to EnergieSamen on how they might augment their existing tools and guidelines to more effectively deliver knowledge and support to TECs. The recommendations are presented without the use of theoretical concepts and constructs, creating accessible language to enhance the understanding of the target stakeholders. Moreover, suggestions for future research are provided, concerning the employed theories and conceptual framework.

7.3.1. Recommendations for TECs

This thesis has found several antecedents that stimulate a TECs ability to deal with challenges revolving around leveraging support and participation of the population as well as dealing with the existing set of protocols and regulations, for example applying for SDE+ subsidies or dealing with stringent regulatory obligations.

First, it is important to not focus too much on creating strict rules and making definitive decisions regarding the technical system and the governance rules during the early project stages. Focus more on building trust and communication. Inevitable changes to both might be made as some needs and wants only become visible once certain dilemmas enter the decision-making process. Therefore, it is better to see the project as navigating a river where you have to overcome obstacles in the river rather than trying to force the river to move in a certain direction, as this is not possible.

In the end the ability of a TEC to overcome challenges and grow as an organisation is closely linked to its ability to build and maintain support with their population. Therefore, focus on keeping the support of your residents through frequent communication and see what narrative resonates most with your community. Especially in larger more heterogeneous populations, this might seem daunting however this approach pays dividends in the later stages of the project as it creates project resilience and increases problem-solving capacity through better access to knowledge and expertise within the community.

Additionally, this thesis found merits in starting communication with the community emphasising benefits for the greater good such as benefits for the environment, as these are great ways of starting a conversation with residents. However, to increase the participation rate of the wider majority gradually shift towards benefits experienced on a personal level as the project progresses including financial benefits, independence from geo-political conflicts and ownership of one's heat supply. This approach broadens appeal, enhances participation, and aligns community members with project objectives.

7.3.2. Recommendation for EnergieSamen

The vantage point for this thesis was the identified possible connection between the successful development of a TEC and the fit of the governance structure with the needs and wants of the local community.

After a thorough analysis of three cases with complete ownership and control this thesis agrees with this observed connection and recommends to further exploring these connections to come to new ways of assisting TECs. This thesis recognized two ways for this to take place.

First, this thesis sees value and opportunity in offering tools aimed at identifying the interplay of values in a specific TEC, enabling them to leverage this knowledge when making decisions on the governance structure and communicating with their community. An example of such as tool is the Participatory Value Evaluation Tool (PWE) as designed by the Delft University of Technology, or a similar tool modified for locally owned initiatives, in the development of TECs. The PWE is a method designed to evaluate policy options and enhance public participation by engaging groups of citizens. It allows citizens to provide input on decision-making in an accessible way. Through an online platform, participants are presented with the choices a decision-maker faces, including an overview of the benefits, drawbacks, and constraints. Citizens are then asked to advise on what they believe the best course of action would be. Finally, participants explain their choices, providing detailed insights into their preferences and considerations. Applying such a tool benefits the TEC in two ways. First, the TEC empowers citizens to actively contribute to project decision-making processes, offering structured input that reflects their values and priorities. This allows the TEC to use the identified values and priorities in their narrative. Second, it is a good reason to communicate with the community in a way that empowers them as individuals, potentially increasing their willingness to participate by leveraging the values at play more focused on the individual and increasing their understanding of the project. Currently, such a tool was not yet identified as being offered to TECs.

Second, this study acknowledges the shortcoming of the research in its ability to create clear guidelines using the limited amount of studied TECs and the amount of data available, however by creating awareness of the connection between values present during its development and the success of choices regarding the projects governance structure, the findings of this study can be used for the better deployment and utilization of the abundance of semi-finished products and principles that already exist a that TEC can flesh out locally themselves [21].

7.3.3. Recommendation for Future Research

This thesis aims to contribute to the academic literature on TECs in the Netherlands and increase the experience of deploying the frameworks by applying it to a new type of energy project. Additionally, the integration of the VLIAD model with the overflowing and backflowing framework souhgt to address the challenge of context specificity in analyzing the role of values in energy projects, as identified by Schram et al. (2024) [52].

For further research this thesis recommends the application of the conceptual model with a stronger emphasis on the relation between the exogenous variables and the emergence of informal institutional change, allowing for a better understanding of how concepts such as social capital, and energy poverty influence the capacity of residents to adapt given their specific circumstances. Furthermore, a more in-depth analysis of the role of values in specific stages seems interesting due to the identified transition

of values at play identified over the duration of energy project. Finally, as TECs are identified to be flexible in their capability of of adopting characteristics from both the formal and informal trajectory of assessment research can be done into the effect different approaches have on creating and maintaining support of the community. Doing research into the logic of value expression, starting point of justice and the democratic principle of authority in different TECs or other civil-led energy initiatives might add a new dimension for categorising governance models beyond ownership and control.

Another area of research to be explored, recommended by this thesis stems from the relevance of social connectivity and spill-over effects discussed in (Section 7.1.1.:*Unstudied Exogenous Variables*). These variables had, according to the interviewees of Thermo Bello and Warm Heeg, a noticeable impact on the development of their TECs. Unfortunately, these dynamics fell outside the scope of this thesis. Research into these factors could leverage the framework of 'Institutional Change' as proposed by Looze & Cuppen (2023) suited for analysing the effect of controversies on the development of the formal trajectory that interacts with TECs over a longer period [41]. This framework is also built on the Overflowing & Backflowing framework from Pesch et al. (2017), however instead of combining the model with the VLIAD the model is complemented by the ecologies of participation (EoP) framework allowing for the analysis and understanding of dynamics of multiple collectives and their interactions with wider systems and change on a government level [41].

On a final note, this thesis recommends research on the impact of energy poverty on the development of TECs. The importance of the average level of income of a populations as a key precursor to participation and the ability to initiate social learning was evident in all three cases and additionally emphasized by interviewees. This aligns with remarks from sources such as Heldeweg & Saintier (2020) and Beauchampet & Walsh (2021), indicating that the transition away from natural gas is more open to individuals with sufficient resources and wealthier communities [7, 31].

8

Reflection

This chapter reflects on the research process and the role of the researcher in it, including how potential biases, experiences and input from others may have influenced the research. Reflection is an essential part of rigorous research as knowledge generated through single-researcher research is never truly objective as it is always experienced through the unique lens of the researcher. To be transparent about the role of subjectivity in this research this chapter covers a reflection on how the researcher dealt with challenges and decisions that had to be made during this thesis project.

8.1. Research Subjectivity and External Influences

The heat transition in the Netherlands, as part of the wider energy transition, is a highly interesting but also challenging field for researchers and other stakeholders. Although scoping and determining my research focus was an enjoyable part of the thesis, it was also the part where I encountered the most challenges. From the start, I was motivated to contribute both to the existing body of scientific literature and to deliver practical insights for key actors in the field, such as Fakton Energy and EnergieSamen. The latter came from the fact that these organizations helped shape my thesis by offering valuable perspectives through multiple interviews and connecting me with other relevant parties. While the desire to assist Fakton Energy and EnergieSamen worked as an incentive to deliver quality throughout the project, it also influenced some of my decisions in ways that went beyond pure scientific research.

An example is when I had my second interview with EnergieSamen. The interviewee proposed an intriguing hypothesis: The success of TECs might be influenced by the alignment between their governance structure and the values present in the community directly involved in its development. This hypothesis originated from two TECs in Zwolle that utilized similar technologies and organizational structures. However, differences in the attributes of the populations involved were believed to have led to the success of one project and the shutdown of the other. This hypothesis was exciting for EnergieSamen as when proved to be true, it would allow them to assist and support TECs in the Netherlands through a different range of tools and guidelines compared to what they had been offering before. This input from EnergieSamen has undeniably influenced the development of my thesis. Partly, in shaping the research objective but also in feeding my desire to present favourable findings to EnergieSamen. While I was thorough in covering the pitfalls of this influence by seeking critical feedback from my

supervisors throughout the whole project and two occasions of peer reviews, this perspective has inevitably affected my view of the heat transition on a personal level.

8.2. Using the Constructed Conceptual Model

Designing and using the constructed conceptual framework is the part of this thesis project that I found most enjoyable. Throughout the development process, I started to grow confident that the framework would allow me to precisely target the research objective I had set for this thesis. However, I also have to admit that combining two existing frameworks was an ambitious attempt and that I hoped that some things would work out better than they did ultimately.

First, leveraging the exogenous variables to allow for the mentioned context specificity of value controversies in existing literature proved to be useful in bringing nuance to the discussion of the results of the value-based model of Schram et al. (2024). However, the context analysis required a very extensive analysis that took much longer than expected beforehand while some of the findings also came forth from the overflowing & backflowing analysis resulting in partial double-work and therefore no optimal efficiency in my research. Additionally, some external factors that turned out to be important for the course of the TEC are missed when mapping the exogenous variables. These are the unstudied exogenous variables presented in chapter 6, and include the effect of spill-overs. These variables became only visible to me during the interviews and had not been mentioned in the examined articles. Finally, the context specificity of the controversies that emerged when examining the cases was even more specific to the local community than expected to the point where the demographics of the exact population were directly connected to their emergence. In Energiek Nagele for example, there was a significant difference between the population living in the village and the wider area. While the residents in the wider Nagele area were very community-driven and the main initiators of local initiatives, the residents in the village area seemed to be the opposite of this. However, only the characteristics of the wider area residents were retrievable through desk research, the profiles of the villagers only became visible during the interview. This emphasizes the extreme context specificity of energy projects and why diligent and rigorous research is necessary for studying the local conditions.

Additionally, using the constructed conceptual model was experienced as rather difficult and complex due to the many connections that had to be made between the exogenous variables, value controversies and social learning within and between the cases. This complexity was not anticipated well enough before starting the research. In hindsight, I should have written out the approach for synthesizing and interpreting the findings in greater detail, determining what information I would need in each step of the process and how to efficiently compare between the cases. As a result, the thesis unfolded in a somewhat chaotic manner, which caused delays later in the project as on more than one occasion I had to go back to the drawing board. Furthermore, the many occasions of comparing, interpreting and synthesising different results have made the research prone to researcher bias. There were multiple occasions where subjectivity could have influenced the results. This challenge has been covered by feedback from experts in the form of my supervisors as well as peers following the same program.

A practical problem with the combination of the constructed conceptual model and the data sources used is that for the researcher to identify instances of double-loop learning either the TEC or the population must express dissatisfaction with certain actions. However, in the case of Warm Heeg and Thermo Bello, it is possible that their effective practices in the form of frequent communication and one-on-one

approaches diminished these value expressions by countering them before they could emerge in media or reports. This potentially leaves instances of social learning and misalignments between the TEC and community unidentified.

Overall, the complexity that came with constructing a conceptual framework and the research process have been a lesson in problem-solving, strategic planning and critical thinking contributing to my ability to tackle complex challenges and resilience when facing challenges I have never encountered before.

8.3. Conducting the Interviews

Reflecting on the process of conducting the interviews, I found it sometimes challenging to balance guiding the conversation while respecting the desire of the interviewees to discuss certain topics. There were moments when I found it difficult to change the course of the discussions politely, which affected my ability to keep the interview on track and cover all planned topics in-depth. This lack of coordination led to instances where the discussion strayed from the focus of the research. In these situations, I was also concerned that being too direct in my communication might negatively impact the enthusiasm of the interviewee and the relationship I had built, especially given how many challenges I faced arranging these interviews and the lack of other individuals who could take the place of the interviewees.

Moving forward, I recognize the need to develop better strategies for maintaining a respectful but better-guided conversation, ensuring that both the interviewee's experiences are honoured and the research objectives are met effectively. Strategies for future interviewees I will take with me are thinking of certain transition or interruption sentences beforehand allowing me to maintain the enthusiasm of the interviewee while still guiding the direction of the interview.

8.4. Academic Writing

This thesis has turned out to be a steep learning curve for me in articulating my thoughts and ideas in both written and verbal form, allowing me to become a more effective storyteller. As someone who takes the most joy in the initiation phase of projects, putting the effort in to add the finishing touches to a report with over 70 pages proved to be difficult at times. In navigating this difficulty, I discovered the best mitigation tool is honest feedback from supervisors or peers. Engaging with their critiques not only improved the clarity of my writing but also deepened my understanding of the subject matter as it forced me to critically rethink certain aspects of my thesis due to identified inconsistencies by the reviewers. Additionally, placing creativity walks into my work schedule helped me generate new ways to present my ideas, while verbally articulating my thought process to nearby roommates or family members proved to be remarkably effective in increasing my pace of work. Ultimately, the challenges I faced have transformed my (academic) writing process, allowing me to better leverage creative thinking and communicate my thoughts and ideas with greater clarity.

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A

Appendix A

A.1. The Governance Models of TECs

This section discusses the characteristics of the different models. As these governance models only entail the actor composition it is important to realize that the exact distribution of ownership and control within the types of governance models still varies [21]. Model (4) is excluded from the discussion due to its variability and its similarity to any of the other models depending on how ownership and control are distributed.

Model 1 - Complete Ownership and Control

Ownership 100% of the ownership and control of the heating system and operating heat company is allocated to the TEC.

Control The residents' cooperative has complete control over the PLC. The statutes and regulations define the distribution of authority between the cooperative's members, its board, and the PLC's director. Setting up these frameworks ensures the heating company operates effectively while involving members in key decisions to maintain democratic processes.

Risk The PLC bears the operational risks and manages contracts with suppliers, financiers, and customers. The cooperative's financial risk is the potential loss of invested capital if the PLC goes bankrupt. There are also social risks, as the cooperative's directors are usually residents, and dissatisfaction could strain community relationships.

Financing Community initiatives face significant challenges in securing financing for project development, as banks are still adjusting to cooperative heating networks as investment opportunities.

Capacities The residents' cooperative, being fully responsible for the heating company, must manage all aspects of project development, business, and operational processes. Many neighbourhood projects benefit from substantial local expertise, which can be supplemented by outsourcing to external parties. These external parties work for the cooperative during development and for the heating company during

construction and operation. This streamlined organizational structure enables the cooperative to act decisively.

Model 2 - Public-Civil Participation

Ownership The shares of the heating company are jointly owned by the residents' cooperative and the municipality. The basic assumption is 51% ownership by the residents. However, the parties can divide ownership differently. The division of shares significantly influences control as the TEC must now conform to the decision-making processes and protocols of the public party.

Control The residents' cooperative and the municipality share control over the PLC. Both the municipality's and residents' interests play a role in the company's operations. In a 50-50 share split, both parties have equal control and must collaborate to make decisions, potentially leading to deadlocks. Regardless of the division, it is crucial to establish clear decision-making agreements in advance. An 'escalation ladder' is often used to resolve deadlocks or conflicts, outlining steps to reach decisions at different levels.

Risk Overall, risks decrease for each party as they are shared. Municipal involvement can also facilitate the permitting process. However, this creates dependency, introducing new risks. Political changes could affect municipal support after elections. Residents remain invested in receiving affordable, sustainable heat, while new municipal administrations might prioritize profit.

Financing Access to capital becomes cheaper as municipalities can borrow money at favourable rates, reducing the final costs due to the lower interest rate. Collaboration with the residents' cooperative increases financiers' confidence regarding occupancy risks. However, financing by another partner can pressure the cooperative's control, making it crucial to establish clear agreements.

Capabilities The residents' cooperative becomes less reliant on its knowledge and skills when an additional party is involved. Large municipalities can contribute specific organizational and administrative capabilities. However, this collaboration can also add complexity, potentially affecting decisiveness. Officials and councillors working with the heating company must be accountable to the municipality, and inquiries from the municipal council can cause delays or changes in direction. The political landscape may also exert pressure to achieve certain goals.

Model 3 - Civil-Private Participation

Ownership The shares of the heating company are jointly owned by the residents' cooperative and the market party. From the residents' perspective, the cooperative should hold a majority of the shares to ensure control.

Control The residents' cooperative and the market party share control over the PLC. Both the market party's and residents' interests play a role in the company's operations, with the common goal of providing reliable heating to customers. However, the cooperative's "profit for purpose" orientation can conflict with the market party's profit objectives. Clear agreements and escalation procedures for decision-making are essential.

Risk Risks are shared between the residents' cooperative and the market party. The market party's expertise can lead to efficiency, cost reduction, and effective risk mitigation. Their professionalism can build trust among residents, although profit motives might also strain this trust.

Financing The market party generally has easier access to capital than the residents' cooperative. Collaboration with the cooperative, however, increases financiers' confidence regarding occupancy risks. A well-managed neighbourhood process and local engagement provide better insights into potential participants.

Capabilities The market party brings in expertise, such as technical and financial capacities, reducing the cooperative's dependence on its own capabilities. However, significant differences in capabilities might pressure the cooperative's interests and control. The cooperative contributes participative capacities and local knowledge of homes and the neighbourhood. The cooperative must keep these capacities visible and actively mobilized.

A.2. Research Flow Diagram

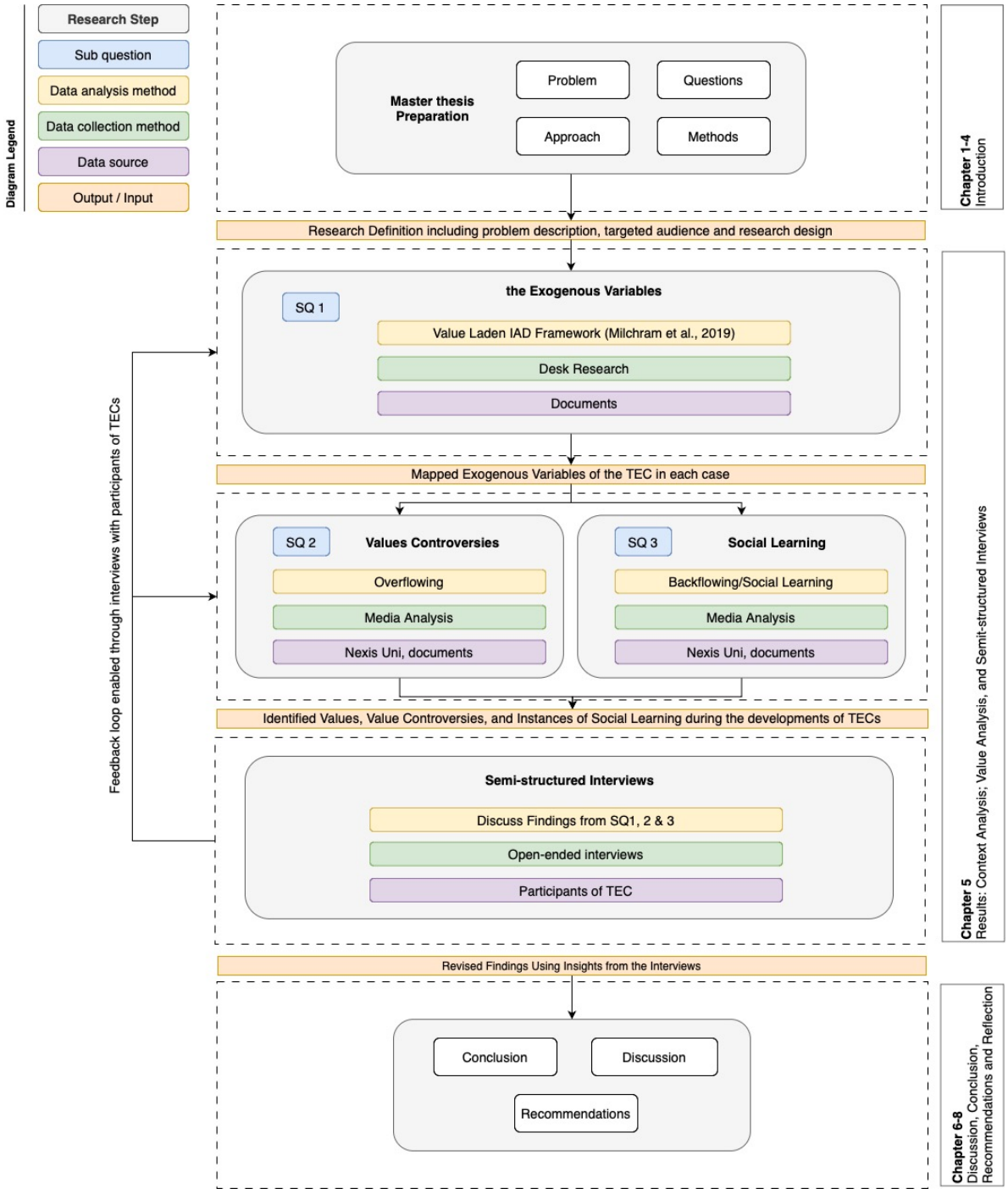

Figure A.1: Research Flow Diagram

B

Appendix B

B.1. Technical Specifications of Heat Systems

B.1.1. Thermo bello

The drinking water is cooled in a heat pump from 12°C to 10°C and uses the extracted heat for residential heating. The water pump station produces approximately 9000GJ of heat per year using an electrically driven heat pump with a capacity of 780kW. The heat is extracted from the drinking water reservoir and distributed through the heating network to residential and commercial buildings. The delivered heat is primarily suited for floor and wall heating, with a maximum temperature of 50°C. The heat station includes two additional gas boilers each of 500kW, which are operational as backup during cold weather (approximately, -10°C) or when the heat pump fails or is under maintenance. A diagram of the heat pump connected to the water station is depicted in Figure B.2. The heat pump contains a compressor that extracts heat from the drinking water and converts it to water that is used for heating. Currently, this compressor is electrically driven. The ratio between the required driving electrical energy and the available heat is approximately 1:4. This means that if the available heat is considered 100%, the heat pump contributes 25% of this total, with the remaining 75% sourced from the heat extracted from the drinking water. The heat demand of Thermo Bello is depicted in Figure B.1. Occasionally, the heat pump falls short with respect to the heat demand. The heat pump can deliver about 30% of the total heat demand, visible in the graph as the darker area under the red line. The heat station therefore contains additional gas boilers. Those gas boiler take the other 70% of the heat supply for their account.

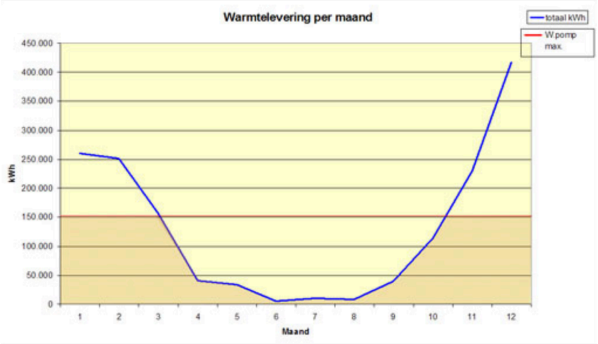

Figure B.1: Heat pump capacity Thermo Bello

The system has distribution losses of 7% as a result of the cooling of the pipes transporting the heat. Another 9,5% of the heat is lost in the crawl spaces within the connected buildings. Thermo Bello has set-up a neighbourhood committee that focuses on lowering the water levels in the crawl spaces to mitigate the heat loss.

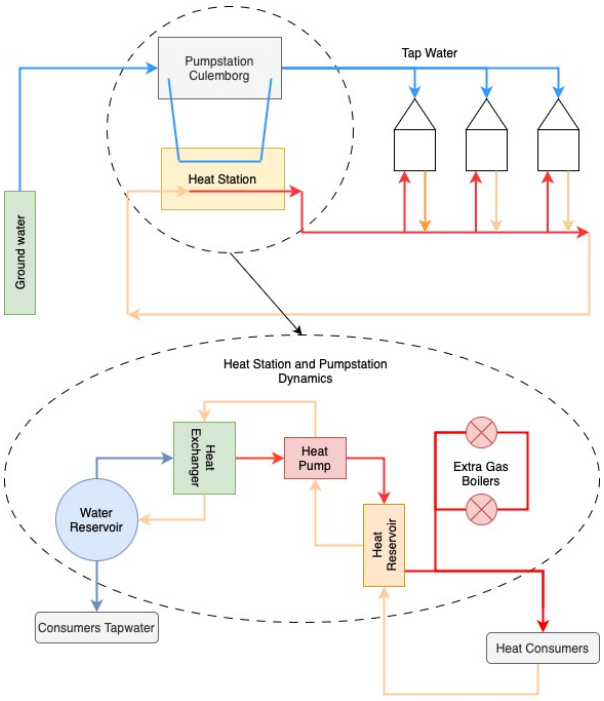

Figure B.2: Collective Heat System Thermo Bello

The system delivers heat to 222 residential buildings and 7 commercial properties. Each connected property has an installed meter indicating the heat intake. The cost of connecting a building to the grid equals 305,54 Euros. This price includes BTW and costs for measuring services. The cost of heat after connection equals 65,00 Euros per GJ. For heat extraction up until 37GJ there is a ceiling price of 47,38 Euros.

B.1.2. Energiek Nagele

The pilot project that was held in Nagele, known as 'Kernvariant,' (core variant) includes several innovative components. The system is visualised in Figure B.3. The connected residential buildings and local community center have solar thermal collectors installed on the roofs of the buildings, providing high-temperature heat exceeding 100°C. There are 84 collectors on the houses and 101 collectors on the community center. An underground central technical room houses the main control technology and two custom-made heat pumps (60kW and 20kW) with an efficiency (COP) ranging between 3 and 5. A 24 m³ day buffer in the form of a water reservoir ensures a stable delivery temperature, heating to 70°C when necessary, and saving energy by only heating the day buffer instead of the entire seasonal buffer. The seasonal buffer stores summer heat using an underground insulated water reservoir, with a capacity of approximately 1,000 m³.

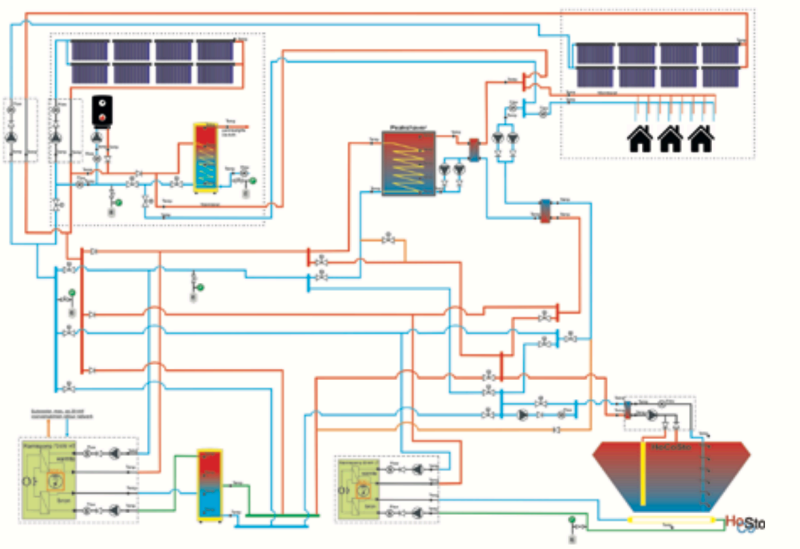

Figure B.3: Collective Heat System Nagele

The heat network delivers heating and hot water, partially running over roofs and using the flue gas outlet for the heating pipe. The original boiler in the community center serves as a backup and peak load installation. Additionally, a chimney facilitates the riser pipes to the roofs. The realized efficiency fell short of expectations after a year of operation due to several factors. Lower heat demand meant that control systems and pumps constituted a larger share of auxiliary energy. Higher return temperatures from installations, due to suboptimal adjustments, further reduced efficiency. The lack of stratification in both the seasonal and day buffers caused additional inefficiencies. The design efficiency was overestimated, leading to extended use of heat pumps. Furthermore, the installed heat pump was incompatible, causing efficiency issues and failures.

B.1.3. Warm Heeg

The heating network in the village operates as an integrated system designed to extract, store, and distribute heat sourced from the local Hegermeer. The network consists of four primary components: the heating facility, heat storage, the pipe network, and the connection pipe. A visualisation of the system is displayed in Figure B.4.

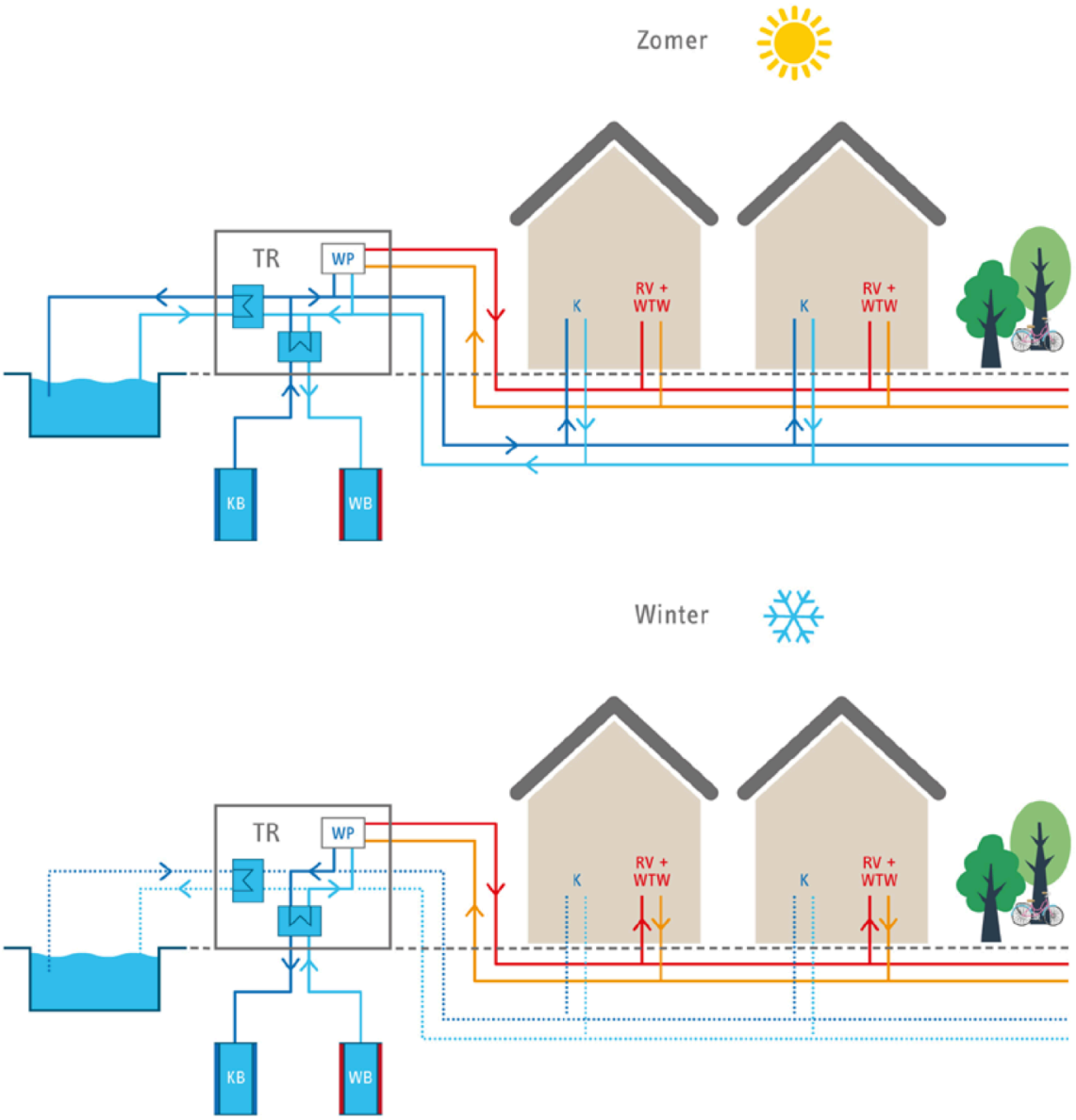

Figure B.4: Collective Heating System Warm Heeg

At the core of the system is the heating facility, located within the village, where heat is extracted from the surface water of Hegermeer to elevate the temperature of water within the collective heating network. During the warmer months (April to October), the facility directly utilizes heat from the Hegermeer, cooling the lake water by a few degrees before returning it. This process is carefully monitored to ensure it does not negatively affect local fish and plant life. Excess heat generated in the summer is stored underground at a depth of approximately 150 meters. This stored heat is then used in the winter to warm houses, ensuring a balanced average temperature in the underground storage throughout the year. The water temperature in the heating network is adjusted seasonally: in summer, it is maintained at 60°C, sufficient for providing hot tap water, while in winter, it is increased to 70°C for heating homes. During periods of severe frost, the temperature can be raised to a maximum of 85°C. The pipe network, starting from the Heating House, distributes the heated water throughout the village. The

system begins with large pipes, approximately 40 cm in diameter, which gradually reduce to medium (25 cm) and small (14 cm) pipes as the number of homes drawing heat from the network decreases. These pipes, made of steel with a PUR insulation layer and a waterproof plastic jacket, ensure efficient heat transfer. A connection pipe runs from the street network to individual properties, delivering heat to radiators and tap water systems similarly to a central heating system. If the house is adequately insulated, no modifications to existing radiators are necessary. The extensive installation of this pipe network required significant excavation throughout Heeg, resulting in the temporary disruption of many streets during the construction phase. The comprehensive design and strategic operation of this heating network ensure a reliable and efficient heat supply to the village, reducing dependence on traditional heating methods.

B.2. Attributes of the Community

B.2.1. The TEC - Thermo Bello

Residents of EVA Lanxmeer actively seek to improve their quality of life by taking responsibility for energy supply, neighbourhood development, landscaping, traffic safety, water management and food production. The neighbourhood has served as a testing ground for social innovation since 2000, with Thermo Bello being one of its successes. Despite the local residents possessing some technical and organisational expertise, the project's complexity necessitated additional support to achieve a successful execution. To address this need, the Association for the Development and Operation of the Heating Network (VOEW) was established in January 2008. The primary objective of VOEW was to enable BEL to make an informed decision regarding the offer from Vitens. The extensive efforts of VOEW ultimately culminated in the establishment of Thermo Bello, a resident-owned local energy company. Thermo Bello is a PLC that is operated by personnel, including a general director, technical operator, president, and representative of participating residents. Additionally, there is a cooperation, with a foundation structure which is excluded from liability, that consists of residents connected to the collective heat system and the general resident's council of EVA Lanxmeer. The positions on the board of the cooperation are taken by members of these two aforementioned bodies. A visualization of this construct is depicted in Figure B.5. Finally, there is the collaboration with various contract partners. The main contract partners are Greenchoice, providing the TEC with business services and DEC helping with the professionalisation of the TEC. These parties are allowed to vote on how profits are allocated.

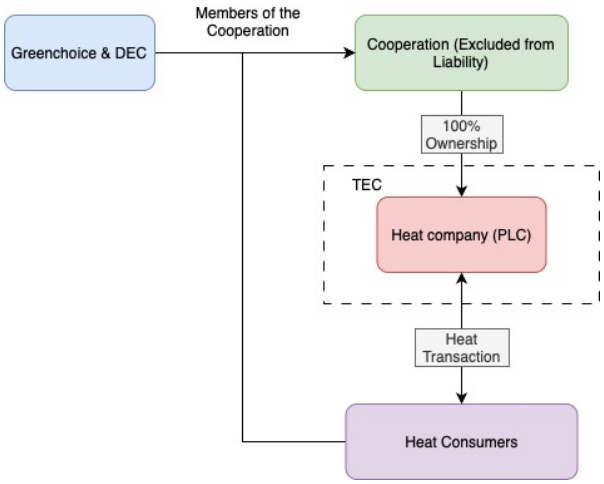

Figure B.5: Governance Structure Thermo Bello, [59]

To create an organisation that fits with the community of EVA-Lanxmeer key principles and demands were formulated the organisation should adhere to. These include independence, connection, simplicity, continuity and security of heat supply, social responsibility, transparency and financial health.

B.2.2. The TEC - Energiek Nagele

Nagele Warmte B.V. was founded in 2021 to manage the 'Kernvariant' project and is wholly owned by the foundation 'Energiecollectief Nagele'. Currently, the foundation's board comprises one director, but it will expand to include representatives from the Energiek Nagele cooperative as the project scales up. Nagele Warmte B.V. owns and operates the installation and acts as the contractor for its clients. There are several reasons for this structure. First, members of the Energiek Nagele cooperative and other stakeholders can influence Nagele Warmte through the foundation, which fully owns Nagele Warmte, and the cooperative contributes at least one member to the foundation's board. Additionally, foundations are exempt from corporate tax if they do not operate a business and if their statutes state that any profits will be used for sustainability projects in the municipality that provided the initial PAW subsidy. Second, by not making residents direct owners of Nagele Warmte, it prevents them from selling the company and distributing profits among the current residents post-project completion, ensuring that the PAW subsidy benefits the inhabitants of the connected properties rather than the residents who were present at the start of the project. Furthermore, a B.V. can be sold if it's advantageous for the heat network to become part of a larger system, a flexibility that is not possible with a cooperative or foundation. Finally, Nagele Noordwarmte B.V. was established for the village-wide approach. This separation was intended to legally isolate the risks associated project from those of the Kernvariant. It was envisioned that the two B.V.s could potentially merge in the future if deemed beneficial.

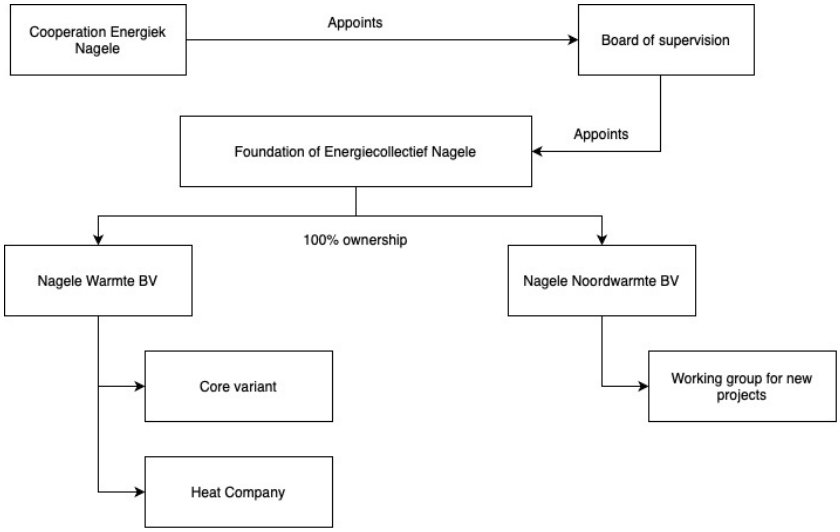

Figure B.6: Governance Structure Nagele, [35]

Besides aiming to be energy independent, the community also values being a model village for other cities, villages and neighbourhoods in the Netherlands.

B.2.3. The TEC - Warm Heeg

The Thermal Energy Community was founded by an initial working group in 2012 that wanted to make Heeg energy independent by 2025. Rather than searching for an suiting organisational structure, the TEC decided to let its governance change over time, hiring a notary to guide this development best. To realise the group founded an energy cooperation which resulted in the foundation Warm Heeg. This foundation started both Cooperation Warm Heeg U.A., included the heat consumers, and Warm Heeg BV, the wholly owned subsidiary of foundation Warm Heeg. To realise the project Warm Heeg BV hires and recruits local professionals for its project. Together these different bodies comprise the Thermal Energy Community Warm Heeg.

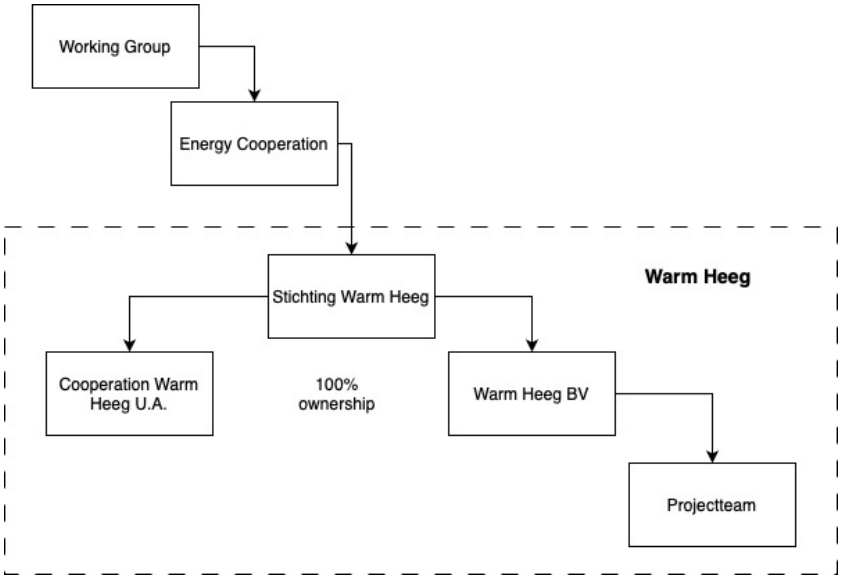

Figure B.7: Governance Structure Warm Heeg, [30]

The community strongly prefers independence and speaks out against collaborating with the national government. However, participants are free to join cooperation Warm Heeg U.A. and free to leave at any time. Additionally, the use of carbon-free energy sources stands in high regard with the community as the preservation of the environment has a priority. Furthermore, heat and electricity should be affordable and feasible for everyone regardless of their financial situation and the level of isolation of their house. Therefore, the monthly costs can not be higher than in the previous situation and connection to the grid should come at a minimum price.

B.3. Rules-in-use

B.3.1. Thermo Bello

Rules-in-use	Description
Boundary rules	Key Stakeholders: - Residents Association EVA Lanxmeer (BEL): This association was a vehicle for residents to participate in the decision-making process of the early stages of the project. - Association for research and exploitation of heat system (VOEW): The sole purpose of the VOEW was to execute a feasibility study. Both heat consumers and critics of the project were allowed to join the VOEW. - Thermo Bello: the local heat company (PLC) that focuses on heat supply in EVA Lanxmeer. - Cooperative Thermo Bello: Together with the Board of Commisioners, sets the goals and objectives of the heat company. - Board of Commissioners: The Board of Commissioners conssists of individuals outside of EVA Lanxmeer; and provides advice regarding the TEC's professionalisation - Heat consumers: Can take part in the decision-making process directly through monthly community meetings; Pay a fee (7,50-) for becoming a member of the cooperative/VOEW/BEL - Non-participating residents: Can take part in the decision-making process through council meetings and give their opinion on project decisions - DEC & Greenchoice: Active shareholder, holding 7/15 votes; Assists in the professionalisation of the TEC
Position rules	- BEL and VOEW were the initial project leaders; after a while the cooperative Thermo Bello took over - The municipality has a supporting role but is not involved in decision-making - Both heat consumer and non-participating resients are involved in the development of the project through the foundation and before, BEL and VOEW - Contract parties such as Greenchoice and DEC have mostly administrative and advising functions
Choice rules	- Residents Association EVA Lanxmeer (BEL): All residents of EVA Lanxmeer are required to participate in the association. This assocation was a vehicle for residents to participate in the decision-making process of the early stages of the project. Later the function of this association was taken over by the VOEW. - Residents were able to become a member of the VOEW for 7,50 per year and participate in working groups concerning: organisational development, finance, technology, and communication. Both heat consumers and critics of the project were allowed to join the VOEW. - Cooperative Thermo Bello: Together with the Board of Commisioners, sets the goals and objectives of the heat company. - Heat consumers: Can take part in the decision-making process directly through monthly community meetings; Are allowed to vote on board and management of different associations and councils. - Non-participating residents: Can take part in the decision-making process through council meetings and give their opinion on project decisions; Are not able to vote on board and management or specific decisions. - DEC & Greenchoice: Active shareholder, holding 7/15 votes; Assists in the professionalisation of the TEC
Information rules	- All stakeholders have access to information regarding decisions that are decided upon and the governance of the TEC; This information is published online and presented during the monthly meetings which are open for all participants of the Coopertative
Aggregation rules	- Thermo Bello works with a majority system regarding decision-making; the votes are divided between the local resdidents who hold 8/15 votes through the foundation and the partner organisations (DEC & Greenchoice) who hold 7/15 votes
Payoff rules	- Profits are reinvested in the heat system or used for other sustainable energy/project in EVA Lanxmeer and Culemborg; Costs fall on the PLC Thermo Bello, the cooperative Thermo Bello is Excluded from Liability.
Scope rules	- Potential outcomes of decision-making includes; the creation of new formal and informal rules; allocation of profits; the appointment of the supervisory board and the creation of new partnerships

Table B.1: Rules-in-use Thermo Bello

B.3.2. Energiek Nagele

Rules-in-use	Description
Boundary rules	Key Stakeholders: - Cooperative Energiek Nagele U.A.: Involved in all decision-making processes and complete owner of the heat company - Foundation Energiek Nagele: Owns 100% of the shares of Nagelewarmte PLC and Nagele Noordwarmte PLC; consists of 1 boardmember - Municipality Noordoostpolder: Is present in decision-making processes as part of the director group - Province: Has a supporting role in the energy project through the sharing of their knowledge and network - Mercatus: Housing corporation company that is part of the director group - Director Group: Group of final decision-makers in the development of the heat system and the organisation - Supervision Committee: Is not allowed to take part in decision-making but can veto or remark on issues and proposals before the director group is involved - Citizen Advice Committee (BAC): Group of 7/8 citizens, one from each house block, that is involved in the decision-making process and is allowed to vote - PAW: Financer Energiek Nagele has a long list of advisors that were allowed to take part in the decision-making process when deemed necessar. This list consists of: - Fakton: Advisor - HoCoSto: Advisor and construction - Innoforte: Advisor - DubbelDwars: Advisor
Position rules	- Decision-maker: Director Group including Energiek Nagele, Mercaturs, and the municipality of the Noordoostpolder - Financer: PAW, Municipality Noordoostpolder - Advisor: Province, Fakton, HoCoSto, Innoforte, DubbelDwars
Choice rules	As the TEC is the only party with ownership of the heating system they have a final say in the decision-makeing process. However, the housing corporation Mercatus is involved in the decision-making process to give their preferences as many of the properties that are connected to the system are theirs. Additionally, the Supervision Committee can veto, propose and adjust ideas before they reach the director group.
Information rules	Monthly meeting ensure the spread of information, however the presence of many different organisations and different working groups sometimes prevents the free flow and coordination of information as multiple process are active at the same time
Aggregation rules	As Energiek Nagele is the complete owner of the project they have the final say in decision-making. However, the preferences of local stakeholders is taken seriously in the development of the project.
Payoff rules	The TEC has a profit for purpose approach meaning that the costs for heat are minimalised to just ensure the financial sustainability of the organisation. Any additional profits are reinvested in the technical system or other projects for the local residents.
Scope rules	Potential outcomes include: new formal or informal institutions; the generation of knowledgel; profits that can be reinvested in the organisation

Table B.2: Rules-in-use Energiek Nagele

B.3.3. Warm Heeg

Rules-in-use	Description
Boundary rules	Key Stakeholders: Warm Heeg BV: The heat company operating the heat system Cooperative Warm Heeg: Allows the heat consumers of the heat system to partake in the decision-making and development of the heat system Foundation Warm Heeg: Takes decisions during the project development of Warm Heeg in collarboration with the municipality sud-west fryslan and the cooperative Warm Heeg Municipality Sud- west Fryslan: Has an active facilitating role in the development of the process without actual ownership or control Kelvin BV: Is involved as heat supplier due to their legal eligibility for these functions. Other than that Kelvin BV is not invovled in any decision- making
Position rules	The position rules in the development of the TEC are the stakeholders part of the project group including: Warm Heeg BV, Cooperative Warm Heeg, Foundation Warm Heeg, Municipality Sud-west Fryslan
Choice rules	The decision-making power liest with the Foundation Warm Heeg and the Cooper- ative; the municipality is involved as advisor in the project Kelvin BV is responsible for the heat distribution and facturing of the heat company New parties can enter the project group and decision-making processes in the future if the project group enters a collaboration with the new party.
Information rules	Due to the non-profit nature of the heat company and obligation to offer heat for the lowest possible price the information channels are open and most information is available on the website of the TEC; Additionally, timelines with all made decisions are shared
Aggregation rules	The decisions are made solely by the Cooperative Warm Heeg and its members. Internally, there must be an anonymity for a proposal
Payoff rules	The Foundation is 100% responsible owner of the heat company and therefore re- ceives all benefits from the operation of the collective heat system; The Cooperative Warm Heeg U.A. is excluded from liabilities so no cost can fall upon the heat con- sumers that are part of the cooperative
Scope rules	Outcomes range from decisions made on the organisations/ governance of the project; financial issues; support and communication channels; and the physical de- velopment of he system

Table B.3: Rules-in-use Warm Heeg

B.4. Value Definitions Thermo Bello

Value	Description
Aesthetics	This value refers to the visual beauty of the area the TEC is located in. The residents of EVA Lanxmeer have stated to value the nature and architecture of their neighbourhood in multiple sources, especially the preservation of nature in the urban area is valued.
Altruism	The desire to do good without expecting anything in return. This value was expressed in, amongst others, the willingness to work full-time without salary and participation in other sustainability projects without compensation.
Autonomy	The desire to realise the heat tranistion with the local community. Displayed in the conviction of the residents of EVA Lanxmeer that they can successfully finish the project and overcome encountered challenges.
Authenticity	Both directors of the TEC and participants value the character of EVA Lanxmeer and its inhabitants, wanting to preserve it. The residents of Lanxmeer are claimed to be pioneering, selfless and involved.
Financial Distributive Justice	Entails the distribution of benefits and ills on all members of the community in an equitable manner. Expressed throug the desire of the participants to know what their future costs (and revenues) will be. Additionally, the probability that these cost stay the same and will not exceed the current situation is deemed important.
Community Sense	Being involved in the community ranging from participants being involved in Thermo Bello to Thermo Bello being involved in other initiatives in Lanxmeer. Expressed, amongst other things, in the high participation rate during community meetings of BEL.

Table B.4: Values, norms, design requirement and controversies Thermo Bello

B.5. Value Definitions Energiek Nagele

Value	Description
Transparency	This value relates to the free flow of information regarding decisions, decision-making processes and future activities.
Autonomy	The ability of the TEC as well as the participants to make their own decisions regarding the future of their energy system and heat supply.
Financial justice	Financial justice refers both to justice for the TEC as well as individual participants. Examples are affordable connection to the grid for individuals; associated property increase with taken risks of participating in the pilot project; as well as access to subsidies and other governmental support sources
Quality of life	This value refers to the preservation of the quality of living in Nagele during and after construction of the heat network. Frequently, cited concerns are the ability to regulate heat, cook and cool as desired.
Recognition	When Nagele was established in the 50s, farmers had to apply for housing in the village. Only certain families were allowed to live in the highly desired new village giving it a prestigious status. Many citizens refer to the old status the town had and the desire to stand-out again as a progressive municipality in the Netherlands. Additionally, the communities take pride in pioneering with new heat technologies in the Netherlands.

Table B.5: Values, norms, design requirement and controversies Energiek Nagele

B.6. Value Defenitions Warm Heeg

Value	Description
Autonomy	The citizens of Heeg have a strong desire to be independent from the national government, private parties and other geo-political factors such as the conflict in Ukraine. This desire drives them to design their own solutions and take initiative in controlling their future.
Community Sense	Citizens in Heeg have a strong feeling of solidarity. Many volunteers help in the heat initiative, causing many vital functions in the project to be executed for free. Additionally, local newspaper emphasize the community sense in the district and their ability to achieve successes together.
Environment	The preservation of the nature in and around Heeg is held in high regard. Especially the wildlife in the lake that will be used for heating in the winter is a topic that is discussed frequently. Researchers of the university of Wageningen have expressed their concernc about the degradation of biodiversity as a consequence of aquathermic heating.
Equality	The TEC has the desire to be equal in the execution of the project to other partners such as municipalities. Besides the TEC citing this through many media channels both internally and externally, the municipality of Sud-west Fryslan takes the same approach to the heat initiative.
Financial Distributive Justice	Entails the distribution of benefits and ills on all members of the community in an equitable manner. Additionally, in the case of Warm Heeg it refers to the ability to acquire funding for the development of the project.
Trust	People in Heeg require tangible proof before making decisions making trust a vital factor in the development of the project. Many of the volunteers put most of their time in preserving this value in the project by organising open houses, induction cooking workshops and 1-on-1 consultations.

Table B.6: Values, norms, design requirement and controversies Warm Heeg

B.7. Overflowing & Backflowing Occurrences

B.7.1. Thermo Bello

Autonomy

Heat Act Permit Requirement Overflowing occurred due to the mismatch experienced by Thermo Bello in the emphasis of the Dutch government on the realisation power of citizens when it comes to the energy transition and the experienced regulatory hurdles experienced by the TEC set by the government. This feeling of not being supported by the government among the direction and citizens did not just arise within the project of Thermo Bello but was experienced by citizens of Culemborg with local solar and wind initiatives. The Dutch Heat Act gives the government 3 tools to exert influence on heat-

producing companies. These tools entails: a permit requirement, a Reasonable Price and a Maximum Price. These tools are meant to protect customers from the monopoly power of heat companies, but their implementation is more favourable to large heat companies according to the direction of Thermo Bello, making it less threatening to them.

At the same time, this legislation poses significant challenges for small-scale local renewable energy companies like Thermo Bello as they have the same administrative burdens and fall within the same regulatory framework as national energy companies such as Vattenfal or Eneco. Not only TECs experienced challenges with the Heat Act. Financial institutions like the ASN Bank mentioned that the increase of the contribution for grid connection cost (BAK) that is maximised under the Heat Act, the Reasonable Price, and the development of long-term cost (+30years) causes it to be difficult to fund TECs as a bank.

In order to overcome the regulatory obstacles that were encountered, the TEC implemented a series of measures. The TEC initially established a dedicated working group with the specific objective of identifying the optimal legal organisational structure for the organisation. This was conducted in collaboration with a notary. The objective of this working group was to mitigate the bureaucratic and regulatory burdens imposed on the TEC to the greatest extent possible. A multitude of judicial structures were investigated, thereby reducing the difficulties encountered in this domain to a minimum. However, as Thermo Bello was a pioneer in this field, there was a paucity of experience available regarding this controversy, which made it challenging for the TEC, as well as for other interested parties, to develop a satisfactory solution.

Therefore, the initiative joined a political debate in 2009 on the initiative of the national government about the development of a Heat Act. In 2009 the execution of the Heat Act was in the hands of the ministry of Economic Affairs and the National Competition Authority (NMA). Thermo Bello participated in the discussion involving how the aforementioned tools should be exercised. The advise of Thermo Bello was to not exercise the Reasonable price tool in the case of TECs as when the consumers are also the owners of the system they have the ability to defend themselves against unreasonable prices themselves. This advice could be realised by exercising the subsidiary principle on these situations. Only the NMA would be allowed to intervene when consumers take the initiative to reach out to them on their own initiative. Unfortunately, the government deemed Thermo Bello an anomally and discarded the proposal.

Collaboration with residents and the municipality To take away the skeptical perspective citizens had on the project Thermo Bello took several measures. In 2009 and 2010, together with a working group on organizational development Thermo Bello worked on adapting the LPC statutes, the deed of incorporation, administrative conditions and internal regulations of the trust office foundation. These documents function as the ground rules for making joint decisions on important matters in the future aimed at creating and maintaining support and involvedness of residents. Additionally, the municipality was involved because the framework agreement required it to agree to establish Thermo Bello. This mandatory collaboration involved several activities. First, the municipality has given resident Culemborg the freedom to experiment with local initiatives 10+ years before the start of Thermo Bello. This built experience with initiating and developing local initiatives. Furthermore, the municipality made it mandatory for new homes in the area to be connected to the heat grid. Both handling made the access to capital for the initiative relatively smooth.

Financial Distributive Justice

The controversies regarding financial certainty have to do with the occasional high gas bills of the participants of the TEC. Sometimes residents call the directors of Thermo Bello to complain about their monthly gas costs. Usually, this is due to sub-optimal equipment at the house of the participant and the configuration of their set-up. Additionally, participants are sometimes unaware of certain agreements regarding for example the rent price for the heat station, the allocation of profits or the price set for the delivered heat.

Financial Struggles at the Participant Level Most controversies surrounding Financial Distributive Justice have been addressed without altering the formal assessment process. For instance, Thermo Bello faced liquidity issues that hindered its ability to pay bills. To manage this, they spread larger costs evenly throughout the year while structuring revenues on a monthly basis. Additionally, they borrowed almost the entire project investment from a bank, using their private capital only as a reserve to cover future financial shocks. The TEC's private capital was preserved for this purpose. Acquiring the investment was facilitated through the provision of a municipal guarantee and a development grant through the Regional Cooperation Program Eigen-Wijs Rivierenland. Moreover, when participants occasionally complained about high bills, management would personally visit their homes to optimize their technical setup. This usually resulted in significant energy savings. These examples reflect local community concerns that, while not leading to formal assessment changes, generated considerable media attention around financial uncertainty

Regulatory Challenges However, several controversies were not solvable internally by the TEC. These controversies came from the goal of Thermo Bello to set a relationship between Giga-Joule (GJ) Price and the cost for Standing Charge in the tariff structure so that customers experience a financial incentive to save energy which is also in line with government objectives to reduce energy consumption in existing buildings. However, the division of lease-independent (LOK) and supply-dependent costs (LAK) makes this impossible, as this system leads to a sharp increase in the standing charge. In addition, Thermo Bello assists customers with achieving energy savings, and would like to incorporate the costs it incurs during this process into the tariff. Unfortunately, this is prohibited because heat large companies are not supposed to provide such services. Both examples show that the regulatory system limits the space that Thermo Bello, as an integrally operating renewable energy company, needs to realize its energy-saving ambitions.

B.7.2. Energiek Nagele

Transparency

The value of transparency generated the most controversies in the Nagele heating project, stemming primarily from communication issues between the Technical Energy Cooperatives (TECs) and residents, as well as between the partner organization Mercatus and the TECs.

Inconsistent Communication The controversies arose mainly due to insufficient or incomplete information sharing. Many homeowners in Nagele felt they lacked adequate information at the project's outset, making it difficult to decide whether to participate. Although residents were generally enthusiastic, they wanted proof that the new heating system would be effective before committing. Additionally, the

partner organizations HoCoSto and Mercatus failed to communicate key aspects of the project clearly. HoCoSto did not adequately emphasize that the initiative involved the implementation of new, untested energy concepts, instead presenting the technical solution as a guaranteed fit rather than a technical experiment. Furthermore, the lack of clarity about the business case between the investing parties from the beginning was not communicated. Mercatus also admitted to failing to keep renters sufficiently informed about the project's progress, which led to a loss of trust when the project experienced delays.

To address the initial scepticism among Nagele residents, the project organizers arranged events to demonstrate the system's technical feasibility. These included open houses at properties already connected to the system, cooking workshops focused on induction cooking, and small-scale information sessions targeting a few households at a time.

Additionally, trust among citizens was damaged due to unclear information about the price that would be charged for heat. The TEC incorporated a not more than now principle. Meaning that they promised residents that their heat price would not exceed the natural gas price at the start of the project. However, some residents interpreted this as the heat price will never be more than the natural gas price at any given time. When the gas price dropped residents were left feeling deceived.

Quality of life

Changing the organisational structure For the second phase of the project, the citizens of Nagele agreed to include an independent technical project leader in the project group. This person would not only bring the necessary project management skills but also serve as a gatekeeper, ensuring the objectives and behaviors of both the client and the contractor are aligned. Additionally, this leader would be responsible for objectively communicating information about decisions and developments to the residents, ensuring transparency throughout the project.

Autonomy

In addition to technical challenges, the Nagele heating project faced significant bureaucratic and legal obstacles. Both project directors and citizens described the experience as Kafkaesque, particularly due to the lengthy decision-making processes resulting from numerous laws and regulations that hindered the TEC.

The project encountered a significant challenge when the municipality received €4.2 million from the government. Due to the large sum, they were required to start a public procurement process, which would have allowed other bidders to participate. This posed a problem for the project team, as they had already selected specific partners, including a unique heat storage system designer, and could not comply with the procurement rules without jeopardizing the project's integrity. To overcome this obstacle, the municipality provided an initial subsidy as an advance payment. This workaround allowed the project to move forward with the project while simultaneously solving the constraints of the procurement process. Over time, this subsidy route proved to be an effective solution that enabled the project to continue without regulatory hindrances. Another example of bureaucratic obstacles was the exclusion of Mercatus from the board of supervisors due to the strict rules imposed by the Housing Corporations Authority. This was a result of a public controversy which another housing corporation located Amsterdam was involved, tightening supervision in the whole sector. While participation by housing corporations in a council is not impossible, it requires extensive legal scrutiny, which would have been both time-consuming and costly. Fortunately, after multiple appeals, Mercatus was allowed to occupy a position in the board of supervisors.

Citizens experienced unsatisfactory results around autonomy on an individual level as they expressed they did not want to be bothered too much by the project both in terms of construction work and in terms of collaborative activities with the TEC. This controversy became most clear after the project was frozen. To mitigate this controversy the TEC wants to change to a collaborative model with the municipality.

Financial Distributive Justice This value includes the most negative arguments found in the informal trajectory of assessment. This is caused by the fact that Nagele has a low average income compared to other Dutch municipalities. Citizens do not have the ability to renovate their house, pay a premium for sustainable energy or pay for expensive grid connections.

To lower the cost as much as possible the Thermal Energy Cooperative (TEC) implemented a system using a unique over-roof heating network. This system involved placing thermal collectors on rooftops to generate heat, which was then transferred through 20-centimeter diameter pipes to a central buffer and back to the homes. The pipes were routed through the existing chimney flues from the old gas boilers, eliminating the need for extensive construction work. Installing the system required only minimal alterations inside the homes. The old gas boiler was replaced with a new delivery set within a day, and all existing heating and plumbing connections, such as those for radiators and showers, were easily transferred to the new system. This approach limited disruptions to just about a day and a half and required no personal investment from the residents, who typically have modest incomes. This strategy made the transition more accessible and less burdensome for the community.

However, new controversies around this value still occurred as the technical performance of the heating system was below expectations. This caused the participants to pay much more for their heat than promised at the start of the project due to the high cost of buying extra electricity. This was worsened by the geopolitical tensions in Ukraine, increasing the electricity price at a vulnerable time during the project. The cost increased further as HoCoSto went bankrupt. As this company was responsible for any reparation and maintenance costs, these now fell on the TEC.

A major issue around financial distributive justice was the application for SDE+ subsidies. These subsidies are property-bound and require a project surface of at least 200 square meters, a criterion that only one building in the project, the school, met. This created two main challenges: first, the limited number of eligible rooftops, and second, the need to complete administrative work and gain approval for each individual property, which proved impractical. These challenges led to feelings of inequality among residents, as large commercial solar farms are allowed be distributed across different areas in the Netherlands and still qualify under a single subsidy application. An expert supporting the project attributed these regulatory struggles to a rigid and bureaucratic mindset among Dutch officials that is not conducive to achieving the goals of the energy transition. The TEC still moved forward with the application as they argued that their project was similar to large wind farms, where energy generated across different parcels is collectively treated as one system. After nearly nine months, a supportive government official helped the TEC find a way to qualify for the subsidy, recognizing the project's innovative nature. During this process, it was claimed in multiple articles this struggle for subsidies creates distrust among citizens with the government as billions of subsidies go to large companies for solar and wind farms while small initiatives struggle to gain access.

B.7.3. Warm Heeg

Autonomy

A flexible institutional Framework Residents of Heeg have expressed many times the desire to be independent of the Dutch national government and private energy companies as they do not believe the intentions of those parties align with the values the community holds. Additionally, the project leader of Warm Heeg has complained that it is nearly impossible for the initiative to hold all balls in the air with the resources and capabilities such a small-scale initiative possesses. The struggle of holding all balls in the air was reduced by the support of the municipality. The initiative dealt with this by delaying the creations of a static organisation structure. Instead they chose to let the organisational structure develop and change during the project.

Additionally, the were willing to invest in a notary with experience in the field of cooperative heat initiatives. This notary delivered them a well thought organisational structure for each of the development stadiums. The municipality and state government have started a program called 'Missy Wetterwarmte' focused on accelerating collective heat projects in Friesland. The project emphasises the local culture and doing things in 'their own way'. This also helped convincing local municipalities in the necessity of the project as some political parties were not convinced of the need for the project. Additionally, the province of Friesland holds participation workshops in collaboration with the Dutch Platform Civil participations and Government policies. During this forum residents of the municipality had the opportunity to collectively answer the question 'How will the municipality of SudWest-Fryslan in the future generate its energy in a sustainable way?' The solutions proposed in this forum are directly used in the formulation of the regional energy strategy (RES). Finally, the TEC decided to pay the project group with a market salary instead of a volunteer's compensation as they deemed this to be unworthy of the complexity that came with the project.

Environmentalism

Concerns about the Heegemer Mar The controversy identified relates to the change the heating system will cause in the ecosystem of the lake it is connected to. A professor of the university of Wageningen cited in one of the news article: 'As a result of the drop in temperature, photosynthetic activity decreases, algae grow at a slower rate and other fish species enter the water. What is certain is that a thermal shock will occur.' This concern for the environment is expressed sporadically in the informal trajectory but not reported upon by the project group or municipality.

Financial Justice

Insufficient Funding One of the central controversies in TEC projects lies in the economic viability of the proposed technologies. The connection between thermal energy prices and gas prices created a significant barrier to the widespread adoption of the system by citizens. As a result, the TEC had to explore alternative sources of revenue or cost reduction to achieve economic feasibility. Another significant controversy was the difficulty in securing funding. The Warm Heeg project faced initial setbacks when its attempt to obtain government support was declined, which threatened the project's progress and eroded community trust. The administrative burden associated with securing subsidies further complicated the process, with the project team noting that the effort required often outweighed the benefits received.

In order to overcome these challenges, the Warm Heeg TEC exhibited adaptive learning behaviours

by seeking and utilising municipal support. The municipality was instrumental on two key occasions. Firstly, the municipality provided invaluable assistance in the form of work and resource support, which proved to be instrumental in the successful application for PAW funding. Secondly, when the TEC subsequently sought financial backing from a banking institution, the municipality's offer to provide a guarantee constituted a pivotal incentive, ultimately influencing the bank's decision to invest. This strategic partnership with the municipality demonstrates the value of cultivating robust relationships with local governments as a means of surmounting financial obstacles.

Additionally, the TEC notes that the ISDE subsidy, while beneficial in theory, posed another challenge due to its lack of compatibility with the specific needs of monumental dwellings. This mismatch presented a significant bottleneck that only national government intervention could effectively resolve. In response, the TEC identified that individual support, coupled with a deep understanding of technical possibilities, could serve as a preliminary solution.

Trust & Community sense

Increasing Participation Initial attempts to reach the 75% participation rate required to move on with the project were not achieved. This was a result of the cautious attitude most people in Heeg have when it comes to innovation and making changes in their daily lives. The TEC countered this challenge by using a 1-on-1 approach when it came to inviting citizens to information meetings and decision-making processes. During the development of the project, the TEC has worked with multiple market parties. What made it difficult to trust these parties is that their calculations and estimations of the technical and economical efficiency differ significantly. Leaving the TEC guessing what they could expect and if the market partners are honest with them. Additionally, the local government of the province did not see the benefit of a local energy company initially and was hesitant about whether the citizens were protected enough against the risk of the project. Third, many databases contain outdated and false data regarding for example local heat demand, and the energy efficiency of houses, making it difficult to project the financials of the project. Finally, the many laws and regulations the small initiatives have to deal with slow down the project and create distrust among citizens as they do not believe the parties that should help them want them to succeed.

To involve the community and include the required share of citizens to move on with the project several initiatives were taken. These initiatives include free property heat scans to determine the energy efficiency of properties. Cooking workshops for cooking with induction and open houses for people to come to visit pilot houses that were connected to the heat grid. Additionally, the direction of Warm Heeg gave free personal energy advice to over 200 citizens of Heeg. Another initiative consisted of the establishment of two promotion teams that were focused on increasing the participation rate amongst citizens. These promotion two focus groups were divided between property renters and owners because both have different incentives and barriers to joining the initiative. These promotion teams mostly took a personal approach and made appointments with households individually.

C

Appendix C

This appendix covers the interview protocol set-up for the interviews. Note that the interviews were semi-structured, therefore the exact transcription might differ slightly from this format. Additionally, the interviews were all held in Dutch. Additionally, the key findings from each interview are presented. Should you wish to access the interview transcripts or the consent forms, please reach out to either the principal investigator of this thesis, Thijmen van den Ouweelen, or the first supervisor, Dr. BinBin Pearce.

C.1. Interviewees

The interviewees selected for this thesis are or were all part of the project group of the TEC in the selected cases. As these individuals were involved in all stages and activities they have contributed valuable insights to the findings, correcting and complementing the results from the analyses. For confidentiality reasons, names and exact job titles are not mentioned to preserve anonymity.

C.2. Introduction

The interview began with an introduction of the interviewer and the reason for the research:

Hello, my name is Thijmen and I am currently working on the graduation project of my studies in Complex System Engineering & Management. I want to start with thanking you for filling in the consent form and your participation in my research. As explained in the e-mail I sent you <insert date>, I am doing research into the development of TECs with complete ownership and control of their DH system, this is what lead me to <insert TEC name>. I am interested in the relation between the relationship between values held by the community and controversies that arise during the development of TECs and how the TEC adapts to this through altering its governance approach or through the deployment of other strategies.

I would like to emphasise that this thesis is voluntary and that you are allowed to withtract answers or refuse to answer questions at any given time. I would like to start with discussing the values and challenges I identified in the case of <insert case name>, followed by a discussion on how I saw these

controversies as being overcome and whether the mitigation measures were deemed satisfactory. Additionally, I am open to any additions to my findings or corrections of possible misinterpretations. Let's start.

C.3. Exogenous Variables, Values, Overflowing & Backflowing

The interview started with the researcher listing and describing the values of the respective case as described in Appendix B. This gave the interviewee the opportunity to ask clarifying questions object or add to this list.

This was followed by listing the value controversies leading to cases of overflowing identified in the case and why the researcher believed they emerged. Additionally, the exogenous variables observed as to impact the decision-making processes were presented. Again the interviewee was given the opportunity to object or add to the insights and findings the researcher derived from the cases. Immediately after each case of overflowing the interviewer made a link, if the case, to occasions of backflowing through either single- or double-loop learning. These cases of overflowing and backflowing are all completely written out per case and connected to the associated value in Appendix B for referral.

C.4. Summary Key Findings Interview Thermo Bello (Interviewee #1)

C.4.1. Exogenous Variables

- The level of education is especially important for the development of TEC, as it increases the ability of the community to deal with problems of a high degree of complexity, as well as makes relevant expertise accessible. The interviewee referred here to project managers, engineers, and lawyers.
- Diversity in education and expertise is highly beneficial for the project.

C.4.2. Values

- The interviewee stated *Community Sense* as the most important driver for the project. More important than *Autonomy* as this refers more to the individual.
- The projects started with a couple of residents, who were interested in sustainability and started the conversation with their neighbours.

C.4.3. Overflowing & Backflowing

- Unlike what was found in the media, the municipality did not play a role in the development of the TEC. The interviewee emphasises this and expresses frustration with this lack of support.
- Important for overcoming challenges were the open information evenings where everyone could join the conversation. These were held weekly.

- The TEC focused on mitigating resistance early in the project, which minimised controversies that came up from residents later. This was done purposefully. In addition, decisions had to be made unanimously.
- Acquiring financing was difficult as not all the subsidies they hoped for were granted, this forced the TEC to look for a commercial partner for funding, and this was successful
- Technical controversies were limited due to the almost ready state of the DH system.
- The project group of Thermo Bello even approached the Ministry of EAC for softening regulatory requirements for them, but their appeal was discarded. The Ministry deemed Thermo Bello an anomaly and did not share its vision.
- A big challenge for the TEC not identified in the literature was the ability to convince others of the viability of their vision. This was due to the fact that Thermo Bello was the first TEC in the Netherlands, therefore the concept of a TEC was difficult to imagine for many of their stakeholders.
- The ability to think in solutions rather than protocols at the Municipality can be a great success factor for the project. If the Municipality is not able to let the project roll-out spontaneously, they are of little use to the TEC.
- To mitigate controversies later in the project, always aim for 100% ownership as you can always get rid of it if it does not work out but you can never get it back once you give it away.
- Learning happens through trial and error. Sometimes you have to repeat the same strategy multiple times before it works. This requires a lot of persistence and endurance from all involved participants.
- Regulatory burdens that are aimed for controlling large energy corporations limited the development of Thermo Bello, making it seemingly impossible sometimes.
- TECs need a different organisation as a partner than municipalities. There are according to him only limited municipalities with the resources to support TECs. This group mostly consists of city municipalities.

C.5. Summary Key Findings Interview Energiek Nagele (Interviewee #2)

C.5.1. Exogenous Variables

- Nagele being Cultural heritage made making modifications to the built environment difficult
- Rental corporation Mercatus was a loyal stakeholder all the way through the project.
- The population had a highly critical stance towards the initiative
- The project was meant as a gift towards the population, taking away the fear of energy poverty
- A lot of residents of Nagele are earning the legal minimum wage in the Netherlands making them weary of potential changes in heat (and energy) costs.

- Some people and the rental corporation were financially able to renovate their house creating a split between them in terms of heat demand and the residents who were not able to do this.
- There was a strong difference in community sense between the residents who participated in the project and the residents who were involved in other local initiatives.
- District Heating has a bad name among residents due to the many 'negative' stories of other projects.

C.5.2. Values

- A strong driver for the project was putting Nagele back on the map again as a pioneer in the Netherlands.
- The project started from a contest where Nagele won as the best proposal for a sustainability initiative. Immediately after the PAW came and wanted to facilitate financing

C.5.3. Overflowing & Backflowing

- Simple tasks such as getting insurance were described by the interviewee as being "one hell of a job" almost exceeding the benefits of receiving them in terms of work. Eventually, this was realised as the insurance company wanted to make exemptions for the TEC.
- The degree of technical complexity was higher than expected and caused many controversies due to poor performances.
- The TEC approached the municipality to participate in the project as a shareholder, taking over the responsibilities for the backbone of the system. However, they have expressed that the project does not necessarily appeal to them due to the many controversies around the development of the project.
- Energiek Nagele does not believe they will become financially feasible however they will try nonetheless.
- Nagele currently has 3 mln of the PAW subsidies left to allocate to the project until 2028.
- The project has completely frozen and the communication with the population has disappeared.
- The TEC communicated twice per year with the community.
- Many residents expressed the desire to be left alone during the project, while agreeing with its existence they did not want to be involved.
- All activities and developments in Nagele are experienced as taking very long although most of the time people want them to happen.
- Residents hold the TEC project group accountable for the unsatisfactory results and want to see more progression.

C.6. Summary Key Findings Interview Warm Heeg (Interviewee #3)

C.6.1. Exogenous Variables

- Interviewee Indicates a large gap in terms of motivation and enthusiasm between a small group of early adopters and the rest of the residents.
- It is important to prevent people from starting the project group when they are driven by their ego or status. The interviewee has experience with these types in other projects and this always leads to friction and challenges.
- The community was highly heterogeneous on all fronts due to the many residents of Heeg (>2000).
- The interviewee disagrees with the status of the villages of Friesland as being adept at setting up local initiatives due to their experience with the Mienskip. As this only is true for a small part of the population.
- The municipality had an inconsistent role, this was partially due to the fast churn rate.

C.6.2. Values

- Most important value is Autonomy, as it drove the project to where it is today.
- Autonomy feeds on trust according to the interviewee. The project group was allowed to continue working as individuals were willing to sign a contract without reading it or knowing what would happen as they trusted the people in the project group.
- People in Heeg reacted strongly to a foreseeable future where they would be dependent on Russian Natural Gas. This further enhanced the desire to be autonomous in energy supply.

C.6.3. Overflowing & Backflowing

- The focus from the start was on building trust, not on advancing the project to the next stage. This has paid dividends according to the interviewee. You should focus on creating a story that is understandable and inspirational for everyone and at the same time does not push individuals away form the project.
- Winning residents for the cause of Warm Heeg had a strong social component as many people were convinced by their neighbours or family.
- Some solutions for the encountered challenges are not rationally explainable. They have a more emotional or social. This is an important dimension to such projects.
- Reaching everyone is impossible, nonetheless, you have to keep trying. Also, you have to be creative as some people are motivated by the technical or financial aspects of the project, others by the social aspects. This asks for creating different narratives as well as opening multiple communication channels.
- During the project you have to make weekly or bi-weekly communication a priority, otherwise people forget about you. In this communication, you need to focus on keeping the news interesting

without lying or becoming annoying.