Co-Creation for Sustainable Energy Transition

A Case Study of Local Energy Cooperatives in the Metropolitan Region Rotterdam The Hague

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Thesis report

by

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to obtain the degree of Master of Science
at the Delft University of Technology
to be defended publicly on March 1, 2024 at 11:00

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Project Duration:	September 2023 - March 2024
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An electronic version of this thesis is available at http://repository.tudelft.nl/.

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Faculty of Technology, Policy and Management Delft University of Technology

Preface

Dear reader,

Last summer, during my final year in the master's programme Complex Systems Engineering and Management, I started thinking about my graduation project. I wanted to do something fun and meaningful, hoping to use my acquired knowledge to make a small contribution to the fight against global warming. Then I came across the concept of local energy cooperatives in the Netherlands, a topic that immediately sparked my interest and enthusiasm. I drafted a research proposal and participated in several interviews and workshops, including a workshop on self-adhesive window film application.

Now, six months later, I am happy to share with you my graduation project at TU Delft: my master's thesis entitled 'Co-creation for Sustainable Energy Transition: A Case Study of Local Energy Cooperatives in the Metropolitan Region Rotterdam The Hague'. I am grateful for the support and inspiration I received from some people, and I would like to take this opportunity to thank them.

First of all, I would like to express my gratitude to my supervisors, BinBin Pearce and Udo Pesch. They initiated the topic of this project and provided me with continuous support, insightful feedback and valuable knowledge. Their availability and guidance, especially when I needed a fresh perspective or to re-evaluate my research questions, were very valuable.

Moreover, I would like to thank everyone who participated in my research. Their willingness to share their time, expertise and experiences through interviews, meetings and workshops made my thesis possible and the whole process enjoyable. I appreciate their passion for local energy initiatives and their collective efforts to combat global warming. Sharing my results with them is just a small gesture to give something back and hopefully an opportunity to contribute a little bit to their work.

Special thanks also go to my family for their support during my studies in Delft. From attending the first parents' day at TPM to their presence at the presentation of this project, their encouragement always motivated me.

Finally, I would like to thank my friends - your interest in my research, your advice and your support have not only made my research better, but you have also made my student life unforgettable. I am happy for our friendships and all the fun times we have had and will have.

F. Meijer
Amsterdam, February 2024

Executive Summary

The irreversible effects of climate change have led to a significant increase in citizen-led and initiated local energy cooperatives. Playing a crucial role in the shift to renewable energy, these cooperatives are evolving from informal community groups to structured organisations. Their success relies on co-creation, a collaborative process in which stakeholders and citizens join forces to improve efficient decision-making, build trust and promote shared responsibility. This leads to creating effective solutions and achieving collective goals across projects and sectors.

This thesis examines the role of co-creation in local energy cooperatives and highlights its importance in promoting sustainable energy practices and empowering citizens. It focuses on investigating co-creation within the energy cooperatives of the Metropolitan Region Rotterdam The Hague (MRDH) and connects theoretical concepts with practical applications in energy transition. The central research question is:

"In what ways does co-creation manifest within local energy cooperatives in the Metropolitan Region Rotterdam The Hague?"

To understand the academic perspectives of co-creation, especially in energy transition, a literature review was conducted using the PRISMA method and snowball technique. This helped identify the scope of the thesis and gaps in current academic knowledge. The thesis contains two theoretical frameworks. The first, from Puerari et al. (2018), examines the dynamics of co-creation in local communities and identifies five key elements: intended purpose, process type, ownership, motivations and incentives, and spaces and places. This research applied these elements to understand co-creation in MRDH's local energy cooperatives through qualitative case study analysis. The analysis reveals the cooperatives' commitment to fossil-free energy and their encouragement of citizen participation through a mix of formal and informal methods, addressing different motivations and adopting a shared ownership model to promote community involvement.

The second framework consists of six criteria that define co-creation activities. These criteria are developed in this study, and derived from academic literature. These criteria include shared goals, active participation, equality and inclusiveness, iterative processes, value creation and mutual learning. Subsequently, the study used these criteria to evaluate the activities of energy cooperatives and assess their alignment with the concept of co-creation. Through interviews and observations, four key cooperative activities were identified: advisory services, information generation, renewable energy production and stakeholder engagement. While these activities meet the criteria for co-creation, there are opportunities for improvement in almost all areas of co-creation to fully realise the potential of these activities.

The findings suggest that cooperatives should organise regular stakeholder discussions, introduce paid functions, make more effective use of physical spaces, promote diversity and develop digital platforms for knowledge sharing. Policymakers can support these cooperatives by recognising their contributions, encouraging professional development and encouraging flexibility and innovation. Future research recommendations address the limitations of this study such as regional focus, time constraints and possible subjectivity of the qualitative method. Suggestions include expanding the geographical scope, involving a wider range of stakeholders, using mixed methods and testing the recommended strategies in different contexts.

In summary, this research is an important step in understanding the manifestation of co-creation within local energy cooperatives. It suggests strategies through which these cooperatives, in collaboration with policymakers, can effectively contribute to environmental sustainability and climate change mitigation.

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Introduction

1.1. Boosting climate action through co-creation on local energy co-operatives

The growing urgency to tackle climate change is undeniable, especially in light of the terrifying consequences of a global temperature rise of 1.1 degrees Celsius. These consequences include loss of ice mass and rising sea levels, as reported by the EKZ (2023) and IPCC (2023). To address these challenges, the Netherlands has begun an ambitious journey to achieve zero greenhouse gas emissions by 2050, with a further goal of moving to negative emissions thereafter (Yesilgöz-Zegerius, 2023). A crucial part of this national strategy is the promotion of renewable energy and support for local-level energy initiatives (Klimaatstichting HIER, 2023b; RVO, 2023).

1.1.1. The rise of local energy cooperatives

These local initiatives have manifested themselves in the form of local energy cooperatives, unique organisations set up and driven by residents with a strong commitment to environmental management (Klimaatstichting HIER, 2023c). Characterised by their collective action and strong local commitment, these cooperatives are crucial in moving communities towards a sustainable energy future (Hufen & Koppenjan, 2015; Van Der Schoor & Scholtens, 2015). They go beyond simply generating renewable energy and include broader initiatives such as energy conservation and sustainable housing (European Commission, n.d.). The success of these cooperatives is largely due to the dedication and expertise of volunteers, who play an important role in driving sustainable energy practices within their communities (Binnenlands Bestuur, 2023).

The cooperatives have experienced significant growth across the country, reaching 705 active entities by 2022, as shown in Figure 1.1. Despite a slowdown in growth, there has still been a remarkable 8% increase in participation since 2021, indicating continued involvement and commitment (Klimaatstichting HIER, 2023a). The Metropolitan Region Rotterdam The Hague (MRDH), with its 2.4 million inhabitants, reflects this national trend (Energie Samen and Klimaatstichting HIER, 2023). As a major player in the Dutch economy, the MRDH is seeing a growing number of local energy groups, each addressing unique regional challenges and contributing to the transition to sustainable energy (MRDH, n.d.-b). These groups demonstrate the region's commitment to sustainability and innovation and position the MRDH as an ideal testing ground for advanced green technologies and smarter energy solutions (MRDH, 2023)

1.1.2. The role of co-creation in local initiatives

The success of these cooperatives depends on the principle of co-creation, a process that improves collaboration, engagement and empowerment among stakeholders (Puerari et al., 2018). It enables different stakeholders to develop solutions and achieve shared goals (de Koning et al., 2016; Ramaswamy & Ozcan, 2018; Ryszawska et al., 2021). This involvement covers the whole process, from problem identification to implementation and evaluation of solutions (Ophof, 2013; Sanders & Stappers, 2008; Vargas et al., 2022). In this way, co-creation promotes not only sustainable results but also organisational development, teamwork and positive community dynamics (Arnold, 2017; Elkjær & Horst, 2023).

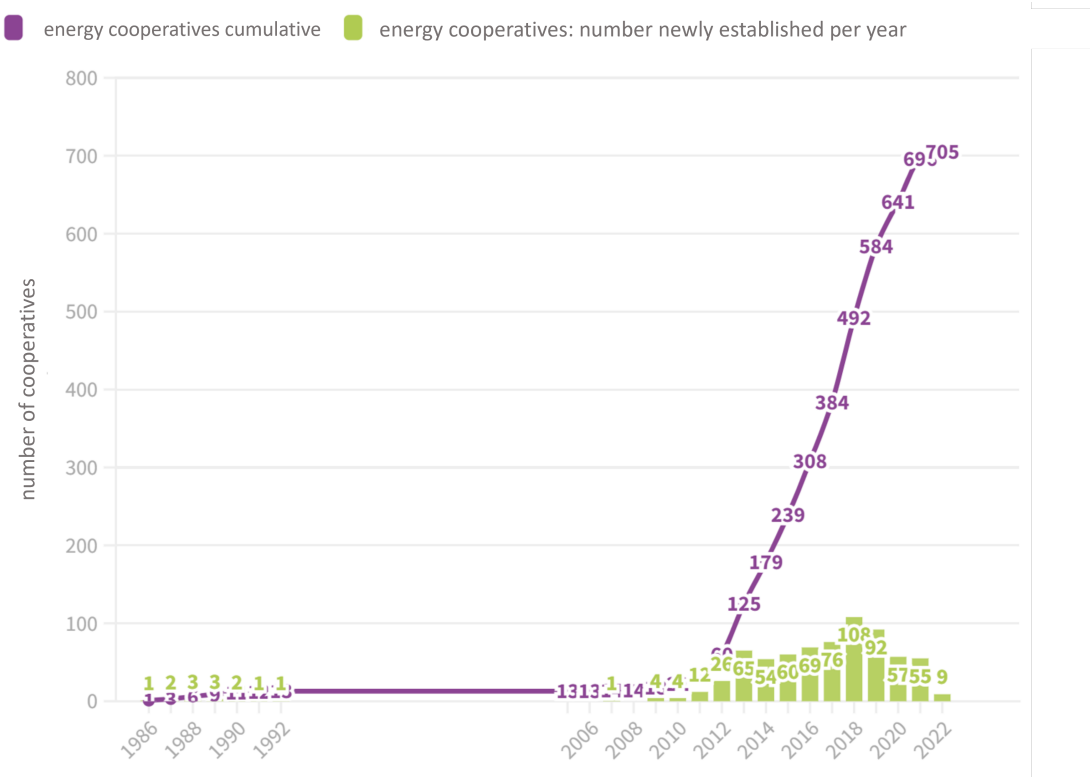

Figure 1.1: Local Energy Monitor 2023 (Klimaatstichting HIER, 2023a)

Examples of co-creation in local initiatives include HIER's co-creation sessions with energy cooperatives, which address the common stories and shared experiences of these groups (Klimaatstichting HIER, 2017), and the innovative development of energy gardens. These gardens are unique spaces where renewable energy generation is integrated with nature conservation, landscape aesthetics, recreational activities and educational opportunities (Van der Plas, 2019).

Another example of co-creation is the planning of a solar park in the municipality of Roosendaal. Here, project developers like Infinergy and Tomorrow Energy adopted co-creation principles in the design phase of the project to align it with local landscape preferences. To achieve this, they conducted a series of webinars, creating a platform for stakeholder engagement. This approach involved not only residents but also municipal authorities and various professional organisations so that a broad spectrum of perspectives and preferences were included in the project development (Infinergy & Energy, 2020).

In addition, the six-step co-creation model by Kennisland and What Design Can Do is a good example of stimulating participation in integrating renewable energy solutions into community planning. This model is shown in Figure 1.2 and provides interesting insights for municipalities to improve local participation in sustainable initiatives (Kennisland, 2023).

1.1.3. Problem statement

The current trend of using co-creation in local initiatives shows a significant gap between theoretical models of co-creation and its practical application in local energy cooperatives. Although these initiatives emphasise the principles of co-creation in terms of equal participation and joint decision-making, there is a predominant model in which municipal authorities or higher-level organisations are in charge, making residents implementers rather than true initiators. This approach contrasts with the definition of co-creation proposed by Voorberg et al. (2015), in which the push for action should ideally come from citizens themselves.

Figure 1.2: Six lessons on co-creation in energy transition (Kennisland, 2023)

Since local energy cooperatives are established by residents with a strong commitment to environmental management and the initiative does not come from higher up, the concept of energy cooperatives is in line with the fundamental concept of co-creation. Therefore, the process of co-creation, in which different stakeholders work together to develop solutions and achieve common goals, is particularly relevant in the context of local energy cooperatives. This approach is likely to produce more community-based and sustainable energy solutions, and therefore a better understanding and refinement of co-creative practices within local energy cooperatives is important. Such an approach can significantly improve their effectiveness in achieving environmental goals, contribute to climate change mitigation and provide valuable insights for the development of future renewable energy policies and practices.

1.2. Research objectives and questions

This section presents the research objectives and questions aimed at analysing co-creation practices within local energy cooperatives in the Metropolitan Region Rotterdam The Hague.

1.2.1. Research objectives

The primary objective of this research is to critically analyse and understand co-creation in the context of local energy cooperatives in the MRDH. Specific objectives of this research include:

1. **Theoretical and practical analysis of co-creation:** The first research goal focuses on understanding both the theoretical foundations and practical implementations of co-creation in the context of energy transition. The aim is to analyse the conceptual frameworks that define co-creation and examine how these concepts are applied in practice. By examining the Dutch context, the study tries to provide insight into how local communities apply co-creation to address the challenges of the energy transition, thus providing a comprehensive understanding of the balance between theory and practice in this field.
2. **Citizen roles in local energy cooperatives:** Furthermore, the research explores how citizens are involved in local energy communities, focusing on their roles as co-designers and initiators. The aim is to reveal the dynamics of citizen participation and assess how their involvement shapes and influences the development and implementation of energy projects. By examining these roles, the study also tries to highlight the different drivers for citizens to contribute to energy initiatives.
3. **Evaluating the sustainability effects of co-creation:** The last objective is to evaluate the effectiveness of co-creation processes in local energy communities, particularly in their ability to achieve sustainable energy goals. It includes identifying and analysing the challenges encountered during the co-creation process and proposing strategies that lead to successful implementation.

1.2.2. Research questions

The main research question and the four sub-questions form a coherent and interconnected framework for this research on co-creation in local energy cooperatives in the MRDH. Each question is designed to build on the insights gained from the previous question. Together, these questions contribute to an overall understanding of co-creation in MRDH's local energy cooperatives.

Main research question

The main research question defines the scope of the research. The aim is to investigate the application of co-creation specifically in MRDH's local energy cooperatives, within the broader framework of energy transition. It uses the insights gained from theoretical understanding, practical implementation and evaluation of co-creation activities to provide a detailed picture of how co-creation concepts are applied in the context of energy cooperatives. furthermore, it addresses the role of citizens and the impact of these practices on sustainability, thereby meeting the main objectives of the study. The central research question is as follows:

"In what ways does co-creation manifest within local energy cooperatives in the Metropolitan Region Rotterdam The Hague?"

The question is broad and needs to be broken down into more specific aspects to be effectively addressed.

Sub-question 1

The first research question forms the basis of the study and lays a theoretical foundation by exploring how academics conceptualise co-creation:

1. *"How is co-creation conceptualised in the academic literature within the context of energy transition?"*

This question examines different academic perspectives, theoretical frameworks and models that support the understanding of co-creation principles within the context of energy transition. It aims to define co-creation and distinguish it from related concepts such as co-production or co-design by reviewing the academic literature. This question also refers to applications in different sectors and gaps in the academic literature related to co-creation and contributes to the first research goal of theoretical analysis of co-creation.

Sub-question 2

Building on the theoretical foundation, the second research question examines how these theoretical concepts of co-creation are practically applied within local energy cooperatives in the MRDH:

2. *"How does co-creation take place in practice within local energy cooperatives in the MRDH, and how does it relate to the local context?"*

The question looks at how co-creation is put into practice, focusing on the methods and strategies used by these cooperatives. The question contributes to the first and second research objectives, by offering insights into how theoretical concepts are operationalised into practical applications and how citizens participate as co-designers and initiators. The question also emphasises understanding the relationship between these co-creation practices and the local context of the MRDH. This includes looking at how regional characteristics influence the approach and effectiveness of co-creation in these cooperatives. The research uses semi-structured interviews and direct observations as research methods to answer this question.

Sub-question 3

The third research question further narrows the focus to specific activities:

3. *"What are the current activities of local energy cooperatives in the MRDH?"*

It aims to identify and analyse the various activities currently being undertaken within local energy communities in the MRDH by conducting the same semi-structured interviews and direct observations. This provides practical examples of the actions undertaken by local energy communities, referring to the first and second research objectives.

Sub-question 4

The information from the previous sub-question on the specific activities is important for the follow-up question on the extent to which these activities align with co-creation, which is the primary focus of the following research question:

4. *"To what extent do the activities within local energy cooperatives in the MRDH align with co-creation and what are the opportunities to improve these activities?"*

This sub-question aims to critically evaluate the extent to which the activities of local energy cooperatives in the MRDH correspond to co-creation principles and practices. It includes a thorough examination of the cooperatives' efforts to determine how well they align with the concepts of collaboration and creation. In addition, the question assesses the impact of co-creation on sustainability and identifies both challenges and effective strategies for implementation, in line with the third research objective. This evaluation aims to contribute to the broader objective of facilitating energy transition in the region.

In conclusion, this research is designed to provide a broad exploration of co-creation within local energy cooperatives in the MRDH. The strategic formulation of research questions creates an interconnected framework, creating a logical sequence that starts with understanding academic conceptualisations of co-creation within the context of the energy transition, moves to examine co-creation in local energy cooperatives, assesses the co-creation principles and ends with identifying challenges and opportunities.

1.3. Research relevance

This master's thesis examines co-creation processes within energy transition studies, addressing both academic and societal gaps. The research reveals a lack of theoretical foundations in the existing literature and aligns with the Dutch' ambitious climate goals. In addition, it aligns with the core principles of the MSc. Complex Systems Engineering and Management (CoSEM) at Delft University of Technology, which links social and technical aspects of energy systems.

1.3.1. Academic relevance

The academic relevance of this master's thesis lies in addressing critical knowledge gaps identified in the existing literature on co-creation, particularly in the context of energy transitions and local energy cooperatives. These gaps include challenges in co-creation processes, scarcity of detailed evaluations and the specific impact and role of local energy cooperatives. Moreover, the research goes beyond a theoretical understanding of co-creation in the energy sector and provides valuable perspectives for practitioners and policymakers concerned with renewable energy. Hence, this thesis has significant academic value and thus fills existing gaps in academic research.

1.3.2. Societal relevance

This research aims to understand the motivations behind individual involvement in local energy communities, assess how these initiatives reflect the core of co-creation, and identify obstacles to successful implementation. In this way, the research supports the Dutch government's ambition to reduce greenhouse gas emissions to zero by 2050, emphasises the social importance of co-creation in the energy transition and highlights the central role of local energy cooperatives in the MRDH.

Moreover, the study's findings are shared among participating local energy cooperatives. Interviewees are informed about the research conclusions and recommendations for improvements via e-mail. They are invited to continue the dialogue and discuss these topics further, with the suggestion to share any latest insights that their cooperatives can benefit from. Although participation in this follow-up is voluntary, it is seen as potentially beneficial to their cooperatives.

1.3.3. Revelance to CoSEM

Finally, the thesis is closely linked to the core principles of the CoSEM programme at TU Delft, which focuses on addressing complex socio-technical challenges. The structure and findings reflect the CoSEM curriculum's focus on merging technical, institutional, economic and social components. This thesis examines renewable energy systems, taking into account the technical challenges and exploring the impact of social initiatives on technological solutions. It looks at institutional dynamics, such as regulations, cooperation with local governments and subsidy frameworks. Economically, it examines the financial feasibility and impact of launching new solar or renewable heat projects within local energy cooperatives. Socially, it analyses the interactions between local energy cooperatives, residents, municipalities, energy companies and other external stakeholders.

By examining these multiple interactions, the thesis sums up the essence of complexity, a central theme in CoSEM. The research takes a critical look at the complex interaction between these elements within energy systems and shows the small differences in co-creation practices and their impact on sustainable progress. In addition, the research offers valuable insights into how social initiatives shape the technical aspects of energy systems.

1.4. Report structure

This section outlines the structure of the thesis and guides the reader through the report from theoretical foundations to practical findings and conclusions.

Chapter 2 begins with a literature review, analysing how co-creation is academically presented in the context of energy transition. It identifies the existing gap in academic knowledge and introduces the theoretical frameworks that ground the research. Chapter 3 describes the qualitative research methodology used in the study, including the literature review strategy, case selection, data collection techniques, analytical methods and ethical considerations.

The following three chapters present the main findings of the study, each concluding with main takeaways. Chapter 4 focuses on the local context of energy cooperatives in the MRDH, while Chapter 5 examines the different activities of these cooperatives. Chapter 6 then explores the co-creation dynamics within these cooperatives, applying the theoretical frameworks from Chapter 2 to assess the alignment of cooperative activities with co-creation.

Chapter 7 and Chapter 8 conclude the thesis by discussing the research findings and drawing conclusions. The appendices contain additional material important for understanding the research methodology and findings. These include interview protocols (Appendix A), observation protocols (Appendix B) and details on the literature methodology (Appendix C) and the coding phase of the data analysis (Appendix D).

2

Literature Review

This chapter presents an in-depth exploration of the academic literature on co-creation, focusing on its role within local energy communities. It begins with an in-depth analysis of local energy cooperatives and the concept of co-creation. The chapter then identifies existing gaps in academic research and concludes with the theoretical frameworks used in this study.

2.1. Local energy cooperatives

This section examines the historical development and impact of local energy cooperatives in the Netherlands. Drawing on several case studies and academic literature, the chapter presents the transition from small, volunteer-driven groups to formal entities and concludes with a general definition of local energy cooperatives.

2.1.1. Historical development and impact

The development of local energy cooperatives in the Netherlands, as described by Hufen and Koppenjan (2015), goes back to the 1980s when the focus was mainly on wind energy. These cooperatives initially involved university researchers and engineers. This changed when environmental groups and local citizens also started forming wind cooperatives and experimenting with new energy technologies. Following this story, Van Der Schoor and Scholtens (2015) noted that between 2010 and 2013, while local community energy initiatives were still in their early stages, many different types of organisational structures and approaches had already been developed. Key to their evolution was the formation of local organisations united by shared visions and tangible goals.

In line with this perspective, Bauwens et al. (2016) stresses the importance of self-organisation and citizen participation in promoting resilient and equitable energy institutions. They warn against the imposition of rules by dominant groups without community consent, as these often do not serve the public interest. Derived from two case studies focused on empowering citizens to reduce energy consumption, Preston et al. (2020) also emphasises the significance of citizen participation. They suggest that project managers should maintain a consistent commitment to engaging citizens throughout every project phase, rather than viewing engagement as a separate component. Hasanov and Zuidema (2018) agree that, while the local focus may raise questions about the wider impact, these small initiatives can stimulate important innovation and help in the transition to a low-carbon economy.

An example of how a sustainable community is shaped and what are critical considerations in organising this, is the research on smart neighbourhoods in the Centocello district in Rome, Italy, by Cappellaro et al. (2019). They argue that the key to the success of these communities lies in developing strong community involvement. This engagement is most effective when it focuses on issues that arise naturally within the community itself, rather than trying to motivate individuals to engage on issues imposed from outside.

In addition, Young and Brans (2020) conducted a case study in Krk, Croatia, which aims to produce 100% renewable energy locally by 2030. In contrast to the dynamics observed at the national level, the community of Krk showed early and ambitious efforts for the energy transition. The key factors contributing to this success were a strong sense of community among Krk residents, shared interests, a common understanding of local problem-solving solutions, political stability and coordinated political action across the spectrum.

Wierling et al. (2018) link the growth of cooperatives to supportive government policies and suggests that policy changes may threaten their role. However, cooperatives are adapting by investing more and attracting more members to ensure financial stability. The community of renewable energy cooperatives has thus grown, arguably dissatisfied in response to policy developments in domestic energy markets (Hoppe & de Vries, 2019).

Over time, local energy cooperatives have broadened their horizons and now include various renewable energy sources and energy efficiency measures. They share a common underlying philosophy but also have their unique approach to implementation (Hufen & Koppenjan, 2015). They are becoming increasingly important, characterised by their participatory and inclusive approach. Their role in the low-carbon transition highlights a shift towards more engaged and sustainable communities. Therefore, understanding the potential of these cooperatives is crucial for progress towards a sustainable future.

2.1.2. Defining local energy cooperatives

In the work of Charbonnier et al. (2023), renewable energy communities are highlighted as one of seven key players in today's local energy markets. These players include energy suppliers responsible for managing the flow of energy, grid operators responsible for maintaining system balance and reliability, and regulators who set the policy framework for the sector. In addition, active participants, such as those who generate and manage energy through solar panels and smart meters, and passive participants, who are mainly energy consumers, play an important role. The list also includes coordinators, who oversee data and financial transactions, and communities made up of citizens and renewable energy groups, who are important in driving market development through their social and financial involvement.

Hoppe and de Vries (2019) further highlights the importance of community energy as a platform for social innovation, central to the transition to low-carbon energy solutions and citizen empowerment. The concept of communal energy is defined in the study by Ambole et al. (2019), in line with the UK Department of Energy and Climate Change. This definition includes initiatives or projects that focus mainly on four key dimensions: reducing energy consumption, improving energy management, producing energy and obtaining energy. These initiatives may involve physical communities or groups united by shared interests in energy-related matters.

The specific characteristics of local energy cooperatives are described by Hufen and Koppenjan (2015). According to them, the cooperatives are established by members of the local community, united by a shared commitment to renewable energy, collaborate with other local stakeholders and often transform from volunteer-driven movements into formal entities with cooperative structures. Hufen and Koppenjan (2015) argue that all cooperatives' members share a strong commitment to energy conservation and renewable energy.

As Bauwens et al. (2016) point out, community energy projects, organised formally or informally by citizens, play a crucial role in advocating for sustainable energy technologies at the local level. They are increasingly recognised for their important contribution to the transition to low-carbon energy systems. In addition, unlike traditional businesses, cooperatives are often owned by their members or consumers rather than external investors and profits are usually allocated proportionately to the members' transactional activity with the cooperative, rather than the size of their investment. Bauwens et al. (2016) highlight that this structure is consistent with Ostrom's emphasis on self-organisation and citizen involvement, which is closely aligned with the participatory and inclusive nature of renewable energy cooperatives.

Local energy cooperatives, as defined in this study, refer to community-driven organisations, committed to sustainable energy practices. They often evolve from volunteer-based groups into formal legal entities and focus on reducing energy consumption, improving energy management and producing and sourcing renewable energy.

2.2. Defining co-creation

Although co-creation has become a commonly used term in our everyday language (de Koning et al., 2016) and a popular buzzword with the potential for multiple positive outcomes (Puerari et al., 2018; Voorberg et al., 2015), this does not necessarily contribute to the clarification of the concept. The concept is still relatively young and evolving but lacks a specific, universally accepted definition. Therefore, this chapter presents a thorough literature review that was conducted to arrive at a shared understanding of the concept and provide an overview of what the existing literature reveals about co-creation.

2.2.1. The concept of co-creation

The literature reviewed for this study presents several interpretations of co-creation, where one common and straightforward definition, as noted by Puerari et al. (2018), is ”making something together.” They argue that including co-creation into everyday processes not only serves as a valuable tool for encouraging conversations aimed at aligning and defining potential actions within decision-making, but also as a method for increasing citizen collaboration, involvement, and empowerment, citing Puerari et al. (2018). This viewpoint is supported by the definition of de Koning et al. (2016), which states that the literal meaning of co-creation is: ’together (co-)make of produce something (new) to exist (creation)’. This article also discovers the existence of a ’joint space of creation’ where co-creation can occur within the shared or intermediary space between two distinct entities.

Other definitions are given by Ryszawska et al. (2021). They provide an overview of co-creation definitions presented by various authors over the past thirty years. Notably, the term has transformed from its initial focus on involving end users (consumers, clients, employees) in a business context to encompass active cooperation with residents and the general public in diverse projects (such as social, technological, and energy-related). Torfing et al. (2019) also observed that the concept of co-creation originally emerged in the private sector, driven by a strong emphasis on optimising service satisfaction, market share, and corporate profits, before subsequently gaining relevance in the public sector. Ryszawska et al. (2021) describes that some researchers observe this evolution regarding the entities employing co-creation, moving from private companies to non-governmental organizations (NGOs), then hybrid organizations, and finally, the public sector. They conclude that a review of these definitions finds common keywords such as cooperation, communication, actor involvement, exchange, doing something together and democratisation. The definitions highlight the active engagement of citizens and stakeholders, promoting a sense of empowerment and citizenship, building trust between stakeholders and communities, improving the social legitimacy of decision-making, delivering solutions in a timely and efficient manner, and sharing power and responsibility. Lastly, according to Ramaswamy and Ozcan (2018), co-creation can be defined as the process of interactive creation within interactive system environments enabled by interactive platforms. This process includes active engagement and entity organisation.

Co-creation, as defined in this study, refers to a collaborative process in which different stakeholders and citizens actively work together to improve decision-making, trust, efficiency and shared responsibility, with the ultimate goal of generating solutions and achieving shared objectives across projects and sectors.

2.2.2. Distinguishing co-creation from co-design and co-production

According to the definition described above, co-creation has similarities with concepts such as co-design and co-production. Nevertheless, a clear distinction exists. Co-design is described as a collaborative procedure within which co-creation may take place, thus presenting co-creation as a subordinate concept (de Koning et al., 2016).

The papers of Ansell and Torfing (2021), Torfing et al. (2019), and Voorberg et al. (2015) explain the distinction between co-production and co-creation. The former concept refers to the user-centred co-production of customised services and the latter to the multi-actor co-creation of new and emerging public solutions. Ansell and Torfing (2021) describe co-production as a relationship between private service users and public service providers, in which both parties can bring their experiences, competencies and resources to the service delivery process. Co-production, according to Torfing et al. (2019), does not capture new and broader trends in the public sector’s engagement with society, which involves a variety of public and private entities working together to discover and deliver innovative and improved solutions to common problems and challenges.

To understand this new and emerging phenomenon, co-creation is described as a collaborative effort between a variety of public and private actors, ideally as equals, aimed at identifying common problems and implementing innovative and practical solutions (Ansell & Torfing, 2021; Torfing et al., 2019). This distinction highlights the focus of co-production on delivering predefined public services and the emphasis of co-creation on generating innovative outcomes with public value.

Furthermore, following an extensive systematic review of co-creation processes, Voorberg et al. (2015) identifies three different types of co-creation, each associated with different levels of citizen engagement. The first type involves citizens as co-implementers, in which citizens take on responsibilities for activities previously carried out by the government. In the second type, citizens are co-designers, focusing on their involvement in shaping both the content and process of service delivery. The third type consists of citizens as initiators, where citizens take the initiative in formulating specific services. Building on this classification, Voorberg et al. (2015) propose to reserve the term 'co-creation' for situations where citizens are involved at the level of (co)initiators or co-designers. In contrast, co-production is defined as the involvement of citizens in the (co-)implementation of public services.

To summarise, the concept of co-creation is mostly used as a trendy term for concepts such as openness, collaboration, and partnership (de Koning et al., 2016). In their concluding remarks, de Koning et al. (2016) define co-creation as a process in which both the company and the customer actively contribute to value creation, promoting a dynamic interaction and sharing between these two parties, in contrast to the traditional model of passive consumer interaction with the company. Co-creation has shifted the relationship between the company and the consumer from a transactional exchange to a more engaged and experiential connection, distinguishing it from co-design and co-production.

2.2.3. Co-creation in different contexts

As mentioned by Torfing et al. (2019), the empirical prevalence of co-creation is seen in different contexts. The current emphasis on co-creation within the public sector is inspired by developments observed in the private sector (Ansell & Torfing, 2021; Torfing et al., 2019).

Focus on consumer engagement and experience

Within the private sector, the concept of co-creation has already found significant application in business marketing, especially in the arena of consumer product design, where there is an increasing emphasis on understanding consumer needs and experiences (Torfing et al., 2019). Private companies have shifted their focus to actively engaging consumers, prioritising users' personal and unique experiences over the product. They emphasise the connection of production and consumption processes, with both service providers and users actively contributing to shaping services. This both influences customer satisfaction and loyalty but also helps companies gain a competitive advantage (Voorberg et al., 2015).

The evolution of co-creation in public sector organisations

Next to companies in the private sector, public sector organisations have also shifted from a legal authority and a service provider to a co-creation arena (Torfing et al., 2019). Co-creation departs from the conventional idea that the public sector only delivers public goods and it challenges the contemporary belief that competition between public and private entities is the primary means of delivering more efficient and cost-effective public services (Torfing et al., 2019). However, co-creation has the potential to replace public service monopolies and the competitive dynamics between public and private sectors with collaborative efforts involving multiple actors. In doing so, it encourages the active involvement of users, citizens, and third-sector organizations in the evolution of public services (Ansell & Torfing, 2021; Torfing et al., 2019). In the literature, there are several examples of collaborative governance in which both the municipality and private companies play a central role in facilitating the participation of diverse audiences, businesses and citizens in joint co-creation efforts.

Co-creation in urban planning and public services

One such example can be found in a Dutch case study on urban planning, in which the municipal government collaborated with a private design firm to redesign a particular area (Ansell & Torfing, 2021). The firm organised a participatory initiative and involved stakeholders in a series of workshops. Instead of presenting a final plan for stakeholder review, participants were given a blank sheet with an image of an empty square surrounded by buildings. They were encouraged to place idea cards on the sheet and suggest new concepts with pencils. From the collective discussions on these ideas, three different proposals emerged for creating a multi-faceted water square.

Other examples are discussed by Torfing et al. (2019). They provide examples of co-creation applied to several fundamental functions of the public sector, including service delivery, common problem-solving, and regulatory issues. Their first example involves the issuing of construction permits that citizens must obtain to build a house in Danish municipalities. They allow citizens to actively participate in online applications and discussions with municipal authorities and allow them to influence and improve their original construction plans to increase the likelihood of permit approval. This was not the case before co-creation was implemented. The second example, set in Florida, demonstrates the involvement of civil society actors in transforming the conventional competitive contracting model for social and family-related services through co-creation. Other examples include parents in France, Germany and Sweden, who are involved in more advanced co-creation roles, such as participating in the governance of childcare facilities; or volunteers in the US who contribute to solutions to the financial challenges of infrastructure renewal. These real-world examples collectively indicate that co-creation extends not only to the production of public services but also to areas where the urgent nature of problems and the need for conflict resolution bring together all relevant stakeholders.

Co-Creation in urban development and innovation

Another context where co-creation is prominently used is in Living Labs. These labs are urban areas or neighbourhoods designated for user-driven research and development within an open innovation ecosystem and aim to empower citizens to co-develop their urban environment (Ansell & Torfing, 2021; Puerari et al., 2018). The research by Plassnig et al. (2022) examines the promotion of food citizenship and sustainability in the context of changing food systems and the concept of living labs. Here the living labs act as temporary spaces where local stakeholders come together to develop, test and improve sustainable urban food innovations based on their unique goals and needs. They are set up by City Teams, inclusive and participatory groups made up of individuals with common interests but different backgrounds. They function as communities of practice and knowledge and include members from different sectors, such as local authorities, social and environmental organisations, businesses, housing associations and schools.

In this way, the primary purpose of the living labs is to facilitate experimentation, learning through multi-stakeholders and understanding how end users interact with products and services in their daily lives (Plassnig et al., 2022; Puerari et al., 2018). In addition, Ansell and Torfing (2021) also examined two examples of Living Labs and illustrated how these labs serve as real-life spaces for user-centred co-creation, that can attract and engage multiple actors by using narrative methods and providing open access to data. In addition,

In conclusion, co-creation is used by public and private organisations to make use of the combined expertise and creativity of users, citizens and other stakeholders. However, besides its application in business and the public sector, co-creation can also be used directly by citizens (Voorberg et al., 2015). This new trend, where individuals take the lead in co-creation processes, represents a significant shift in the dynamics of municipal energy efforts. It empowers individuals and groups to actively adapt to their environment while encouraging a more inclusive and participatory approach to problem-solving. This citizen-led co-creation is an example of the changing position of citizens as active contributors and co-creators rather than passive consumers.

2.2.4. Assessing co-creation in strategic planning for urban energy transitions

Building upon the discussed insights and the review of co-creation as a collaborative strategy within different sectors, Sillak et al. (2021) formulated an evaluation framework for co-creation in energy transition strategic planning. Their study outlines a co-creation process with three phases: initiation, design, and implementation. However, de Koning et al. (2016) examined numerous established co-creation models and found co-creation processes with four to six steps. According to them, the debate focuses on whether co-creation is a method that requires tools, techniques or strategies to achieve specific goals, or whether it is more of a general approach characterised by the underlying attitude needed to guide the process. In light of the absence of a consensus, they developed a model that incorporates both the design methodology and innovation approach perspectives of co-creation, as shown in Figure 2.1.

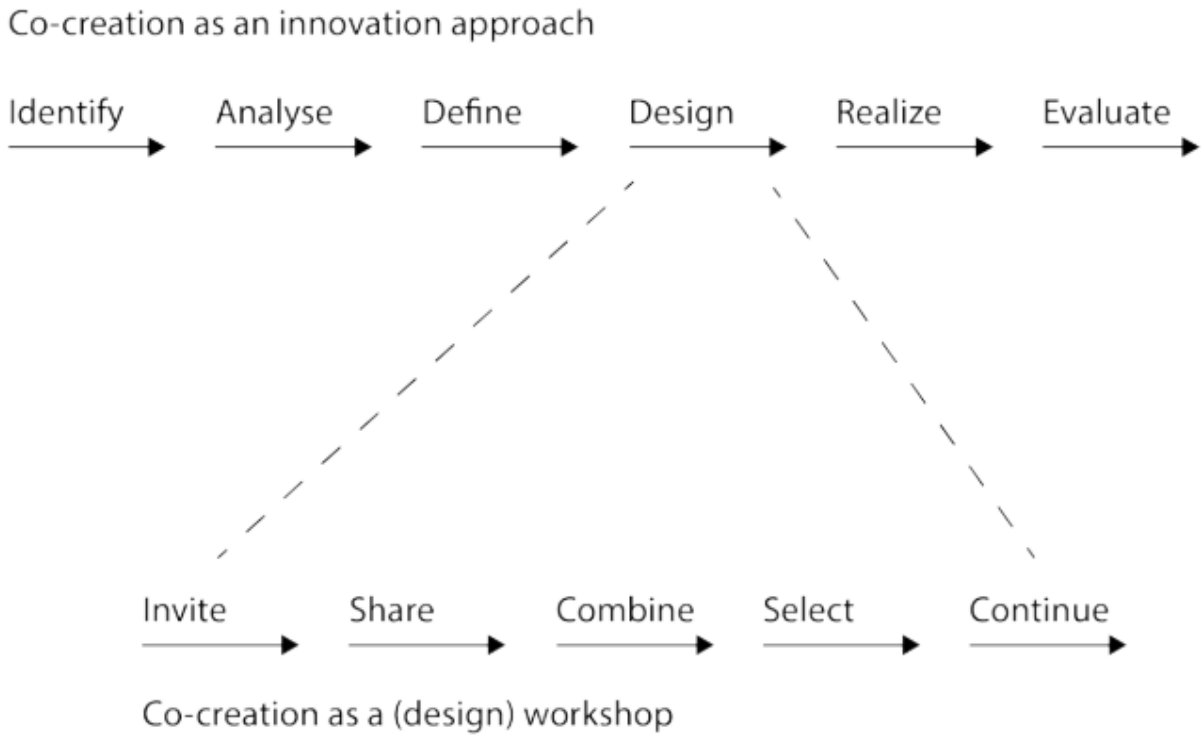

Figure 2.1: The steps in a co-creation process (de Koning et al., 2016)

Furthermore, Sillak et al. (2021) concludes that participants in co-creation can come from various sectors, including government, the market, communities, and the third sector. This four-tiered classification allows us to better comprehend their formal or informal nature, profit or non-profit orientation, and their public or private characteristics, as well as the roles and associated power dynamics. In line with this perspective, the article authored by d'Engelbronner-Kolff et al. (2020) highlights that co-creation involves forming partnerships and collaborating with diverse stakeholders. They state that a fundamental aspect of a 'true co-creation' approach includes active engagement with stakeholders and cooperation with multiple organisations, such as businesses, educational institutions, civil society organisations, and government bodies, to achieve local content development objectives collectively.

Additionally, Sillak et al. (2021) present four co-creation activities, which include the following:

1. **Expectation alignment:** This involves aligning stakeholder expectations about the process, objectives and expected outcomes.
2. **Social learning:** This includes both social and experiential learning. It includes first-order learning (understanding 'how to achieve a goal') and second-order learning (determining 'which goals are worth pursuing').
3. **Resource acquisition:** This refers to acquiring the necessary resources, including physical assets, materials, financial instruments and specialised expertise.

4. **Assessment and evaluation:** This activity involves the continuous examination and assessment of the process, including its objectives and results. This is done through the systematic collection of data and feedback.

According to Sillak et al. (2021), these activities have the potential to generate what is termed 'transformative power.' As explained in Avelino (2017), this concept of power refers to the capacity of individuals or groups to establish new structures and institutions, that involve elements such as legal frameworks, physical infrastructure, economic paradigms, or religious ideologies. Consequently, within the context of energy transition, transformative power means the ability to make changes in how we produce and utilise energy, such as adopting cleaner sources, improving energy efficiency, and reshaping public attitudes towards energy. Avelino (2017) distinguishes 'transformative power' from innovation power, which involves the capacity to create new resources, as well as from reinforcing power, which relates to the ability of actors to strengthen and maintain existing structures and institutions.

Based on these findings, Sillak et al. (2021) has formulated a conceptual framework for evaluating co-creation in the context of strategic planning for energy transitions, illustrated in Figure 2.2. Overall, they suggest that co-creation assessment should include the involvement of actors from the state, market, community, and the third sector, their specific roles across the initiation, design, and implementation phases, the application of four critical activity sets (namely, expectation alignment, social learning, resource acquisition, assessment, and evaluation) to encourage transformative impact, and the evaluation of outcomes in terms of effectiveness, efficiency, and social acceptability.

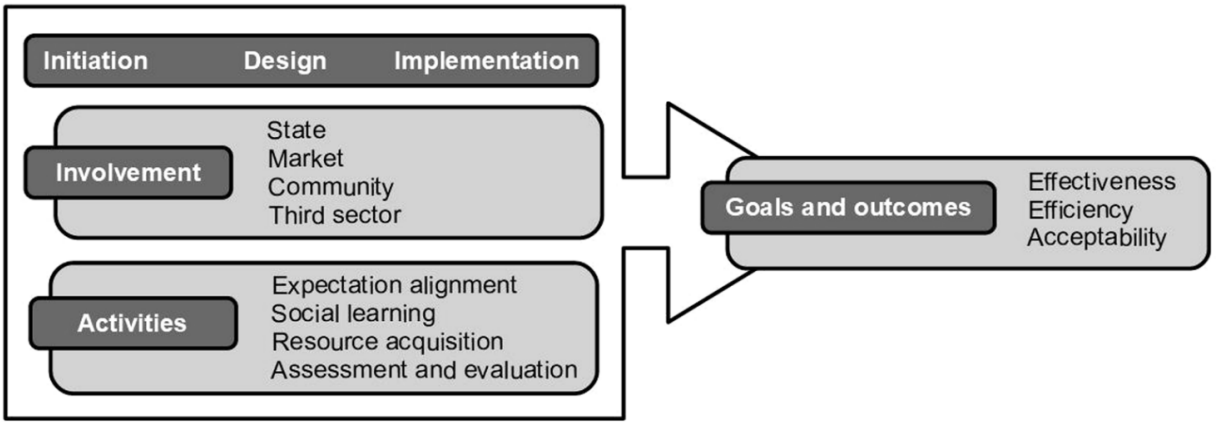

Figure 2.2: Framework for assessing co-creation in energy transitions (Sillak et al., 2021)

2.3. Knowledge gaps

Following the extensive exploration of the definition and application of co-creation in both the public and private sectors and its extension to citizen initiatives, it is necessary to examine the existing knowledge gaps in the academic literature. The reviewed literature reveals significant knowledge gaps in co-creation and energy transitions, including challenges, assessment shortcomings, and the role of local energy cooperatives.

2.3.1. Co-creation challenges

The first knowledge gap concerns the challenges and strategies within co-creation processes in the context of energy transition studies. This gap includes the lack of theoretical foundations, practical implementation challenges, and the need for more effective co-creation processes (Ryszawska et al., 2021; Sillak et al., 2021). As noted by Ryszawska et al. (2021), the existing literature on collaborative approaches like co-creation in energy transition studies often lacks theoretical integrity or encounters practical implementation challenges. They suggest that researchers should focus more on the obstacles and challenges associated with co-creation processes in energy projects. Future research efforts could focus on identifying the essential requirements for co-creation at every phase of project execution: before starting the project, during project implementation, and when evaluating the project.

Sillak et al. (2021) agrees that future studies should go deeper into the most successful approaches for facilitating co-creation during the initiation, design, and implementation phases within the energy transition context. It would also be valuable to explore how co-creation is expressed in spatial planning rather than strategic energy planning, particularly in processes related to the location and development of wind or solar farms in specific geographic areas.

2.3.2. Scarcity of evaluations

Furthermore, there is a scarcity of thorough assessments in the field of energy transitions and co-creation. This gap includes shortcomings in the evaluation of sustainable heating transitions (Itten et al., 2021; Manktelow et al., 2023), non-monetary benefit creation initiatives (Kularathna et al., 2019), and a heavy reliance on qualitative evidence derived from singular case studies (Manktelow et al., 2023; Young & Brans, 2020). In response to the lack of assessments in the field of sustainable heating transitions, future research should look into the application of co-creation in sustainable heating, the various participants and their respective roles, and the resulting outcomes, as noted by Itten et al. (2021). The article concludes by inviting stakeholders, citizens, and researchers from different fields to take on these proposed research questions, initiate research initiatives, and promote research into co-creation with a diverse range of communities.

In addition, many studies rely on evidence from single case studies, resulting in a scarcity of comparative analyses of co-creation (Manktelow et al., 2023; Voorberg et al., 2015; Young & Brans, 2020). This dependence on specific cases, along with the unclear concept of co-creation, frequently results in evaluations lacking theoretical and methodological precision. Manktelow et al. (2023) attempts to fill this gap by investigating two pilot projects in Belgian cities that are implementing co-creation for sustainable heating. Following the recommendation of Manktelow et al. (2023), future researchers are encouraged to replicate the research design of their study, incorporating a broader range of factors such as city-based involvement in climate policy, varying city sizes, and different urban governance structures.

2.3.3. The impact of local energy cooperatives

Lastly, while the combination of the pressing need for renewable energy and the active involvement of civic and social groups in recent local energy initiatives has led to significant growth in energy cooperatives over the past years, there are also uncertainties to what extent they truly contribute to the shift toward renewable energy production in the Netherlands, as discussed by Hufen and Koppenjan (2015). They proved the effectiveness of local wind energy cooperatives and argued there are other circumstances in which other local energy cooperatives can also succeed. As a result, the final category of limited academic literature emphasises the importance of focusing study on the significance of local energy cooperatives and their capacity to stimulate radical innovation in the renewable energy area. Thus, the need remains for understanding different energy transitions and radical innovations, along with the exploration of effective mechanisms within various local energy cooperatives (Ryszawska et al., 2021; Sillak et al., 2021).

In addition, the research conducted by Preston et al. (2020) suggests that to unlock the full potential of low-carbon smart cities, it is important to conduct further research aimed at comprehending how various cities and local authorities react to citizen engagement and how this influences behaviour change within the context of smart and sustainable cities. In this way future research should focus on citizen engagement within smart cities, emphasising the importance of investigating cooperative activities. Also, instead of making predefined models based on successful self-organized initiatives, future studies should focus on activities that help to understand different ways of working together (Hasanov & Zuidema, 2018). This will not only help to connect public, private, and societal sectors on a larger scale, but it will also help to develop collaboration skills to solve problems.

Moreover, Bauwens et al. (2016) suggests the importance of a more in-depth study of cooperative activities, evaluating, in particular, their responsibilities, founding processes and stakeholders involved. These activities are likely to differ in their focus on economic functions compared to political functions. Some are largely economic, while others are mainly political. A valuable area of study would be to examine these differences and their interactions with other contributing factors.

Finally, addressing an earlier point, Voorberg et al. (2015) highlight the need to explicitly consider the role of citizens in future research. Their observation highlights that the majority of studies focus on citizens in the capacity of co-implementors and that there are relatively few studies on the role of citizens as co-designers or co-initiators.

2.3.4. Academic contributions of the thesis

As shown in a study by Ryszawska et al. (2021), co-creation projects should consider the unique local conditions in which they are implemented. The authors advocate for developing situation-specific strategies to promote co-creation, rather than adopting a one-size-fits-all approach. Therefore, this master's thesis focuses on the practical implementation of co-creation within local energy cooperatives in the MRDH, carefully taking into account the unique circumstances specific to each community. By conducting an in-depth analysis of these communities through the lens of co-creation, the research will address the previously mentioned knowledge gaps:

1. **Co-creation challenges:** Regarding the first knowledge gap related to the challenges of co-creation, this master's thesis addresses the practical implementation challenges within local energy cooperatives. Focusing on citizen initiatives, the research provides insight into how co-creation can be effectively operationalised in diverse local settings, distinguishing it from the strategic planning framework by Sillak et al. (2021). This approach addresses the gap between theoretical foundations and practical implementation and contributes to a better understanding of the essential requirements for successful co-creation in the energy sector.
2. **Scarcity of evaluations:** Furthermore, the research addresses the second gap by conducting in-depth evaluations of co-creation processes within different local energy communities. This approach addresses the limitations of single case studies and contributes to a more comprehensive understanding of the impact of co-creation in sustainable energy initiatives.
3. **The impact of local energy cooperatives:** Lastly, this thesis contributes to understanding the role and effectiveness of local energy cooperatives in the transition to sustainable energy. Using local energy cooperatives within the MRDH as a case study, the research examines their potential to drive innovation in the renewable energy sector. In addition, the thesis examines citizens' involvement in these cooperatives, assessing their role as co-designers and co-initiators. This provides valuable insights into how these cooperatives contribute to energy transitions and the broader implications for sustainable neighbourhoods.

2.4. Theoretical frameworks

This research addresses existing knowledge gaps in the academic literature by investigating the practical application of co-creation within local energy cooperatives in the MRDH. It aims to connect the theoretical aspects of co-creation with its practical application in specific community environments. The research is structured into two main parts: the first part examines the broader dynamics of co-creation in local energy cooperatives, in line with the theoretical framework established by Puerari et al. (2018). The second part conducts an in-depth evaluation of co-creation processes, guided by six criteria developed specifically for this study and informed by a review of relevant literature.

2.4.1. The five distinct types of co-creation elements

In their study, Puerari et al. (2018) examined the dynamics of co-creation within Urban Living Labs (ULLs) and consequently introduced five categories of co-creation components, each referring to certain aspects of participation, facilitation, and organization. The elements do not stand alone but are interconnected, interact and mutually influence each other.

1. **Intended purpose:** The first element of co-creation they identify is its intended purpose, which can be classified into two distinct types, each with its own set of goals. The first category involves the collaborative development of a specific aim, such as developing a new product, service, or innovative process. This approach, often referred to as value co-creation, emphasises the interactive collaboration between producers and consumers to create mutual value generation (de Koning et al., 2016). The assumption of value co-creation is that meaningful interactions between stakeholders result in maximized benefits for all parties involved (Nie & Tang, 2022). In contrast, the second type of co-creation focuses on encouraging collaboration for knowledge generation, mutual learning, and the establishment of networks among individuals. This approach emphasizes knowledge production and innovation, eventually contributing to socio-technical and societal system transformations.
2. **Formal/informal:** The second element describes the formal and informal aspects of co-creation, which is also related to the intensity of engagement. Formal co-creation processes are deliberately structured, characterized by defined steps, timing, selected participants, and specific objectives, and usually set up by initiators. Informal co-creation, on the other hand, arises from shared goals or the necessity to collaborate, often involving non-selected participants, shorter-term engagement, and evolving practices and rules. In urban contexts, co-creation tends to have an inherent level of informality due to the complex, self-organizing nature of cities.
3. **Ownership:** The third element of co-creation relates to ownership of the co-creation process, which involves specific skills such as defining roles and providing appropriate resources. The degree of influence and rules in the co-creation process depends on whether a clear group of initiators dominates the process or whether the initiators want to involve a wider group, which requires more consultation and consensus-building to determine how co-creation is carried out.
4. **Motivations and incentives:** Motivations and incentives are the fourth element in co-creation. Costs and benefits are reviewed during co-creation processes, with participants' motives resulting from their goals, resources, and outcome expectations. Motives might be intrinsic (for personal fulfilment) or extrinsic (motivated by external rewards), and the clarity of incentives varies. In cases when the benefits are less visible or unequally distributed among participants, initiators may make compensation or offers to encourage participation.
5. **Spaces and places:** The fifth element of co-creation relates to the importance of spaces and places within socio-spatial contexts. This component is an important condition that facilitates interaction between actors with creative ideas and resources. Ansell and Torfing (2021) also explore two elements, platforms and arenas, which correspond to these spaces and places. Platforms serve as channels where individuals with an interest in a particular issue can come together to discuss possible solutions, access relevant knowledge and information, and exchange their insights and experiences. These platforms include both digital domains and physical locations such as community centres, public libraries or cultural centres, which serve as meeting places for different stakeholders to participate in group discussions and workshops, among other activities. Arenas, on the other hand, are temporary and relatively self-organised spaces designed for participation, communication and collective action. These places also enable relevant and engaged actors to interact with each other, encourage experimentation and enable participants to participate in the co-creation of public value.

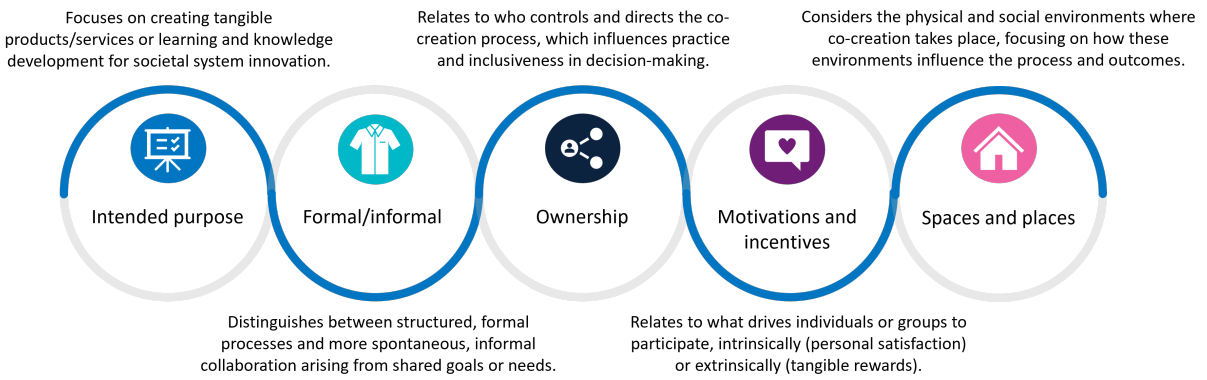

Figure 2.3: Five elements that shape the overall dynamics of co-creation (Puerari et al., 2018)

To sum up, the five elements identified by Puerari et al. (2018) shape the overall dynamics of co-creation. They form a fundamental framework for understanding co-creation in practical scenarios and are shown in Figure 2.3. In Chapter 6, this framework will be applied to understand the dynamics of co-creation within local energy cooperatives.

2.4.2. Six criteria for co-creation

Building on the broader dynamics of co-creation in local communities, as explored by (Puerari et al., 2018), this thesis introduces a refined framework designed to evaluate specific co-creation activities. This framework, built around six criteria for co-creation and developed specifically for this study, is based on a detailed review of academic articles addressing co-creation within the context of energy transition. The methodology used to select and analyse the relevant literature is described in Section 3.1. These articles were analysed for common themes and concepts important for effective co-creation practices. To qualify a theme or concept as a criterion, it had to be mentioned repeatedly in the literature, indicating a broad academic consensus on its relevance. This process took into account the different terminologies found in different studies. Consequently, similar concepts, although under different names, were grouped under one of the six criteria essential for the success and effectiveness of co-creation activities.

The framework thus developed distinguishes itself from the existing academic literature by providing a structured approach to evaluating co-creation in energy transition projects. It not only summarises the aspects of co-creation that are most prominent in the literature but also organises them into a coherent model that guarantees their practical applicability. The criteria are described in this section and divided into two main aspects, as shown in (Figure 2.4): ”co”, which emphasises the importance of collaboration, and ”creation”, which focuses on the generative process of producing new entities. It is important to recognise that although these criteria are different, they are closely linked and potentially influence each other. For example, the lack of shared goals can impact on the level of active participation, potentially leading to reduced engagement among participants.

Collaborative aspect

The prefix ”co” has an important meaning within the concept of co-creation, as it indicates the importance of collaboration (Ansell & Torfing, 2021). It refers to active and meaningful cooperation among participants and working together to generate value, as discussed by de Koning et al. (2016) and Ramaswamy and Ozcan (2018). In addition, Torfing et al. (2019) describe that the ultimate goal in addressing the pressing challenges of our time is not to exercise sole authority but to co-create solutions in partnerships with other relevant and committed stakeholders. They propose that the famous but traditional ”ladder of participation” by Arnstein (1969) should be supplemented with a new ”ladder of co-creation”. The ultimate goal of this ladder would be the involvement of relevant public and private entities in jointly initiating, designing and implementing effective new solutions. Furthermore, a systematic review on co-creation by Voorberg et al. (2015), concluded that there seems to be an underlying assumption that engaging citizens is valuable and that the primary goal of co-creation is citizen engagement. In this co-creation context, ”co” emphasises the collaborative aspects of goal sharing, active participation, and equality and inclusiveness:

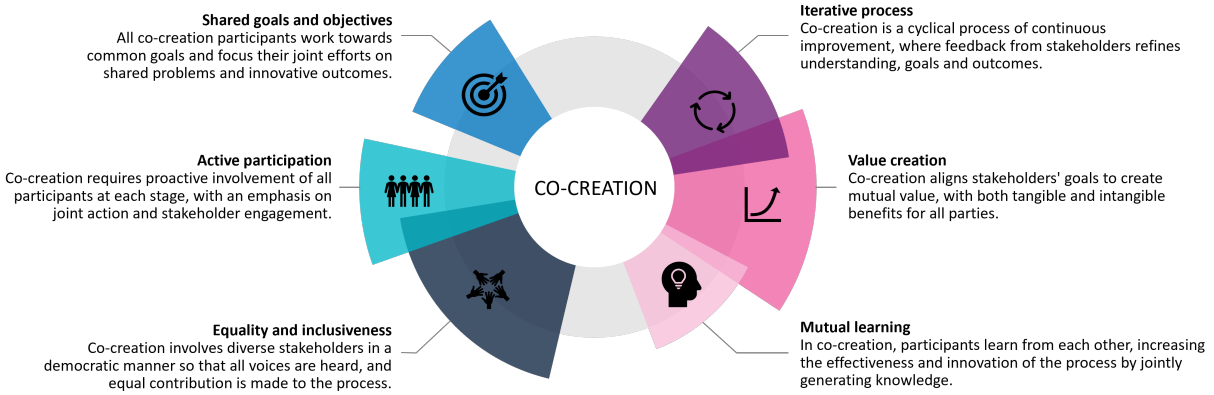

Figure 2.4: Co-creation criteria (own work)

1. **Shared goals and objectives:** The first criterion for co-creation is that all participants pursue common goals. They should strive to address jointly shared problems, challenges and goals (Torfing et al., 2019). When participants have a clear understanding of common goals, it helps them focus their efforts in one direction. Therefore, co-creation is characterised as a problem-oriented approach with the overarching goal of generating new and innovative outcomes (Ansell & Torfing, 2021; Itten et al., 2021). This approach effectively ensures that all stakeholders tackle complex problems together and provides clear guidelines for their joint efforts. Thus, shared goals and objectives also promote ownership and responsibility. If individuals or groups participate in the decision-making process, they are more likely to take responsibility for the success of the project (Itten et al., 2021). This makes decision-making more effective and aligned, as it helps to set priorities and resolve conflicts by referring back to the shared goals.
2. **Active participation:** Because co-creation results from shared goals, individuals demonstrate a proactive attitude and commitment throughout the process (Ansell & Torfing, 2021). The concept of co-creation goes beyond passive engagement and requires the active involvement of all participants. This is reflected in the definitions of sources such as de Koning et al. (2016), Puerari et al. (2018), and Ramaswamy and Ozcan (2018), which emphasise joint action, involvement of actors and interactive creation. In line with these perspectives, the article authored by d'Engelbronner-Kolff et al. (2020) states that a fundamental aspect of a 'true co-creation' approach includes active engagement with stakeholders and cooperation with multiple organisations. Ryszawska et al. (2021) agree and highlight the dependence of co-creation activities on the type of organisations involved and the engagement of various stakeholders, each with unique interests, motivations, and value systems. Co-creation, according to Sillak et al. (2021), refers to the active involvement of end-users at all different stages of the process. This active involvement of stakeholders in co-creation offers a more specific emphasis than the broader concept of participation, which can also include passive involvement (de Koning et al., 2016; Voorberg et al., 2015), and can lead to transformational power, as explained by Avelino (2017).
3. **Equality and inclusiveness:** Furthermore, co-creation, as described by authors such as de Koning et al. (2016) and Puerari et al. (2018), emphasises the involvement of a diverse group of stakeholders in a democratic and empowering way. This approach ensures that all voices, including those of less represented groups, are heard and valued in the co-creation process. According to Torfing et al. (2019), co-creation recognises a variety of actors coming together to address common problems, challenges and tasks. It encourages individuals and organisations to step out of their comfort zone and share fresh ideas. Itten et al. (2021) describes this fundamental element of co-creation as promoting inclusiveness and organisational diversity. As outlined by Manktelow et al. (2023), for successful co-creation, it is important to recognise citizens as equal participants alongside public and private sector entities. In line with this perspective, the article authored by d'Engelbronner-Kolff et al. (2020) highlights that the decision-making within co-creation should remain unbiased and equitable, with all stakeholders equally involved and having the same opportunity to contribute to innovative and practical results (Ansell & Torfing, 2021; Torfing et al., 2019).

Creative process aspect

Focusing on the ”creation” aspect of co-creation, it is clear that its essence lies in generating new ideas or products through a collective effort. The literature emphasises the importance of jointly creating or bringing about something that did not exist before. This concept of creation is summarised in definitions such as ’making something’ by Puerari et al. (2018) and further elaborated as ’making or producing something new’ by de Koning et al. (2016). This aspect of co-creation is not just about the act of creating; it is about an interactive and adaptive process where input and feedback from all stakeholders are important. In this co-creation context, ”creation” emphasises the creative aspects of an iterative process, value creation and mutual learning.

4. **Iterative process:** Co-creation processes involve a series of activities that collectively form an iterative process that allows co-creation to evolve and become more effective as participants continually refine their understanding, goals and outcomes (Ansell & Torfing, 2021). This corresponds to the fourth activity of co-creation, identified by Sillak et al. (2021), which involves continuous assessment. They argue that co-creation activities are interconnected and create a cycle of learning, adaptation and improvement by allowing stakeholders to reflect on what has been done, understand the results and apply these lessons to future phases of the project. In addition, Hori et al. (2020) describes a feature of co-creation as the use of a ’participatory backcasting’ methodology. Co-creation is said to facilitate an interactive and iterative process, allowing continuous feedback on design methods for developing future scenarios. Moreover, according to Itten et al. (2021), co-creation facilitates the exploration of different methods and concepts, along with a willingness to adapt strategies in response to changing circumstances, feedback and evolving requirements.
5. **Value creation:** As noted in the literature, co-creation is shifting from traditional models of passive interaction between consumers and companies to a more dynamic interaction where both parties actively contribute to value creation (Torfing et al., 2019). As the process of co-creation involves aligning the goals and objectives of different stakeholders, the value that is created is recognised and appreciated by all parties. Especially the work of de Koning et al. (2016) and Puerari et al. (2018), emphasises the idea of value creation. It is all about the interactive collaboration between different stakeholders to create mutual value. This means that co-creation provides meaningful interaction between stakeholders resulting in maximised benefits for all parties involved (Nie & Tang, 2022). Therefore, it is characterised by the fair distribution of co-benefits, as described by Itten et al. (2021). These benefits can include tangible outcomes, such as the creation of new products or revenue, as well as intangible benefits, including learning and relationship development (de Koning et al., 2016). Nex to these outcomes with immediate results, co-creation can also create value in long-term systemic change. This becomes clear in the context of local energy communities and urban planning, where co-creation is used to develop innovative solutions for sustainable development. Here, value is created to contribute to the transition to sustainability and the reduction of environmental externalities (Ansell & Torfing, 2021; Torfing et al., 2019).
6. **Mutual learning:** The final aspect of co-creation, as revealed by the literature review in this study, relates to mutual learning as a consequence of the process. As described by de Koning et al. (2016) and Puerari et al. (2018), co-creation is not only about producing tangible results but also about creating a collaborative environment for knowledge generation and sharing. This involves participants learning from each other, which increases the overall effectiveness and innovation of the co-creation process (Puerari et al., 2018). In addition, mutual learning is in line with the concept of social learning highlighted by Sillak et al. (2021), where learning is not only about achieving a goal but also about understanding which goals are worth pursuing.

In summary, based on a literature review, six criteria that define co-creation are developed and divided into two aspects: collaboration (”co”) and the creative process (”creation”). These include focusing on shared goals and objectives, active participation, equality and inclusiveness, iterative process, value creation and mutual learning experiences. These elements are fundamental to achieving effective and innovative results in co-creation initiatives.

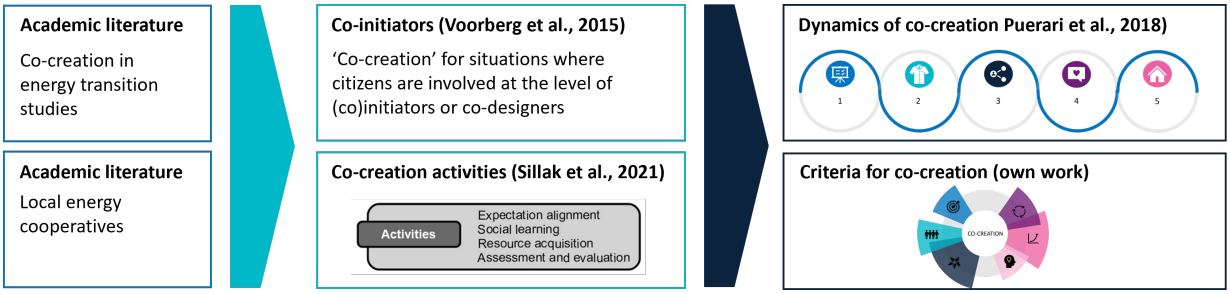

Figure 2.5: Conceptualisation of theoretical framework

2.4.3. Conceptualisation of theoretical framework

The literature review offers an exploration of both local energy cooperatives and co-creation within the energy sector. Linking all academic literature provides a theoretical framework (Figure 2.5) for research into the exploration of co-creation within the domain of local energy communities. The framework incorporates the definition of co-creation in which citizens take on roles as co-initiators or co-designers, emphasised by Voorberg et al. (2015). Given that local energy cooperatives have naturally emerged from the initiatives of residents, there is a strong link between them and the concept of co-creation. Therefore, applying the five co-creation elements - intended purpose, formal/informal processes, ownership, motivations and incentives, and spaces and places - identified by Puerari et al. (2018) provides a structured lens to examine the complex dynamics of cooperative efforts and thus a theoretical framework for the analysis of local energy cooperatives in the MRDH.

In addition, the theoretical framework of this study recognises the four central activities described in the evaluation framework for co-creation in strategic planning for energy transition by Sillak et al. (2021). However, as highlighted in the Section 2.3, local energy community projects often do not emerge from structured strategic planning, but rather from interactive and spontaneous methodologies. This distinction requires a tailored approach, leading to the introduction of six criteria that define co-creation in this context. The criteria - shared goals and objectives, active participation, equality and inclusiveness, iterative process, value creation and mutual learning - include both collaborative and creation aspects. This leads to a better understanding of the practical implementation of co-creation and its improvement in diverse local settings. These criteria were developed in response to identified gaps in the existing literature and are intended to add insights into the practical implementation of co-creation within local energy cooperatives.

In conclusion, using the co-creation elements of Puerari et al. (2018) as a theoretical basis, together with the six specifically developed co-creation criteria, constitutes an overall and methodical approach. This strategy is suitable for analysing and understanding the diverse nature of co-creation in local energy cooperatives, and effectively bridges identified knowledge gaps in the existing literature.

3

Research Methodology

The study uses a qualitative research approach because it allows for an examination of the meanings individuals or groups assign to social or human problems, as noted by Creswell (2009). Within this approach, the case study method was chosen as it is known for its ability to explore complex social phenomena in depth, especially those not fully addressed by existing theoretical frameworks, as described by Creswell et al. (2007) and Crowe et al. (2011). Moreover, Yin (2002) emphasises the ability of case studies to clarify, describe and analyse events in their real-life context. In this thesis, the case study method is used to gain an in-depth understanding of the unique characteristics and contributions of different co-creation activities within local energy cooperatives. Data collection for this case study is conducted through interviews and observations, and the analysis uses a combination of deductive and inductive methods. In this chapter, the research methodology will be explained further.

3.1. Literature review

Before applying the qualitative research approach, the literature review examines the relevance of a topic for research and provides insights into refining the scope into a necessary area of research. Moreover, findings from closely related studies and ongoing discussion in the literature are examined and gaps in previous research are identified (Creswell, 2009). The literature review in this thesis follows a systematic approach to identifying and analysing all relevant literature. The details for selecting the literature are described in Appendix C.

A first thorough search of the literature was conducted, with both a keyword selection process and a manual selection process. The literature search used Scopus, following the PRISMA approach, which is a systematic and transparent methodology for conducting literature reviews that ensures careful synthesis of evidence (Page et al., 2021). A search was conducted using the keywords ”local”, ”energy”, ”communities” and ”creation” to find relevant articles. This initial search yielded 28 scientific articles. To focus specifically on co-creation within the energy domain, the search was limited to the subfield ”ener”, resulting in a selection of 18 articles. The subsequent refinement consisted of a manual inspection of the articles, examining the titles, abstracts, introductions and conclusions. This review resulted in a limited selection, with 15 articles included in this literature review.

Besides the PRISMA method for article selection based on keywords, the snowball method was also used. This approach included citation analysis examining the references and citations of the initially selected articles (Lecy & Beatty, 2012). This revealed 18 additional scientific references which were initially not identified through keyword selection. In summary, keyword selection facilitated the identification of key initial articles, including the framework of Sillak et al. (2021), while snowballing facilitated the inclusion of further relevant literature by examining citations and references from the initial selection, including the framework of Puerari et al. (2018). These two methods together collected all relevant literature on co-creation used in this research.

3.2. Case selection

To evaluate co-creation initiatives within the context of local energy cooperatives, it is important to choose specific cases for detailed research. Therefore, this chapter explains the criteria for selecting cases. The selection process is visually presented in Appendix C.

3.2.1. Selection process

Besides describing the concept of cooperatives in Chapter 2, Energie Samen distinguishes cooperatives from other entities based on a set of distinct criteria, collectively known as the 'seven cooperative principles' (Energie Samen, n.d.). For this study, these principles will serve as the guiding criteria for the selection of the four cooperatives that will be interviewed and observed.

1. **Open, voluntary membership:** Cooperatives are open to anyone who can benefit from their services and is willing to accept the responsibilities of membership without discrimination based on factors such as social background, ethnicity, political opinions, gender, or religion.
2. **Democratic membership board:** All members actively participate in developing policies and decision-making processes. The cooperative's leaders are elected by the members and are accountable to them. Every member has an equal voting right.
3. **Fair member contribution:** The capital within the cooperative is considered to be collectively owned, and any surplus funds are used for the development of the cooperative, including building reserves, returning a portion to members in proportion to their transactions with the cooperative, or investing in other activities approved by the members.
4. **Autonomy and independence:** Cooperatives always maintain autonomy and independence while remaining accountable to their members. When entering into agreements with external organisations or governments, there are protections to ensure democratic control of members and preserve the cooperative's autonomy.
5. **Education and training of members:** Cooperatives ensure that all members are well-informed about the nature and benefits of cooperative participation, enabling members to actively contribute to the growth and achievement of the cooperative's objectives.
6. **Cooperation between cooperatives:** By working together at local, regional, national, and possibly international levels, these organisations strengthen the cooperative movement and deliver effective services to their members.
7. **Community development:** Cooperatives play a central role in contributing to the sustainable development of society, operating within a framework supported by their members.

In 2022, a list of 705 citizen energy collectives, including cooperatives and foundations, was made based on the seven principles that distinguish cooperatives from other entities, as listed on the Local Energy Monitor website (Energie Samen and Klimaatstichting HIER, 2023). This list facilitated the initial selection of case studies for the research focusing on the MRDH, which resulted in 36 collectives within the 21 municipalities of this region (MRDH, n.d.-a). After reviewing the websites of these collectives, 26 were selected for more detailed desk research, as some collectives did not have an online presence.

These 26 cooperatives displayed a variety of activities, such as offering energy coaching, organising information meetings and generating energy collectively, such as shared solar roofs. To ensure that some form of co-creation was present, only those cooperatives that were involved in all these different activities were included in the following selection. An overview of these activities at 26 cooperatives can also be found in Appendix C. The final selection of energy cooperatives was limited by the time frame of the study, their schedules for information meetings and the willingness of individuals to participate in interviews and observations. The selected cooperatives also had to vary in their municipal location, reflecting the influence of different municipal policies on energy communities. This selection process focused on various contexts within these energy cooperatives and resulted in the selection of four cooperatives.

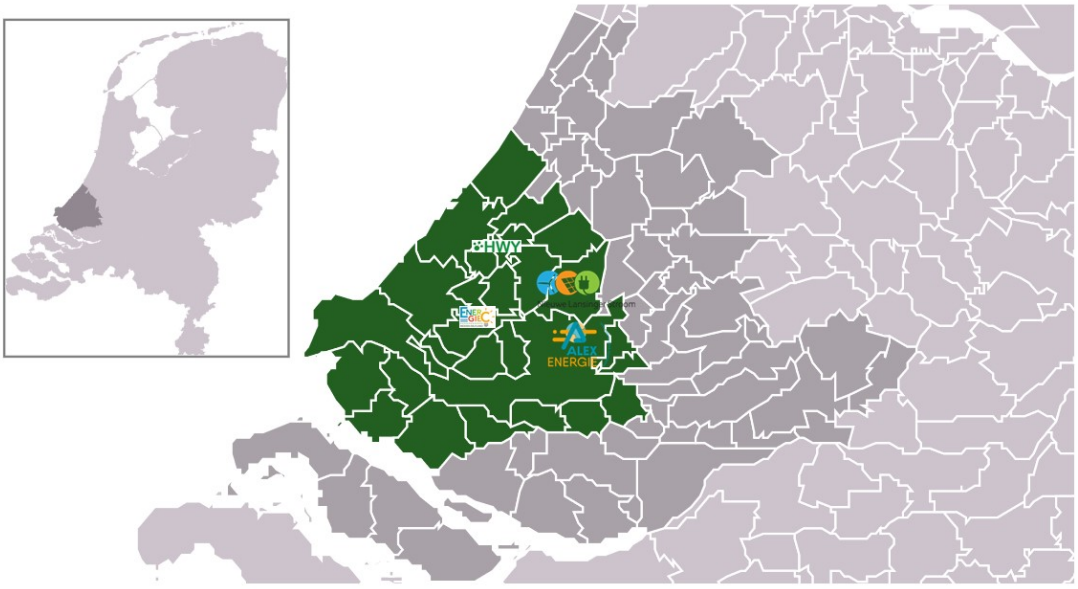

Figure 3.1: Selected cooperatives in the MRDH

3.2.2. Selected cases

Based on the outlined selection criteria, four cases were carefully chosen, visually represented in Figure C.3 and described in the following section.

Nieuwe Lansinger Stroom

Nieuwe Lansinger Stroom (NLS) is a Lansingerland-based initiative focused on energy conservation and the transition from fossil fuels to renewable sources (https://www.nieuwelansingerstroom.nl/). The initiative takes independent action and avoids dependence on the government and big energy players. It recognises the unsustainability of the current energy system, which relies heavily on finite fossil fuels, contributing to climate change and economic vulnerability. They aim to maintain a clean and sustainable local environment, achieve energy independence and ensure that energy gained stays within Lansingerland. The initiative emphasises community involvement and gives residents and businesses a voice in decision-making. Despite different motivations for participation, the common goal is to combine local knowledge, strength and enthusiasm for a resilient, sustainable, economically robust and affordable energy supply in Lansingerland.

Hernieuwbare Warmte Ypenburg

Hernieuwbare Warmte Ypenburg (HWY) is an independent foundation by and for residents in Ypenburg that advocates CO2-neutral district heating by 2025 (https://www.hernieuwbarewarmteypenburg.nl/). This is in line with the climate goals of the municipalities of The Hague and Pijnacker-Nootdorp. It aims to optimise residential heating for sustainability, reducing energy needs and benefiting both costs and the environment. Currently, Ypenburg's district heating depends on natural gas, which emits CO2. Therefore, the initiative has been taken to explore renewable sources such as solar and geothermal energy, while maintaining affordability. HWY is driven by residents through the Bewonersplatform Ypenburg (BPY) and cooperates with local authorities, the province and Eneco as an energy supplier and heat network operator.

Alex Energie

Alex Energie, founded on 9 October 2019, is a community-driven effort that aims to empower residents to actively contribute to and benefit from the sustainable transformation of the Prins Alexander area of Rotterdam (https://www,alexenergie.nl/). The initiative believes that cooperation between residents is more effective than individual actions, making residents co-owners of the transition. This co-ownership allows them not only to influence the direction of the initiative but also to collectively benefit from the results. Members of Alex Energie are the decision-makers and collectively decide on actions in the members' meetings, while the board oversees day-to-day tasks.

EnergieC Midden-Delfland

Finally, EnergieC Midden-Delfland works with its members to make their town more environmentally friendly by using solar panels on large roofs (https://www.energiecmiddendelfland.nl/). This provides clean energy and gives those involved a good return on investment. They recently completed a large project on the Post-Kogeko sports hall in Schipluiden, with about 3,300 solar panels. Besides making energy, they also work on ideas to help everyone use less energy. Currently, they have 122 enthusiastic members and have done a good job of having 5,301 solar shares. In 2022, they produced 162,300 kWh of energy from three rooftops.

3.3. Data collection method

The study collects qualitative and empirical data through online documents, observations and in-depth interviews, which are explained in this chapter.

3.3.1. Documents

After completing the first phase of desk research, which led to the identification of the four cases discussed earlier, the next phase involves a more in-depth analysis of online documents. This analysis examines the organisation and goals of the selected communities. The documents studied consist of publicly accessible material such as minutes of energy community meetings or monthly newspapers. This type of data collection reflects thoughtful engagement, as participants have paid attention to making these documents (Creswell, 2009). However, it is essential to recognise potential limitations, such as incomplete material and inaccuracies in the documents. Therefore, this data collection method was specifically used to gather information on planned and organised information meetings for the observations and to identify key people within each energy community for the interviews.

3.3.2. Observations

After determining information through desk research, the next stage in collecting qualitative data consisted of direct observations. These observations included studying behaviours and interactions between stakeholders, by attending information evenings or other activities organised by the community. This approach offers the advantage of collecting first-hand experiences with members of local energy communities, noticing initial aspects of co-creation activities during observations and making initial contacts with individuals of interest for later interviews (Creswell, 2009). However, there are also limitations, such as the possible perception of the researcher as intrusive and the possibility of observing private information that cannot be reported (Creswell, 2009). Therefore, for this thesis, these limitations were mitigated by the fact that the researcher remained transparent about the purpose of her presence and no written records of the observations were kept. An overview of the observations that were carried out is shown in Appendix B.

3.3.3. Interviews

Interviews as data collection methods facilitate the exploration of undocumented information. A total of 10 participants were interviewed, enabling direct engagement to explore their perspectives, experiences, and insights regarding the various forms of co-creation (Creswell, 2009). The primary aim of the interviews was to improve the understanding of local energy cooperatives and their co-creation activities, taking into account the different experiences and perspectives. The interviews are semi-structured, offering higher response rates compared to surveys, providing in-depth information, and allowing flexibility in questioning, making them ideal for this study (Creswell, 2009). Interviews have certain limitations, such as the possibility of providing information indirectly filtered by the interviewees' perspective or the fact that they are conducted in a designated environment rather than in a natural field setting. Moreover, the presence of the researcher may lead to biased responses (Creswell, 2009). Nevertheless, the interviews for this thesis were always conducted in locations chosen by the participants, thus mitigating the limitations associated with natural field environments. Each interview, which lasted about an hour, took place via Microsoft Teams, or at the participant's preferred location. All participants consented to the recording and transcription of the interviews to enable further data analysis. The interviews were conducted between November and December 2023. The interview protocol and an overview of the interviewees and their different roles within the cooperatives can be found in Appendix A.

3.4. Data analysis procedure

The data analysis procedure involves understanding textual information and ending up in the interpretation of its broader meaning (Creswell, 2009). The process facilitates the identification of key issues, based on both the literature and the collected data (Crowe et al., 2011). To construct patterns, categories and themes around these important issues, the data must be organised into abstract units of information, showing an iterative process of working back and forth between themes and the database (Creswell, 2009). This continues until the researchers have identified a comprehensive set of themes.

In this research, the coding process initially starts with inductive coding, where codes are extracted directly from the data without constraints imposed by pre-existing categories (ATLAS.ti, 2023c). This method made it possible to discover themes and concepts that might not have been anticipated. When analysing the transcripts of the interviews, for example, current activities within the cooperatives were found to differ from those discovered during the first stage of desk research when selecting the cases for the case study. Other topics that emerged during inductive coding were people's motivations to engage with communities and the challenges that get in the way of activities.

In combination with inductive coding, deductive coding is used to integrate the theoretical framework and research questions into the analysis (ATLAS.ti, 2023a). This method used the predefined criteria for co-creation as codes that provided a framework for structuring and interpreting the data with the theoretical foundations of the study. For example, during the analysis of the interview data, codes such as ”collaboration” and ”diverse” were used to examine discussions on collaboration and inclusiveness in the activities organised by the cooperatives.

During the coding process, ATLAS.ti plays a crucial role in comparing data segments for different codes, allowing the identification of similarities and connections between concepts. By combining inductive and deductive coding methods, this analysis process facilitates a detailed exploration of the collected data, capturing both unexpected insights and the integration of relevant theoretical concepts (ATLAS.ti, 2023b). A more detailed explanation of the coding phase and the final coding scheme used to analyse the results can be found in Appendix D.

3.5. Ethical considerations

As described by Creswell (2009), researchers need to anticipate and address any ethical dilemmas that may occur in their research. Therefore, to maintain the highest ethical standards during this research, an ethical plan was developed in line with the General Data Protection Regulation (GDPR) and guidelines prepared by the Human Research Ethics Committee (HREC). After careful preparation, the ethical plan was examined and approved by TU Delft's HREC. This approval serves as confirmation that the study meets ethical research principles and respects the rights and privacy of participants.

The first ethical consideration concerns defining the purpose and questions of the study, a crucial step to avoid deception and maintain transparency with participants (Creswell, 2009). Communicating the purpose of the study to participants serves to avoid misunderstandings, by ensuring that before each interview they are given a comprehensive overview of the study, including its objectives, methods and possible implications.

In addition, ethical considerations in the collection, storage, analysis and interpretation of research data are critical as they relate to respectful handling and mitigation of potential risks associated with participants' data (Creswell, 2009). To address these issues, a central part of the ethics plan focuses on data storage protocols. Given the sensitivity of participants' data, strict measures are in place to ensure secure storage and restricted access for research purposes only. To ensure participants' anonymity, personal identification data are removed during data analysis and pseudonyms will be used in any publications resulting from the study.

Furthermore, the images in this report, especially in Chapter 5, are taken from public websites, for which permission has already been obtained from the individuals in the photos. The sources are cited to ensure transparency. As an additional precaution, the images have been blurred to make sure that the individuals are not identifiable. Together, these ethical precautions ensure that the study complies with ethical standards, with the privacy of the participants and the integrity of the data being paramount.

4

The context of local energy cooperatives

This chapter aims to provide context to the historical development and organisational structure of four local energy communities in the Metropolitan Region Rotterdam The Hague. It examines the motivations of cooperative members and current and future trends.

4.1. History of local energy communities in the MRDH

Each of the four energy cooperatives examined in this study emerged from the collective vision of passionate and concerned citizens, driven by their shared commitment to environmental welfare and sustainability. As board members of NLS and Alex Energie point out, these initiatives *'often start at the kitchen table'*, initially driven by the dedication of a few individuals.

What started with a small team of six volunteers within NLS grew into a community of 35 active members. They evolved from an initial focus on wind energy (Lansingerwind) to broader initiatives such as solar energy (Lansingerzon) and energy saving (Lansingerbespaar). In the case of Alex Energie, the origins go back to two neighbours of the current chairman and himself. The close bond between members is the driving force within the cooperative. The formation of HWY was inspired by the Bewonersplatform Ypenburg (BPY), an umbrella of residents' organisations in Ypenburg. HWY recognised a gap in the approach to sustainable heat within the framework of BPY and emerged as a specialised entity. Meanwhile, EnergieC Midden-Delfland owes its establishment to the preparation of the current chairman, who already had experience in setting up cooperatives in Pijnacker. He wrote a message in the local newspaper and received many responses, from people from different professional backgrounds.

All four communities thus started with a small group of committed individuals and later gradually united into cooperatives. However, while cooperatives find their roots in committed citizens, it is necessary to recognise the important role of municipalities. In the case of NLS, their first project, an energy market, came about through cooperation with the municipality of Lansingerland. Similarly, HWY received its first funding from the municipality of The Hague, which considers them a model neighbourhood and provides crucial subsidies that are partly used to compensate their coordinator - the only member paid for his contributions within the cooperative.

4.2. Organisational structure

Interview results show that local energy cooperatives in the MRDH have a dual organisational structure, combining community involvement with business activities. As described by a board member of the cooperative NLS, this structure consists of an *'association part'*, alongside a *'business part, with formalised structures and statutes and the possibility of making a profit'*. The association part is mainly concerned with the cooperative's community-oriented objectives. These include promoting sustainable energy practices, raising awareness about renewable energy and actively involving residents in local energy-related decision-making.

On the other hand, besides its community-oriented side, the local energy community also operates with a certain business orientation. This means it engages in activities, such as generating revenue, investing in renewable energy projects and distributing profits to its members or reinvesting them in the community. This aspect allows the organisation to be financially self-sufficient and potentially profitable. This dual structure allows cooperatives to respond to community needs and goals while ensuring their economic growth.

In this type of organisation, individuals participate and play different roles, each of which makes a unique contribution to the functioning and success of the cooperative. This concept is expressed by an NLS board member, who outlines the different types of members and their respective roles: *'We have our members, the highest bodies, and directly behind the members are the volunteers. These are people who are strongly committed to the energy cooperative. Then we have the participants. They contribute financially and get something in return. Unlike the volunteers, who feel emotionally involved, the participants get a tangible return.'* Based on this perspective and confirmed by other interviews in this study, the following roles in these cooperatives are clear:

1. **Board members:** These are the core members of the cooperative. They are usually involved in key decision-making processes and have a say in the direction and policies of the cooperative. They often lead a specific working group with volunteers focusing on topics like communication or technical issues. They have regular board meetings where they ensure the coordination of these working groups and discuss the cooperative's strategies. The board members are usually very involved in the goals and activities of the cooperative.
2. **Volunteers:** Volunteers are essential to the cooperative and offer their time and skills without expecting financial compensation. Their motivation often comes from a personal commitment to the cooperative's social and environmental goals, such as promoting renewable energy or supporting the local community. Volunteers can engage in various activities, from administrative tasks to actively participating in working groups or being energy coaches.
3. **Financial participants:** These individuals purchase their energy through a local energy cooperative. This arrangement not only contributes to the financial stability of the cooperative but also aligns with its commitment to sustainable energy consumption. By choosing to buy their energy from the cooperative, these participants support the development and implementation of local energy projects and initiatives.

4.3. Collaboration with external organisations

To achieve their objectives, cooperatives maintain relationships with a range of external organisations and groups. This chapter describes each type of partnership, as identified from the interview data.

4.3.1. (Local) energy cooperatives

Cooperation between energy cooperatives is essential for sharing knowledge and resources. Energie Samen, a leading national cooperative and advocacy organisation, is important in promoting such partnerships. They represent the interests of local energy initiatives, including NLS, HWY, Alex and EnergieC, to governments, regulators and grid operators. Thanks to their collaboration with Energie Samen, local energy cooperatives can gain more knowledge, share best practices and gain insight into national trends and policies in the energy sector. This can also give them a stronger voice in national energy policy discussions. Moreover, Energie Samen creates not only a network for sharing resources but also emphasises intellectual and strategic growth. NLS board members highlight the benefits of this relationship: *'Our partnership with Energie Samen encourages us to re-evaluate and improve our strategies for engaging different audiences to ensure that our collaboration is deep.'*

Local energy cooperatives also cooperate. The same NLS board members point out the importance of this interaction between cooperatives: *'We take inspiration from the various initiatives and progress of other energy cooperatives and actively look for learning opportunities by visiting them from time to time.'* Interactions between cooperatives are thus essential to effectively pool resources and expertise. By forming these partnerships, local energy cooperatives not only contribute to the growth of sustainable practices but also advocate for a more unified and cooperative approach to renewable energy projects across the country.

4.3.2. Local governments and municipalities

Energy cooperatives also form partnerships with local governments and municipalities. The cooperatives are actively involved in shaping local energy policies and participate in municipal initiatives. This involvement not only enables cooperatives to influence policy but also often results in them receiving funding from municipal bodies for specific projects or operational needs. An illustrative example is the municipality of The Hague, which actively encourages citizen participation in sustainable initiatives. Their Energy Challenge programme, for example, encourages residents to propose innovative sustainability projects and potentially receive funding. An energy coach from HWY reflects on his involvement in this programme and emphasises its importance in encouraging new, creative approaches to sustainability: *'I have participated in the Energy Challenge three times, each time asking for new, innovative ideas, systems or research.'*

The synergy between local energy cooperatives and government agencies is characterised by mutual benefits. Cooperatives receive legal approvals, grants and financial support from municipalities. At the same time, municipalities benefit from the cooperatives' specialised expertise and established networks. An interesting example of this effective cooperation is the relationship between Nieuwe Lansinger Stroom and the municipality of Lansingerland. In their early years, NLS initiated a cycling tour for the community and the municipality, which served to raise awareness about sustainable energy in their neighbourhood in a uniquely interactive way. NLS board members describe their relationship with the municipality as strong: *'We have developed an effective co-creation model with active involvement from both sides. Our approach is united and characterised by regular, meaningful discussions.'*

Due to their active involvement, local energy cooperatives often get lost in the complex bureaucratic procedures of government agencies. In response, these cooperatives advocate a more streamlined and cooperative approach to managing energy projects. The NLS board stresses the importance of supportive municipal partners who understand and actively support the cooperative's goals. The success of these cooperatives often depends on the level of commitment and understanding of municipal officials. This dynamic is reflected in the words of a HWY board member, who acknowledges the central role of the municipality in setting energy policy but also emphasises the role of the cooperative in mobilising community participation and strengthening these initiatives. He states, *'Ultimately, the municipality is responsible for setting energy policy and we can only help, contribute and try to involve as many people as possible in these initiatives.'*

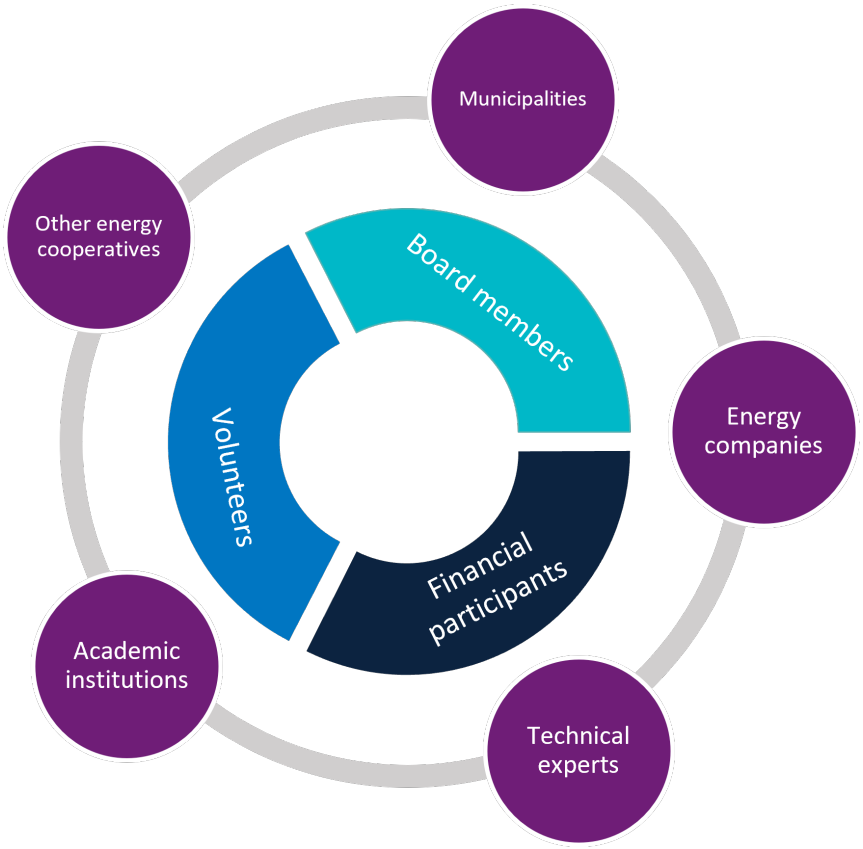

Figure 4.1: Organisational structure local energy communities

4.3.3. Energy companies

Energy companies such as Eneco can provide technical expertise, infrastructure and financial resources. By partnering with such companies, the cooperatives can undertake larger or more technically complex projects than they could do on their own. On the other hand, cooperatives also contribute to energy companies by sharing valuable insights and recommendations. Through such interactions, local energy cooperatives can bring significant influence on energy companies' operational strategies and policy-making, creating a mutually beneficial relationship. A good example of this beneficial dynamic is the cooperation between HWY and Eneco. As an HWY board member says: *'Our cooperation with Eneco has brought significant benefits. Through our help in optimising temperature control, we have enabled Eneco to significantly reduce gas consumption, resulting in significant cost savings.'* This case study illustrates the impact of partnerships between cooperatives and energy companies. It shows how cooperative initiatives can provide practical and economically viable solutions to larger energy companies, benefiting both parties involved.

4.3.4. Technical experts

Moreover, local energy communities collaborate with technical experts and small businesses specialised in different areas of energy production, distribution and conservation. These specialists introduce advanced technological solutions and innovative approaches to assist cooperatives in their projects. For example, manufacturers and installers contribute not only by offering practical solutions but also by participating in thematic events organised by cooperatives. The specialists also provide technical expertise and essential materials such as solar panels. While cooperatives maintain their independence and are committed to providing unbiased advice, they benefit enormously from the knowledge and experience of these technical experts, helping them better understand and implement energy-related projects.

4.3.5. Academic institutions

Lastly, an important form of cooperation for MRDH's local energy cooperatives is their collaboration with academic institutions, such as Delft University of Technology and The Hague University of Applied Sciences. An NLS energy coach illustrates this collaboration: *'Our project against overheating consisted of 45 houses, each equipped with two measuring boxes. As these boxes generate data every 10 minutes, the collected data is huge. We provide this data to students at The Hague University of Applied Sciences for their graduation theses or research projects.'* Both parties benefit from this collaboration: the cooperative gains valuable insights from the fresh eyes and analytical skills of students and researchers, which can be applied to improve their projects and deepen their understanding of energy-related challenges. Conversely, students and researchers gain access to real-time empirical data from local energy initiatives. This provides an excellent opportunity for applied learning and research and contributes significantly to improving knowledge in areas such as renewable energy, environmental science and data analysis.

In summary, the different roles individuals play in energy cooperatives, combined with partnerships with external organisations, are key factors for successful local energy communities. The involvement of board members, volunteers and financial participants contributes to a diverse cooperative structure. In addition, partnerships with entities such as other energy cooperatives, local governments, energy companies, technical experts and academic institutions increase the potential and impact of cooperatives. Figure 4.1 provides a visual representation of the organisation of energy cooperatives.

4.4. Motivations of members of cooperatives in MRDH

Based on findings from observations and interviews conducted for this study, this chapter examines the reasons that drive citizens to join these communities.

4.4.1. Environmental concerns

To begin with, the interviews show that environmental concerns are an important driver for people to join local energy communities. This motivation comes from the desire to contribute to a sustainable environment and actively participate in using renewable energy sources, in line with a shared commitment to reducing the carbon footprint. One interviewee, a former business developer fascinated by complex environments, sees the transition to sustainability as a challenging game. Although he is considering leaving the cooperative because the 2025 sustainability target is in danger of not being met, he remains motivated to contribute to a more sustainable world. He describes the members of the cooperative as *'well-intented amateurs striving for a sustainable society'*.

Furthermore, a common feeling among participants is dissatisfaction with the actions of the government and politicians on environmental issues. This is summed up in a statement by an Alex Energie board member: *'The general motivation is mainly that we all see that things are not going well and if we leave everything to the government and especially to politicians, well, then we won't get anywhere at all.'* This expresses a shared belief that individual and collective action is essential to tackle environmental problems, a sentiment that is increasingly reflected in growing civic initiatives. Therefore, commitment to environmental conservation, climate awareness and a shared sense of responsibility for future generations are the first important motivations.

4.4.2. Community engagement

Interviews with members of local energy cooperatives also show that community involvement plays an important role as a motivator for participation. Central to this involvement are social and community aspects, which were repeatedly highlighted by interviewees. Participation in local energy initiatives promotes a strong sense of belonging and collective achievement. One interviewee indicated that it is nice to work in a local environment, where informal interactions take place, *'perhaps over a beer'*. Many people have this preference, especially those who have transitioned from an active job to a more relaxed lifestyle. For retirees, it is a way to spend their time, keep them young and together and contribute to society after retirement.

The social dimension of these communities is illustrated by NLS's energy shop. This space, initially intended as a practical centre for questions about sustainable energy is developing into a lively social meeting place, similar to a café. It is a place where community members can enjoy coffee, tea or an evening beer. As described by an NLS board member: *'At the energy shop it is super cosy, so a lot of people visit. I'm there on Wednesday mornings. It opens at 9.30 am, but I'm often there by 9.00 am because I love being there way too much.'* This statement sums up well the essence of community involvement in these initiatives - it is not just about volunteering or contributing to a charity, but about the pleasure of being part of a like-minded community, in line with shared interests and values, and the simple pleasure of sharing a drink or spending time together.

4.4.3. Personal interests

People's involvement in local energy cooperatives is strongly linked with their personal interests and passions, according to interviews with cooperative members. Participating in activities such as holding energy coaching sessions, attending informative meetings or spending time in the energy shop goes beyond just participating; these activities serve as sources of personal satisfaction and energy. An NLS board member illustrates this feeling by noting, *'Sometimes I organise a meeting at someone's home, we sit down for about 2 or 3 hours to inform those people. That's incredibly fun. I always go there with a bit of energy, but I go home with much more energy.'*

An energy coach from HWY also describes his role as *'a kind of hobby, but with serious undertones'*. He tells an experience where he and other residents built a cart to measure energy efficiency. This project, which serves both a practical and a communal purpose, is also in line with his personal interests and combines fun with an important contribution to his community.

Figure 4.2: The motivations of members of cooperatives in MRDH

Another energy coach sometimes uses cooperative opportunities to turn his ideas into funded projects. He explains that if he wants to get government grants, they do not send them directly to him, but suggest he set up a foundation, which requires a board, treasurer, chairman, a Chamber of Commerce number and registration. He describes his involvement as *'a paid hobby'*, driven by a desire to experiment and use the community as a platform to realise creative ideas. This experimentation includes practical implementation, considering aspects such as cost, materials and feasibility. By joining these cooperatives, people can engage in activities that match their passions and interests.

4.4.4. Cost savings

The final recurring motivation is the significant impact of cost savings. Participants show enthusiasm for initiatives that not only contribute to environmental sustainability but also provide financial benefits. The affordability aspect covers different demographic groups, from retirees to young couples looking for practical energy efficiency solutions. People become more aware of their energy consumption and explore options for cost-effective solutions. They are actively seeking ways to reduce their energy costs. Collective purchasing power, shared infrastructure costs and the prospect of government incentives or subsidies help make participation financially attractive.

Moreover, in times of economic pressure and uncertainty about energy prices, people are turning to local energy communities for answers. The community acts as a valuable source of insights, support and expert guidance in navigating complex energy landscapes. As an NLS board member points out, the rise in energy prices has significantly increased the demand for guidance in the community: *'When prices were under pressure, many people came here with questions about their energy bills and for an energy coach. We had only 4 or 5 energy coaches and we had to double up quickly because we just couldn't cope. Our peak then was at 300 calls a year. In September, we had a very high peak in requests for energy coaches. That was when the price cap was introduced and it was very unclear at the time what that meant, so it was extremely busy here. A lot of people came here worried and then they came to us for information.'* This statement highlights the important role played by local energy communities in times of uncertainty. The increase in the number of queries and the need for energy coaching reflects the essential function of the community in providing relevant information.

In summary, the motivations that drive people to participate in local energy cooperatives include the desire to address environmental challenges, participate in community-oriented projects, engage in personal interests and achieve cost savings. The motivations contribute to the success and liveliness of these communities and are visually represented in Figure 4.2.

4.5. Key trends in the local energy community initiatives

Several key trends also emerged from the observations and interviews, highlighting the evolving nature of these communities and their environment.

4.5.1. Technology awareness and adoption

As a first key trend, the interviews show a shift among participants in local energy communities from scepticism to acceptance of and interest in renewable energy technologies, especially heat pumps and solar panels. Initially, there was a lot of resistance and negative stories about these technologies. Now, there is not only a general acceptance but also a strong interest in choosing the right type of technology, indicating a deeper understanding of and commitment to renewable energy options.

This change is also reflected in the questions that energy coaches receive. An energy coach who is often in the energy shop in Lansingerland notes, *'What we have noticed is that people's questions have changed. In the beginning, people came in knowing absolutely nothing and we had to explain everything to them. Now they are already asking specific questions, such as how much electricity a heat pump consumes. We notice that people are asking more and more specific questions. It's a great development: everyone is becoming more aware of everything and it's happening really fast.'* This quote indicates that people who were previously unaware are now stepping into local energy shops with specific questions and going into technical details. The shift reflects a positive trend towards greater awareness among community members but also requires adjustments in the provision of information during organised meetings for members and in the approach to citizens by energy coaches.

4.5.2. Behavioural change and energy awareness

Another trend is greater energy awareness among community members, leading to behavioural change. This is reflected in discussions on energy consumption patterns, the use of LED lamps and taking energy-saving measures without large capital investments. For example, energy awareness is reflected in people's energy consumption. A case study conducted by a HWY energy coach at five reference homes illustrates this effect. The study found that heat consumption had reduced by 15% thanks to the installation of monitoring devices in homes. The energy coach explains: *'People are suddenly aware because there are these measuring boxes with lights all over the house. Presence cannot be denied, so people become constantly aware of things like ventilation and heat demand. It's a free reduction because people haven't invested anything or changed their homes, it's just the behaviour of people.'*

Such anecdotes contribute to the overarching story of a community paying increasing attention to the details of their energy consumption. Local energy communities are becoming more informed and actively participating in the pursuit of optimal energy solutions. One of the reasons for the fall in energy consumption and rise in energy awareness was the high gas prices due to the unexpected conflict in Ukraine. This led to a sudden and widespread awareness. One interviewee mentioned conventional boilers as an example. These boilers were a system that served residents well until the sharp rise in energy prices became apparent. Consumer awareness benefits local energy cooperatives because more and more people now seek advice on energy bills, which significantly increases the demand for energy coaches.

4.5.3. Cooperative development and professionalisation

The trend towards professionalisation in energy cooperatives is becoming increasingly obvious, especially within the MRDH. As energy communities grow, with an increasing number of individuals involved, there is a recognised shift from informal, volunteer-based cooperation to a more formal, structured organisational framework. NLS, for example, began as a small volunteer-led group with a handful of members and has since expanded to 35 members. This professionalisation is characterised by the development of more organised and efficient administrative systems, the formalisation of roles and possibly the hiring of paid staff or coordinators.

Another crucial aspect is the effective organisation and application of the huge knowledge and experience gained by these communities. A current NLS board member highlighted this by saying, *'We collect so much information, but our methods of gathering and focusing this information need to be improved. Our goal is to use this enormous amount of experience and knowledge of our 35 volunteers in a better way, as it currently remains unused.'*

Figure 4.3: Key trends in the local energy community initiatives

Moreover, with the growth of cooperatives, the importance of partnerships with other cooperatives and organisations has increased as well. Energie Samen, the umbrella organisation for Dutch local energy cooperatives, plays a central role in facilitating the exchange of ideas and promoting productive interactions between communities. However, cooperation and knowledge exchange with other cooperatives is still limited. Moreover, energy communities not only want to connect with fellow cooperatives but also to improve cooperation with local government bodies. They aim to work with municipal authorities to influence policy-making.

4.5.4. Political and economic influences

Finally, external factors such as government policies, subsidies, economic conditions and international events such as the conflict in Ukraine have a major impact on the activities and strategic decisions of local energy cooperatives. Changes in government support for renewable energy, fluctuations in energy prices and responses to global crises can significantly affect the progress or decline of these local initiatives. The influence of national and global factors is diverse and ranges from adapting to energy price volatility to adopting best practices from around the world.

NLS board members have seen how external factors influence consumer behaviour. For example, they noticed that public interest in alternative energy solutions, such as heat pumps, increased when energy tariffs became unstable: *'Boilers were fine until energy tariffs fluctuated. Then people suddenly panicked and wanted to know what they could do with heat pumps.'* In addition, the success of implementing heat pumps in countries such as Switzerland and Norway did not go unnoticed in the Netherlands, inspiring local initiatives to consider similar models for the Dutch market.

Moreover, other economic trends, such as the falling cost of solar panels, are also shaping cooperative strategies. Shorter waiting times for solar panel installations reflect a keen awareness of and response to market dynamics. This flexibility, particularly evident in the solar sector, demonstrates a forward-thinking approach that aligns these communities with global economic movements and facilitates the adoption of sustainable practices.

In summary, research on local energy cooperatives in the MRDH has found important trends that show their evolving nature. These key developments emphasise the adaptability and growing importance of local energy cooperatives in the energy transition and are graphically illustrated in Figure 4.3.

4.6. Main takeaways

This chapter explores the environment of local energy cooperatives in the MRDH and summarises with these conclusions:

- **Historical development:** Local energy cooperatives emerged from small, passionate groups committed to environmental sustainability. They grew from informal meetings around the kitchen table to structured cooperatives, supported by municipalities and expanding their focus from wind energy to broader renewable energy initiatives.
- **Organisational structure:** Cooperatives operate with a dual structure that combines community involvement with business activities, allowing them to pursue sustainable goals while being financially self-sufficient. Members play different roles, such as board members, volunteers and financial participants, and contribute to the success of the cooperative in different ways.
- **Collaboration with external organisations:** Successful cooperatives establish partnerships with other energy cooperatives, local authorities, energy companies, technical experts and academic institutions. These partnerships improve knowledge sharing, support project implementation and strengthen the cooperatives' influence on local and national energy policy.
- **Motivations of members:** Members join cooperatives out of environmental concerns, community involvement, personal interests and cost savings. These motivations highlight the role of cooperatives in promoting a sense of belonging and common purpose among members, while also addressing practical issues such as energy affordability.
- **Emerging trends:**
  - **Adoption of technology:** There is a clear shift from scepticism to acceptance of and interest in renewable technologies, with community members becoming more informed and curious about options such as heat pumps and solar panels.
  - **Behaviour change:** Increased energy awareness among members leads to reduced consumption and more sustainable behaviour, partly driven by external factors such as rising energy costs.
  - **Professionalisation:** As cooperatives grow, there is a trend towards more formalised and efficient operations, including the ability to hire paid staff and improve management of accumulated knowledge and resources.
  - **Influence of external factors;** Political, economic and global events have a major impact on cooperatives, from technology choices to strategies to address energy price volatility.

5

Current activities in MRDH's local energy communities

This chapter examines the main focus of local energy cooperatives in the MRDH. It provides a detailed exploration of their primary activities, which include providing advice, generating information, producing renewable energy and implementing various engagement strategies.

5.1. Advising

Advisory services within local energy cooperatives are important to lead communities towards a more sustainable and energy-efficient future. As described in the chapter Chapter 4, there has been a significant shift in public awareness of technology and sustainability. This shift is especially seen in changing attitudes towards adopting sustainable practices in homes and everyday consumption behaviour. Local energy cooperatives actively offer various forms of advice to support this transition to more sustainable living. In this section, four activities to provide guidance and support towards a greener, more sustainable future, are discussed.

5.1.1. Home visits by energy coaches

First of all, the activity of home visits by energy coaches, as described in the interview results, is important to promote sustainable living and energy efficiency in households. In October 2018, NLS established a team of energy coaches and since then they have already conducted more than 600-700 home visits. These home visits are designed to help homeowners understand how to make their homes more sustainable. Energy coaches provide personal advice on improving energy efficiency, reducing energy consumption and integrating renewable energy sources. As the NLS volunteers say, *'The aim of this activity is really for people to understand how to make their homes more sustainable and thus find a simple approach to do so. As an energy coach, you talk to all kinds of people who may or may not have money, or who are going to move soon. All sorts of things are going on. The trick is to listen to them and make a plan of action together'*.

Depending on the local municipality, the energy coaches usually receive minimal compensation and travel expenses for their work. They play a crucial role in providing personalised advice to households, but given the diversity of homes and situations, this can sometimes be challenging. To maintain a high level of service, the coaches receive specialised training and meet regularly to exchange knowledge and experiences. Their training covers both technical aspects of energy efficiency and softer skills such as effective communication and motivational techniques. The aim is to equip them with the knowledge to give practical, unbiased advice while encouraging and motivating homeowners to take action on sustainability. Although the coaches receive training and meet regularly, they can still face difficult situations. An EnergieC volunteer highlighted this aspect: *'Our energy coaches, many of whom have technical professions, meet every two to three months to discuss and learn from each other. However, sometimes they come across situations outside their expertise. In such cases, our standard advice is to consult with the municipality first.'*

Individual advisory sessions

Energy coaches visit homes and give advice on an individual basis or during group sessions. Individual home visits are usually quite informal and consist of several key steps. Before the visit, energy coaches gather essential information about the household, such as energy consumption patterns, current insulation, heating systems and the homeowner's specific concerns and goals. During the visit, they carry out a more detailed assessment but also take the time to personally connect with homeowners. One HWY energy coach describes the approach as follows: *'Every 2 or 3 weeks, I volunteer to help someone. We start with an informal chat over coffee, often complimenting their home to create a pleasant atmosphere. Then I gently introduce topics such as energy-saving options.'*

Energy coaches focus on aspects such as the quality of insulation, the state of windows and heating systems and signs of inefficient energy use, such as mould or moisture. The coach listens to the resident's concerns, financial considerations and future plans, such as moving. The coach adapts the advice based on these conversations so that it is relevant and practical for the specific household. Subsequently, energy coaches give practical advice on simple but effective energy-saving measures. These could include tips on using curtains or draught strips to improve insulation, optimising heating system settings and identifying appliances that consume a lot of energy.

The coach can also discuss possible upgrades or changes to make the house more sustainable, for example implementing solar panels, heat pumps and other renewable energy options. The feasibility and cost of these options are considered, along with any local incentives or subsidies available. After the visit, the coach prepares a detailed report summarising the findings and recommendations. This report is sent to the homeowners for review. It often includes options for further actions, such as requesting offers for solar panels. In this way, as HWY board members stress: *'Energy coaches can easily identify the problems and provide valuable advice free of charge.'* In some cases, energy coaches also encourage homeowners to get involved in their community, for example by participating in neighbourhood sustainability initiatives or collective energy-saving projects.

Group advisory sessions

Besides individual assessments for each household, home visits can also be extended to group advisory sessions for a neighbourhood or even an entire street. An innovative approach by NLS is the "heat safari". This unique concept uses an infrared camera to take images of houses, highlighting areas of heat loss such as roofs, windows, doors and facades. This method not only identifies energy inefficiencies, but also promotes collective awareness within the community. One NLS volunteer described the impact of these safaris: *'After sharing the infrared images, we discuss them together. Residents are also encouraged to bring their energy bills from the past year. It is particularly rewarding when these sessions lead to community initiatives, such as groups deciding to jointly renovate their roofs and install solar panels, or jointly insulate cavity walls and floors. It's about more than just energy; it's about creating a socially connected community, with energy efficiency as a catalyst.'*

After a heat safari, participants receive tailored insulation advice together with actionable strategies from the coaches. Participation in the heat safari is free but requires the involvement of at least six neighbouring homeowners who must be present during the exercise. In addition, one participant must volunteer at their home for the presentation afterwards, where the findings and recommendations will be discussed. It is important to note that a heat safari for thermal imaging accuracy is only feasible when the outdoor temperature is 10°C or lower, so there is a clear contrast between indoor and outdoor temperatures.

5.1.2. Informative and themed evenings

Secondly, the local energy cooperatives in MRDH organise informative and themed evenings to raise awareness. These gatherings serve as a platform for sharing knowledge, discussing new ideas on sustainability and engaging a wider audience in an informal setting.

Nieuwe Lansinger Stroom

NLS organises themed evenings throughout the year on key aspects of energy conservation, such as insulation, solar panels and heat pumps. These informative events are specially designed to guide community members on the most effective steps they can take to improve the energy efficiency of their homes. These meetings are not only informative but also interactive, with both board members of NLS and a panel of experts, including energy coaches from the cooperative and technical specialists or representatives from energy companies. Their presence ensures that participants have direct access to professional advice and can get answers to their specific questions.

In addition, these themed evenings are designed to be attractive and enjoyable. As a participant, you not only gain valuable knowledge but also get the chance to take part in competitions that allow you to win a prize. This approach not only educates but also creates a fun and stimulating environment, encouraging more members of the community to participate and engage in the topic of energy efficiency and sustainability. A picture taken during one of their themed evenings is shown in Figure 5.1.

Figure 5.1: Themed evening at NLS (De Heraut, n.d.)

Stichting Hernieuwbare Warmte Ypenburg

HWY also holds informative sessions to educate the community about energy-saving techniques and ways to reduce energy bills. For example, in November 2023, HWY organised an informative event titled *'Hulp bij energie besparen!'* ('Help with saving energy!'). This event was designed in response to the overwhelming interest shown at an earlier residents' meeting. A board member of HWY said, *'Our previous residents' meeting was so popular that we, unfortunately, had to turn away about 100 people due to the limited space in the church. To meet the high demand, we are organising another meeting on 7 November, this time at the spacious Lyceum Ypenburg.'*

The event was held in cooperation with the municipalities of The Hague and Pijnacker-Nootdorp. Several stalls were showcasing both large and small energy-saving measures applicable to both tenants and homeowners. These stalls were manned by experts and energy coaches who provided detailed information on various topics. They included updates on ventilation systems, the installation and benefits of heat pumps, insulation techniques, the use of solar panels and guidance on obtaining grants for these improvements. An example is shown in Figure 5.2.

Figure 5.2: HWY's information market (Duurzaam Den Haag, 2023)

Besides the interactive information stalls, the evening also included presentations. These presentations covered various topics, from practical measures that can be applied for energy savings to an overview of current and future HWY projects. A key element of the event was the presence of the alderman of the municipality of The Hague, who highlighted the supportive role of local government in encouraging sustainable development from the community. The alderman presented the wider initiatives undertaken to make the Ypenburg and de Venen districts in Nootdorp more sustainable. These informative meetings, organised by HWY in collaboration with local authorities, thus provide valuable information and promote direct interaction between residents and experts, stimulating a collective movement towards a more sustainable future.

5.1.3. Energy shops

Energy shops also offer advisory services and social interaction. However, not all energy cooperatives in the MRDH have access to such a facility. Of the four cooperatives, NLS is the only one to have an energy shop. The shop is located in a popular area of Berkel en Rodenrijs, where many people pass by when they go out for dinner. This convenient location often attracts the attention of passers-by, encouraging them to spontaneously visit the shop.

The atmosphere in the shop is similar to that of a café, with a relaxed and welcoming atmosphere. Here, people feel comfortable asking for advice, delving into energy topics or just connecting with other sustainability enthusiasts. One NLS volunteer describes their vision: *'I see the energy shop as a kind of café. Visitors should feel welcome for coffee, tea or even a beer, especially in the evening. It's about creating a space where like-minded people can come together.'*

The shop is staffed by committed volunteers who work in shifts and ensure that someone is always available to help visitors. These volunteers talk to citizens about sustainable living, different insulation techniques and eco-friendly installations, all demonstrated in a model home (see Figure 5.3). This model home in the energy shop gives visitors a concrete demonstration of sustainable solutions. As an NLS volunteer explains, *'In the Energy Shop, we can show practical things, which is essential for many people. Without this, sustainable solutions can feel abstract and impractical, almost like abracadabra to them.'*

Figure 5.3: NLS's Energy Shop (Nieuwe Lansinger Stroom, n.d.)

Contrary to what the name suggests, the Energy Shop does not engage in commercial transactions. It is a not-for-profit energy cooperative dedicated to voluntarily helping community members with all matters related to energy. The shop provides independent, unbiased information aimed at empowering community members to make well-informed energy decisions. As volunteers at NLS put it themselves, *'There are sometimes questions about our independence, but our focus is to be as transparent as possible. Although we offer guidance and information, the final decision to take action lies with the people themselves. We encourage local initiatives and recommend requesting multiple quotes from different companies.'*

5.1.4. Online resources and websites

Lastly, local energy cooperatives' websites provide comprehensive, user-friendly resources on sustainable living and energy conservation. The websites provide articles, guides, and videos covering everything from basic energy-saving tips to detailed explanations of how different renewable energy systems work. Also, the websites offer regular updates and news on ongoing projects, such as collective purchasing schemes for solar panels or community initiatives like the heat scan. They also keep users informed about the latest developments in energy policy, technological advances and changes in subsidy schemes. Information about upcoming events, workshops or themed evenings is also available. In addition, the websites often provide opportunities for direct contact, such as scheduling a visit from an energie coach or seeking advice from a specific board member. This feature ensures that individuals who need more personalised guidance can easily ask for help. These digital platforms are thus important for reaching a wider audience and providing easy access to information and support. Figure 5.4 shows the homepage of EnergieC Midden-Delfland, with the latest news updates, an option to request a meeting with an energy coach and detailed information about the organisation.

Figure 5.4: Homepage EnergieC (https://www.energiecmiddendelfland.nl)

5.2. Generating information

Within local energy cooperatives, information is generated through different activities such as pilot projects, research within working groups, and having access to a whole local network. In this chapter, the different ways of generating information within the local energy cooperatives are categorised into two key areas.

5.2.1. Pilot projects and technical research

Pilot projects are very useful for local energy cooperatives and provide a practical platform to test new ideas and technologies. These projects allow cooperatives to develop, implement and evaluate technical solutions, such as upgrading outdated mechanical ventilation systems to more efficient models. A HWY board member explains the importance of these efforts: *'Our working groups come up with tangible, practical solutions. It is remarkable how a residents' group works so technically and intensively with a heat grid energy supplier to optimise solutions.'*

These initiatives are usually organised by working groups led by volunteers and overseen by cooperative board members. An Alex Energie board member explains their process: *'Our working groups formulate project proposals and submit them to us for evaluation. Our job is to assess the feasibility and potential impact of these proposals.'* The scope of these working groups is diverse and includes topics ranging from improving external communications and home improvement strategies to pioneering developments in solar energy and moving away from gas-dependent homes.

Their research activities include critical and technical examination of existing systems and direct community involvement. This also includes conducting practical experiments such as adjusting home temperatures to evaluate heating efficiency, and turning local neighbourhoods into dynamic 'living laboratories'. One of HWY's volunteers highlights this unique aspect: *'My neighbourhood is not just a laboratory; it is a living laboratory. This is an important difference, especially since many companies have R&D departments but no real testing environment. In contrast, I can apply and test ideas in a real community environment.'* These practical tests are crucial and provide invaluable feedback and insights. The direct involvement in practical applications allows cooperatives to refine and further develop new ideas and technologies so that they are suitable for implementation in the real world and can meet the specific needs and circumstances of the community.

HWY is an example of a cooperative with a strong technical focus and commitment to research. They actively participate in numerous pilot projects and technical studies and are researching innovative energy solutions. An important initiative of HWY is the research into geothermal energy as a viable alternative to traditional energy sources for the Ypenburg region. About 10,000 homes in Ypenburg are currently connected to Eneco's gas-fired heat grid. Therefore, HWY is working closely with Eneco to make its existing heat grid more sustainable. HWY board members highlight their research and collaborative efforts, *'Our research focused on critical factors, including grid losses and choice of energy sources. The findings show that geothermal energy is the most effective source. Eneco makes the final decision on the energy source, but our role is to contribute technical expertise.'* This initiative led to a strategic switch from conventional gas-fired power plants, which heat water to around 100 degrees Celsius, to geothermal energy, which offers a more sustainable alternative with water temperatures around 70 degrees. The usability and implementation of this lower-temperature heat grid is a key focus of HWY's ongoing research efforts.

Besides geothermal energy exploration, HWY is actively involved in other technical investigations. An important focus is the working group dealing with technical safety issues in collaboration with Eneco, external consultants and local government agencies. This group tackles complex challenges such as the removal of pumps from heating systems and evaluates the subsequent effects on domestic cooling systems. At the same time, another team within HWY is looking into strategies for the transition of homes currently powered by gas. Their research centres around crucial questions, such as: *'What are the optimal solutions for homes that rely on gas heating? Should these homes be integrated into a communal heat grid, or is it more feasible to opt for individual, stand-alone energy solutions?'* Finally, HWY has formed a working group focused on improving the efficiency of heating systems. This team has focused on modernising heating infrastructure, particularly targeting outdated mechanical fans that have been in use for more than 20 years. According to HWY board members, one of their volunteers *'discovered that replacing traditional mechanical fans in a heating system with more energy-efficient DC motors controlled by sensors can significantly reduce heat loss. The estimated reduction in heat loss is between 23% and 40%.'*

When HWY's research reveals positive results, they proactively spread these findings to both members of their cooperative and the wider neighbourhood community. As one HWY volunteer put it, *'When our efforts prove successful, we make sure our club members and the wider community are informed. We publish our reports on our website. In addition, our energy coaches are kept informed of these developments and I often meet colleagues who are working on similar projects in their neighbourhoods. This also allows us to compare different house types in different neighbourhoods.'* This approach underscores HWY's commitment to improving energy efficiency and minimising waste throughout the community.

5.2.2. Local network

Local energy cooperatives play an important role in collecting and researching information about life in the community. This includes details about house designs, how people use energy and what the community prefers. As these cooperatives take on various advisory roles, they learn a lot about their neighbourhood. For example, during their home visits, energy coaches not only give tips on better energy use but also collect important information such as insulation quality and energy production methods. One energy coach from NLS looks back on this experience and points out the personal benefits of their training and interactions: *'What surprised me was how the knowledge I gained during the courses and discussions not only benefits the homeowners I visit but also turns out to be very useful in my own life. It is a practical application of knowledge that is also useful in my own home.'*

Like energy coaches, volunteers in energy shops also play a crucial role in creating information through local networks. They listen attentively to people's questions and needs, giving the cooperative a better understanding of local needs. This interaction promotes a network that enables the cooperative to create and implement energy solutions tailored to their community. An important aspect of this process is collecting and analysing feedback from community members. This goes further than just information sharing and education; it involves actively listening to and responding to residents' needs and experiences. Such feedback is important for refining the cooperative's strategies and aligning them with community expectations.

While cooperatives generate a lot of local knowledge, there is a need for more effective use of this gathered information. An NLS volunteer stressed this aspect: *'We get so much information from our interactions, but we do not know how to combine and strategically use this data. We want to develop this further because we realise that together our team of 35 volunteers has so much experience and knowledge. We are well aware of how much we know, but we need to get better at using this knowledge for impactful actions.'* In this way, the cooperatives are actively looking for ways to systematically organise and apply this generated knowledge in a way that benefits both the community and their initiatives. This shift towards better use of information is a step towards professionalisation, as discussed in Chapter 4.

5.3. Producing renewable energy

This chapter looks at the different approaches of local energy cooperatives in the MRDH region to utilise renewable energy sources. It focuses on solar initiatives but also looks at the development of renewable heat networks.

5.3.1. Solar energy

Nieuwe Lansinger Stroom, EnergieC Midden-Delfland and Alex Energie are all local energy cooperatives focused on generating solar energy, mainly through rooftop solar projects.

Nieuwe Lansinger Zon

NLS has successfully developed three operational solar roof projects, the largest of which is on the roof of a pepper grower's large shed in Bleiswijk, with almost 1,000 solar panels. The other two projects, each with around 200 solar panels, are on the shed of a contractor and the roof of a large retail shop. These sites were chosen not only because of their building suitability but also because of the mutual business benefits they offer, as one NLS volunteer emphasises: *'The availability of these rooftops is not just coincidental, there is also a business aspect to it. Those involved also enjoy financial benefits.'*

In collaboration with energy supplier SamenOm, NLS efficiently manages the distribution of energy generated by these solar installations. However, the cooperative faced obstacles in implementing the project, including various challenges and local government politics. The cooperative advocated for more government involvement, especially in facilitating the use of rooftops of public buildings for solar projects. An NLS volunteer looks back on his experience: *'We currently have three operational rooftops that are performing well. This was an effort within our cooperative, a process we can describe as 'mono-creation'. We wish the municipality would contribute by offering public spaces, such as roofs for sports halls. But despite their intentions, little progress has been made for years.'*

In this way, NLS has implemented these projects independently of the municipality and has actively approached several companies to assess the suitability of their roofs for installing solar panels. This proactive approach demonstrates the cooperative's commitment to renewable energy and its ability to navigate and overcome the challenges of implementing such projects.

Alex Energie

In the Rotterdam municipality of Prins Alexander, neighbourhood-driven Alex Energie is also hard at work on initiatives to make use of solar energy from unused rooftops, as shown in Figure 5.5. The aim is to contribute to a cleaner future for Rotterdam and the planet and to add a financial return for participants. Currently, the cooperative is preparing a new solar project on the roof of a public school in Schiebroek, for which they *'will soon start the recruitment campaign,'* said an Alex Energie board member. There are also plans for two collective solar roof projects in the Prins Alexander area.

Figure 5.5: Solar power generation by Alex Energie (https://www.alexenergie.nl/)

Figure 5.6: Five steps to participate in the solar panel initiative (Alex Energie, n.d.)

Interested individuals in these solar roof projects are encouraged to sign up, with the option to finance multiple panel sections at €25 each. Investors will receive a full repayment with 2.5% interest, but leave profit for the community fund. Participants in these projects, known as 'PaneelDelers' play a central role in the realisation and yield of a collective solar roof. This opportunity is particularly attractive for people without a suitable roof for solar panels or for existing solar panel owners who want to further contribute to sustainability. On Alex Energie's website, they outline a five-step plan to participate in the solar panel initiative, detailed in Figure 5.6.

EnergieC Midden-Delfland

EnergieC Midden-Delfland has also made significant progress on renewable energy. Their first solar project was completed in just one year with the participation of about 38 members. Since then, they have expanded their efforts to solar installations on rooftops of apartment buildings in Maasland and recently completed their largest project on a sports hall in Schipluiden, significantly increasing their membership. Currently, the cooperative has four solar roofs and an impressive annual energy production in 2022 of 162,300 kWh. The cooperative's success is remarkable compared to other local cooperatives. As one of their board members said: *'Deelstroom Delft, for example, is very active but suffers more from a shortage of available roofs than from a shortage of members. With us, there is no shortage of rooftops. So we are open to cooperation and let members of other cooperatives participate in our projects.'* However, they also face challenges in expanding projects due to grid capacity and fluctuating energy market conditions.

Investing in solar energy with EnergieC is easy and user-friendly, as described on their website. Interested people can sign up quickly to be notified when new rooftops become available. EnergieC then responds by emailing those registered with additional information and the opportunity to acquire shares in the project. Owners of large, unused rooftops are invited to contribute to the cooperative's efforts by offering their space for solar panels. By buying solar shares, participants provide the funding that makes these solar projects possible. Moreover, EnergieC receives government subsidies for the electricity produced, thanks to the Rijksdienst voor Ondernemend Nederland (RvO), which are distributed fairly among participants. This collaborative model not only promotes sustainable energy initiatives but also encourages a community-based approach to investing in renewable energy.

5.3.2. Heat networks

In addition to solar energy initiatives, cooperatives in the MRDH are also involved in other forms of renewable energy projects. One interesting example is HWY, which is taking the lead in developing sustainable heat networks. An HWY board member expressed their mission as follows: *'The initiative came from a residents' group from different neighbourhoods calling for lower heating costs. We established this foundation, aimed at achieving sustainable heat by 2025 - an ambitious but tangible goal that we are working towards together.'* Key to HWY's approach is its proactive engagement with the community and stakeholders to evaluate the prospects of geothermal energy in Ypenburg and to understand the feasibility and safety of tapping geothermal resources for district heating.

In a related project, Alex Energie is also investigating the possible construction of a compact district heating network in part of Prins Alexander. Setting up these heat networks, which distribute heat from a central source to a series of buildings, marks a transition to a more uniform and environmentally friendly approach to heating solutions.

5.4. Engagement

This chapter addresses the fourth activity within MRDH's local energy cooperatives. It describes the different strategies the cooperatives use to work with different groups to promote renewable energy. Initially, the chapter examines the approaches used by these cooperatives to attract new members. It then discusses the tactics used to maintain the involvement of existing members and concludes with an examination of how cooperatives work with external stakeholders to promote their renewable energy initiatives.

5.4.1. Involvement of new members

Energy cooperatives use different strategies to attract new members, ranging from community involvement to digital engagement. NLS, for example, organises thematic events that are not only educational but also help build a community among people with a common interest in sustainability. Similarly, HWY organises the annual 'Dag van de Warmte' to inform residents about current and upcoming projects and provide tips on energy saving. These events have a powerful impact on attracting new members, as they offer interaction with passionate volunteers. A current NLS volunteer shared his experience, *'I remember attending an energy fair at the town hall four years ago. There I met an energy coach who offered a home visit to assess my energy consumption. It triggered something in me and I immediately signed up. That led me to take an energy coach training course myself.'*

Besides these neighbourhood events, the cooperatives also use digital channels to extend their reach. They use social media platforms such as LinkedIn, Facebook and TikTok, and maintain a strong online presence with their websites. This approach is crucial for reaching a wider audience, including younger people. However, as noted by NLS, it is essential to have members who can use these platforms effectively, especially the newer ones like TikTok.

On the other hand, traditional methods, such as newspaper advertisements, also remain effective in attracting new members and volunteers. These people often become board members, volunteers or financial participants and add new ideas and expertise to the cooperative. As a current Alex Energie board member said: *"I became a member myself because there was an advertisement in a local weekly. It said they were looking for people with financial or legal backgrounds. I had none of these backgrounds, but I signed up anyway and asked what I could help with. In the beginning, I mainly reported our meetings and so I got the role of secretary"*.

Finally, potential new members can be approached directly by handing out flyers and brochures in neighbourhoods or at local events. One HWY volunteer describes this as follows: *"When we started the first project, I just started flyering: printed a leaflet, pushed it in the mailboxes the old-fashioned way and then you do get responses"*. These personal interactions are about providing information and helping build a personal connection with potential members.

5.4.2. Involvement of current members

Furthermore, cooperatives are working hard to engage their current members. These members play important roles as they are involved in decision-making processes through regular meetings known as 'Algemene Ledenvergaderingen' (ALV). At these meetings, members vote democratically on important issues and thus influence the strategic direction of the cooperative. An Alex Energie board member stresses, *'Our semi-annual general members' meetings focus on important issues, such as the recent discussion on two new solar roofs. These dialogues are essential to get members' views on complex issues such as procurement costs.'*

These regular meetings are important for both promoting member engagement and guiding financial decisions. As an EnergieC board member notes, *'Critical financial decisions require unanimous consent, at least from those present at our semi-annual meetings.'* Parallel to these membership meetings, the board of an energy cooperative usually meets about every five to six weeks to discuss important issues, ensuring continuous engagement and information flow. A HWY board member explains *'At these meetings, we review progress and address challenges faced by all working groups.'*

The working groups are another way of involving the current members of local energy cooperatives. They focus on relevant issues and allow members to actively contribute their expertise to the cooperative's projects. A HWY board member notes, *'Engaging people in working groups goes beyond participation; it is about motivating them and managing them effectively.'* This approach improves group dynamics and leads to collective progress. Members, regardless of their specific backgrounds, find roles in the cooperative that match their skills and contribute in areas such as secretarial work or project management.

Finally, regular updates through newsletters and direct communication channels, such as e-mail, play an important role in keeping members informed of the cooperative's efforts. These updates are essential to update members' financial investments and maintain a well-informed membership base. In summary, a mix of regular meetings, skills-based working groups, financial engagement and consistent communication ensures that all members, including volunteers, board members and financial participants, remain actively engaged and well-informed about the cooperative's ongoing projects and participation opportunities.

5.4.3. Involvement of external stakeholders

Local energy cooperatives work with various external stakeholders, such as energy companies, municipalities, manufacturers, installers and other cooperatives to promote their initiatives. Although these collaborations are described in detail in Section 4.3, they are briefly repeated in this chapter to highlight their role as a form of activity and a means of engagement.

Energy companies

Cooperatives often enter into partnerships with energy companies. This is important for financing and implementing their projects. These partnerships not only facilitate project implementation but also allow cooperatives to influence energy companies in improving the efficiency and sustainability of their operations by providing valuable insights and recommendations. Through such interactions, a mutually beneficial relationship is created.

Local governments

Furthermore, cooperatives actively cooperate with local governments and municipalities, building strong relationships through regular involvement and participation in community projects. This cooperation often extends to other stakeholders, as demonstrated by HWY's participation in *'triangular meetings'* with the municipality and Eneco.

Nevertheless, the cooperatives sometimes experience difficulties in dealing with municipal procedures. The effectiveness of these cooperatives often depends on the support of municipal officials who advocate and support the cooperative's interests. An example of successful cooperation with local authorities can be seen in Figure 5.7, where the municipal alderman celebrates the commissioning of two new solar roofs for NLS. This example highlights the potential for achieving positive results through close cooperation between municipalities and cooperatives.

Figure 5.7: Engagement governments (Hart van Lansingerland, 2023)

Energie Samen and other energy cooperatives

Cooperation between energy cooperatives is important for sharing knowledge and resources. Energie Samen represents the interests of local energy initiatives such as NLS, HWY, Alex and EnergieC and engages with governments, regulators and grid operators. In addition to this national partnership, energy cooperatives also cooperate with each other, strengthening the concept of regional cooperation. An example is the discussion between EnergieC Midden-Delfland and Deelstroom Delft on sharing solar roofs, which illustrates the practical application of such cooperation in solar energy. These interactions are crucial to effectively pool resources and expertise. By establishing these partnerships, local energy cooperatives not only promote sustainable practices but also encourage a more integrated and collaborative approach to renewable energy projects across the country.

Others

Finally, some other external stakeholders play a crucial role in the success of local energy cooperatives as well. These include academic institutions and technical experts. Cooperatives partner with academic institutions to share knowledge and insights on energy challenges, and they partner with companies and manufacturers for project support, including procurement of materials and access to technical expertise. This strategy of collaboration with academic institutions, companies and manufacturers highlights the cooperatives' commitment to using different areas of expertise to promote renewable energy initiatives.

5.5. Main takeaways

This chapter examines the current activities of local energy cooperatives in the MRDH and summarises the main activities as follows:

- **Advising:** Cooperatives offer personal advice on energy efficiency and sustainable practices through home visits by energy coaches, individual sessions, group sessions and other informative events. These services are important in guiding communities towards a more sustainable future by providing tailored advice on integrating renewable energy sources and improving energy efficiency in homes.
- **Generating information:** Through pilot projects, technical research and local networks, cooperatives create valuable insights into sustainable living practices. These activities include testing new technologies, conducting research on renewable energy solutions and gathering community input to develop practical solutions tailored to local needs.
- **Producing renewable energy:** Cooperatives are actively involved in solar energy initiatives, such as installing solar panels on rooftops and exploring renewable heat networks. These efforts are aimed at generating clean energy, reducing dependence on fossil fuels and providing financial benefits to participants through collective investments in renewable energy projects.
- **Engagement:** To attract new members and keep current members, cooperatives use various strategies, including organising thematic events, online presence and digital and traditional media. Collaboration with external stakeholders, such as energy companies, local authorities, fellow cooperatives and academic institutions, is also key in promoting renewable energy initiatives and achieving sustainability goals.

6

Co-creation in local energy cooperatives

As described by Voorberg et al. (2015), the term ’co-creation’ characterises situations in which citizens act as initiators. The formation of MRDH’s local energy cooperatives, as observed in Section 4.1, fits the co-creation model rather than co-production. This allows investigation into the general dynamics of co-creation within these cooperatives, based on the theoretical framework of Puerari et al. (2018), and into their specific activities using the six criteria developed for this study.

6.1. Co-creation dynamics in local energy cooperatives

The research by Puerari et al. (2018) into the dynamics of co-creation within Urban Living Labs identifies five key elements (Section 2.4.1). This section uses these five elements to understand the dynamics of co-creation within local energy cooperatives.

6.1.1. Intended purpose

The first element of co-creation focuses on its intended purpose, which refers to two main goals: ’making together’, where participants work towards a common goal, product, service or process innovation; and ’learning together’, where the focus is on building knowledge, learning from each other and creating networks. As reflected in the interview responses, local energy cooperatives in the MRDH aim for both purposes. A board member of the cooperative NLS expresses their dual focus: *’For us, it is about two things: A) sustainability: we aim for more fossil-free energy, with the way of production is less important than the overall volume. And B) encouraging citizen participation. Although the final responsibility does not lie with us, we think it is very important to facilitate co-creation and form a collective bond.’*

Thus, on the one hand, cooperatives aim to produce more fossil-free energy and engage in sustainable projects, which aligns with the ’making together’ aspect. This involves collective action that produces results in terms of energy production. On the other hand, the focus on citizen participation and co-creation aligns with the ’learning together’ aspect of co-creation. This includes spreading knowledge about sustainable practices and educating both members and the wider community about energy conservation. A HWY board member summarises this approach: *’We provide support and contribution, and we try to motivate as many people as possible to actively participate.’* Therefore, in these cooperatives, both the creation and learning processes are important.

6.1.2. Formal and informal

The second element of co-creation is the balance between formal and informal co-creation processes. Based on the balance observed within ULLs, participation is divided into three groups: the core group, the inner circle and the outer circle. These groups each refer to an important player in the organisation structure of the cooperatives, shown in a previous section (Figure 4.1).

1. **Core group:** The core group usually consists of initiators or founders of the organisation. Their co-creation activities are formalised and often defined by legal responsibilities. In the context of local energy cooperatives, this group consists of board members or founders who are responsible for setting the direction of the cooperative and making key decisions.
2. **Inner circle:** The inner circle consists of dedicated individuals around the core group and engages in semi-formalised forms of co-creation. It includes volunteers who are formally invited to contribute to specific aspects of the cooperative's activities, such as advisory roles or participation in specialised workshops.
3. **Outside circle:** This group consists of individuals who are not strongly or officially connected to the cooperative. Their participation in co-creation is usually more informal and can take place by attending open events organised by the cooperative, participating in community engagement activities or contributing to the cooperative's initiatives in less structured ways.

So in the context of local energy cooperatives, there is a balance between formal and informal co-creation. Formal co-creation involves structured decision-making processes within the cooperative, with core members and the inner circle working together on specific projects, policy formulations and strategic initiatives. Formal agreements or partnerships with, for example, local authorities or other organisations may also be included.

Informal co-creation, on the other hand, is reflected in the educational workshops and information events aimed at raising awareness about sustainable energy. These activities provide opportunities for wider community involvement, allowing people from the outer circle to participate and contribute to the cooperative's goals in a more flexible and less structured way. By effectively combining these approaches, cooperatives can maintain a structured core while involving a wider community. This balance is crucial for promoting inclusive participation, with formal structures ensuring effective decision-making and strategic direction, and informal activities encouraging the involvement and support of a wider community.

6.1.3. Ownership

The third element of co-creation focuses on the concept of ownership within the co-creation process. It is observed in several Urban Living Labs that the initial ownership of the core group significantly influences the co-creation process. However, the extent to which this ownership extends beyond the core group varies from lab to lab.

Ownership in the context of local energy cooperatives is usually by the core group (often current board members and founders). These people are responsible for initiating projects, setting the direction of the cooperative and making crucial decisions. The vision and commitment of this group are important factors in the success of the cooperative.

However, successful co-creation in cooperatives involves extending ownership beyond the core group. This can be achieved by actively involving volunteers and financial participants in decision-making processes, project development and other activities. By doing so, cooperatives can ensure that these groups feel a sense of ownership and commitment as well to the cooperative's goals. For example, volunteers may be attracted by their involvement in renewable energy and community welfare, while financial participants may be motivated by their investment in the cooperative.

In conclusion, applying the concept of ownership in the co-creation process to local energy cooperatives involves recognising the important role of the board group, which works to extend their ownership to volunteers and financial participants. This approach helps build a more inclusive and participatory environment within the cooperative, where all members feel a sense of ownership and commitment to the cooperative's goals and projects.

6.1.4. Motivations and incentives

The fourth element of co-creation, as elaborated by Puerari et al. (2018), distinguishes between intrinsic and extrinsic motivations. In local energy cooperatives, intrinsic motivations include environmental concerns, community involvement and personal interests, all of which are driven by individual values and the search for personal satisfaction. Environmental concerns, for example, are deeply rooted in personal values and reflect a commitment to sustainability and a proactive approach to minimising environmental impact. Involvement in a community underlines the human desire to belong and the intrinsic satisfaction that comes from being part of a collective with shared goals. Personal interests, such as hobbies or passions that align with cooperative activities, provide personal satisfaction and fulfilment, including a fascination with technology that can come from involvement in cooperatives.

On the other hand, extrinsic motivations are driven by external rewards, particularly tangible benefits such as cost savings. These motivations include not only financial benefits but also access to subsidies, which serve as important incentives for participation in cooperative activities.

In summary, intrinsic motivations are associated with personal values and internal satisfaction, while extrinsic motivations are associated with practical benefits and tangible rewards obtained by participating in a co-creation process. Within MRDH's local energy cooperatives, there is a mix of these two types.

6.1.5. Spaces and places

Finally, the last element of co-creation relates to the importance of "spaces and places" in the co-creation process. This element highlights how physical locations and environments can significantly influence the co-creation experience and its outcomes. Similar to Urban Living Labs such as Blue City which used an old swimming pool to create a symbolic innovation hub, as described by Puerari et al. (2018), energy cooperatives can also use existing buildings or spaces to establish their presence. By choosing locations that are prominent or meaningful within a community, cooperatives can have a connection with the local environment, which could encourage more community members to engage and learn about renewable energy and co-creation. However, the only cooperative analysed in this research, that makes use of this kind of location is Nieuwe Lansinger Stroom.

NLS's energy shop is a centre for education, innovation and community meetings, attracting a wider audience and promoting collective energy projects. This space also plays a crucial role in reaching the 'outer circle' of co-creation participants. Its recognisable and central location in the village attracts people who are not deeply involved in the cooperative's activities, increasing its impact and reach within the community.

Cooperatives that do not have a fixed building or space, such as Alex Energie, EnergieC Midden-Delfland and HWY, may need to invest more time and energy in outreach and engagement activities. Also, when organising an information event, the cooperatives should provide an external location. For example, the recent 'Dag van de Warmte' organised by HWY in the first week of November took place at a high school located in Ypenburg.

In conclusion, applying the concept of 'spaces and places' in local energy cooperatives means using physical locations not only as functional locations for activities but also as strategic tools for promoting community engagement, visibility and a sense of shared purpose.

6.2. Co-creation activities in local energy cooperatives

As discussed in Section 2.2, 'co-creation' is a concept that includes two primary aspects: 'co', which stands for collaboration or joint effort between stakeholders, and 'creation', which refers to the production of innovative solutions or new ideas. This chapter provides a detailed analysis of collaborative activities using the six established criteria for co-creation, as described in Section 2.4.2. To assess whether each activity meets these criteria, a three-point scale is used as shown in Table 6.1. This systematic evaluation begins by examining how advisory services within local energy cooperatives align with each of the co-creation criteria. Subsequent evaluations will similarly examine the processes of information generation, renewable energy production and engagement. The results of this alignment are visually represented in a hexagonal diagram. In this diagram, proximity to the outer circle indicates a high level of alignment, while positioning towards the inner circle means no or low alignment with the co-creation criteria. This approach identifies the strengths and opportunities for further development in the co-creation efforts of local energy cooperatives.

Table 6.1: Three-point scale

Score		Explanation
1	**No or low alignment**	The activity does not integrate or only minimally integrates the co-creation principle in question.
2	**Medium alignment**	The activity partially meets the co-creation criterion, integrating it sufficiently but not optimal.
3	**High alignment**	The activity is strongly aligned with the criterion of co-creation and fully illustrates the principle.

6.2.1. Advising

As described in Section 5.1, local energy cooperatives in the MRDH proactively offer various advisory services to facilitate the transition to a more sustainable lifestyle. The four main activities used by these cooperatives to provide support and guidance include home consultations by energy coaches, informative and thematic meetings, energy information centres and the use of digital tools. What can be described as what is been created is the formulation of advice or recommendations. These may relate to energy consumption, investments in renewable resources, implementation of energy efficiency measures or broader energy policy. It also relates to generating creative and effective solutions to specific challenges faced by cooperative members or residents. In this section, the six criteria of co-creation will be applied to the advising services offered by local energy cooperatives.

1. **Shared goals and objectives:** The advisory services offered by cooperatives are closely aligned with the shared goal of promoting sustainable living and energy efficiency. While the type of advice requested by different individuals may vary, the common goal remains the same - making progress towards a greener future. This is illustrated by a statement from an EnergieC Midden-Delfland board member, who highlights the diverse needs within the community: *'Tenants, who often live in poorly insulated houses, are often looking for practical advice to improve their living conditions. In contrast, our more educated members are interested in topics such as cost-effective options for charging electric cars.'* These different advice needs, although different in their direct focus, collectively contribute to the broader goal of sustainability. This alignment towards a common end goal of a more sustainable future contributes to the first criterion about shared goals and objectives.
2. **Active participation:** Advisory services represent active participation because they require the proactive involvement of both the advice providers (e.g. cooperative board members, energy coaches) and the recipients (e.g. non-members, external stakeholders). Energy coaches engage directly with homeowners and provide tailored advice, while residents actively ask for knowledge and solutions for sustainable living. This active exchange of ideas and solutions is a core aspect of co-creation and demonstrates a high level of active participation by all stakeholders involved and therefore has a high alignment score.
3. **Equality and inclusiveness:** The cooperatives' advisory services try to involve a wide range of stakeholders. This inclusive approach is reflected in activities such as home visits, theme nights and energy shops, which are designed to welcome and help everyone who is looking for advice. Yet some people seem less committed to asking for advice. An HWY board member notes, *'Our information events, such as the 'Dag van de Warmte', are open to all and very approachable, which encourages interaction among attendees. However, while we value and strive for diversity, we see that certain groups are less represented during these events.'*

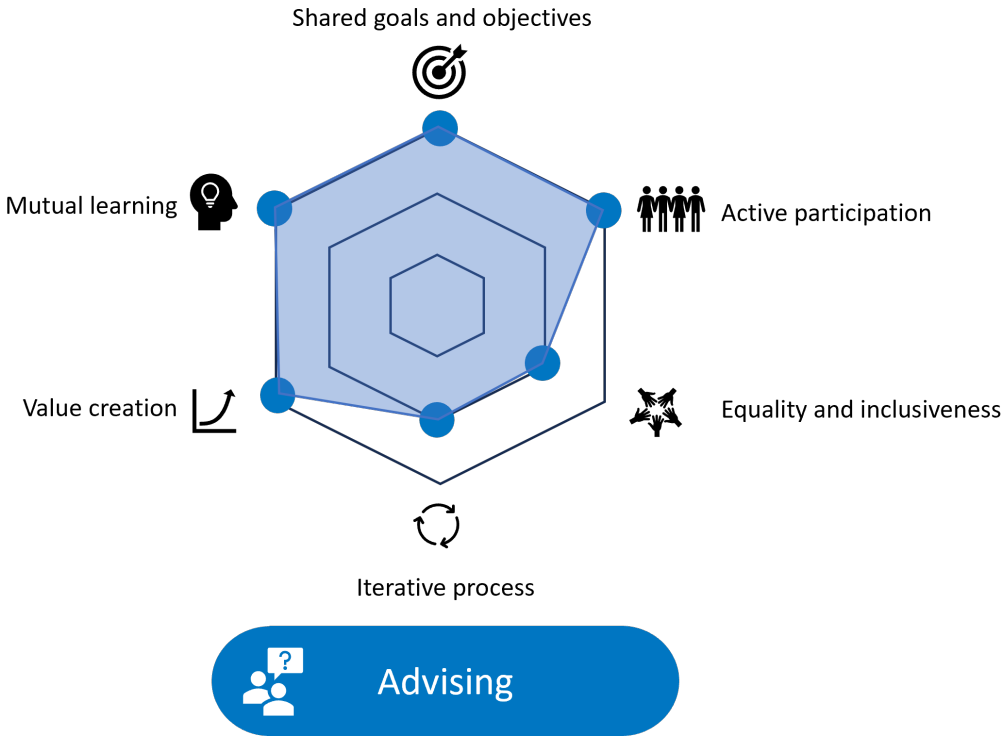

Figure 6.1: Aligning advising activities with co-creation

Moreover, inclusiveness is also sometimes lacking among those who offer advice. Initially, the pool of energy coaches and advisers was less diverse, consisting mainly of white adult males. Although things are slightly better now, there remains room for improvement to ensure that the advisory teams are as diverse as the communities they serve. One HWY energy coach stresses, *'In the beginning, we had three energy coaches, but this number has now increased to seven, including some women, reducing the dominance of the 'white male room a bit.'* This diversity is crucial to ensure that the advice given is inclusive and reflects the whole community.

4. **Iterative process:** The process of advising is iterative, with continuous feedback and improvement. As discussed in Section 5.1, energy coaches follow specialised training, learn from each home visit and share experiences and knowledge at regular meetings. Listening to the experiences of other energy coaches allows them to adjust their approach based on feedback and new insights. In addition, themed evenings and energy shops also evolve based on community feedback and changing needs, so that the advice remains relevant and effective. However, a consistent way in which knowledge is exchanged among community members and knowledge is stored is lacking. Therefore, this criterion receives a moderate alignment score.
5. **Value creation:** The fifth element of co-creation, value creation, is also applicable in the advisory services of local energy cooperatives. These services generate value because they meet both the mission of the cooperative and the needs of the community. They provide energy-saving measures, promote sustainability and strengthen community involvement and education. The benefits are tangible, such as lower energy costs, but also intangible, such as shared knowledge and improved empowerment. One NLS energy coach summarises the value: *'Many residents face financial barriers when considering sustainability investments. Such investments are often expected to be paid back within two to three years, which is not always the case. Moreover, individuals often lack clarity on the most effective actions for their unique circumstances. This is exactly when our role as energy coaches becomes important - we provide the insight and direction needed to overcome these challenges.'*

6. **Mutual learning:** As a final criterion, these advisory services include mutual learning, with energy coaches contributing their technical knowledge and creative solutions and community members offering their local knowledge and practical experiences. This mutual exchange is crucial for improving the quality and impact of the advice provided. An NLS energy coach sums up the essence of this interaction well: *'Our approach with people is very personal. We work directly with individuals and families, which gives us so much insights, first-hand knowledge and information.'* So this two-way exchange is very much in line with the principle of mutual learning within co-creation.

In summary, the four ways in which advice is given - home energy coaching, theme meetings, energy information centres and online resources - enable the local energy cooperatives in the MRDH to guide their community towards their shared goal of promoting sustainability. The advisory services represent also active participation, with energy coaches and residents working together and exchanging ideas. However, despite efforts to involve diverse participants, some groups are underrepresented, indicating the need for greater inclusiveness. The consulting process is iterative, with coaches regularly adapting their methods based on shared insights, although there is room for a more systematic exchange of knowledge. Value creation is clear in the benefits such as lower energy costs and community empowerment. Finally, mutual learning is an important component, with coaches and residents sharing expertise and experiences, which improves the quality of giving advice. Together, these elements meet the criteria of co-creation to varying degrees, which is shown graphically in Figure 6.1.

6.2.2. Generating information

Generating information within local energy cooperatives involves conducting pilot projects and technical research within working groups and engaging in local networks. Different stakeholders bring together their expertise and insights to come up with practical energy solutions to meet community needs. The activity does not only create solutions; it also includes creating data on energy consumption patterns and gathering insights into effective energy strategies for the local community. The activity is assessed against the six co-creation criteria as follows:

1. **Shared goals and objectives:** Generating information through pilot projects and technical research aligns with the criterion of shared goals to develop sustainable solutions. By being in a working group that volunteers themselves find interesting, including topics such as geothermal energy or technical safety issues, they work together on the overall goal of the research group. In the end, all working groups together collectively work towards the overarching goal of sustainability.
2. **Active participation:** Volunteers and board members of energy cooperatives actively participate in the co-creative process of information gathering. They contribute to pilot projects, collaborate in working groups and conduct technical research. This high level of commitment is matched by other stakeholders, including municipal authorities and residents, who willingly offer their support and resources. A HWY energy coach acknowledges the municipality's willingness to help: *'We rarely encounter obstacles. If we need municipal support for research, The Hague is directly involved and offers thorough and generous help with the research.'*

   Another HWY member emphasises the active and enthusiastic participation of residents: *'The response is overwhelming. Participation is entirely voluntary, yet the number of households involved has more than doubled, allowing us to significantly increase the reach of our project.'* Such proactive and voluntary involvement from all corners - cooperative members, local government and citizens - reflects the essence of active participation in the co-creation process.
3. **Equality and inclusiveness:** Both working groups and pilot projects within energy cooperatives are designed to be open and accessible, yet involvement is not as diverse as it could be. An ALEX Energie board member notes that older, white males dominate: *'We have long faced the problem of this demographic group dominating.'* A board member of NLS agrees, highlighting the lack of diversity: *'Our volunteer base consists mainly of retired men. Even though we are open to younger participants, their busy lives often get in the way of their involvement.'*

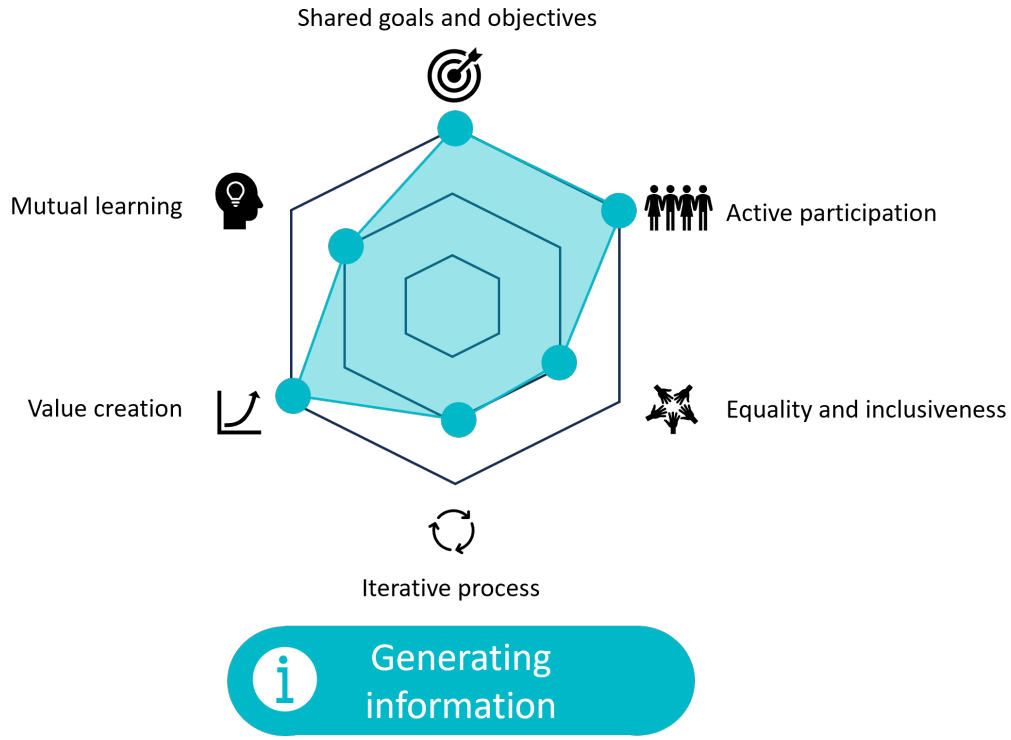

Figure 6.2: Aligning information generation activities with co-creation

This homogeneity may limit the scope of perspectives, as another NLS board member suggests: *'The problem is not age per se, but rather the uniformity in views that comes from shared past experiences.'* A HWY board member points out the challenges in diversifying participation: *'Despite our efforts to encourage diverse involvement, participation from everyone remains low and few women or other underrepresented groups remain involved.'* While the desire for inclusiveness is clear, the actual participation of various demographic groups is lacking.

Within these groups, however, the sense of equality is strong. A HWY board member states, *'Everyone's input is equally valued, although those with more technical expertise may have a slightly more influential voice. Overall, everyone's input is equal'* To strengthen the criterion of equality and inclusiveness, some efforts are needed to attract and retain a more diverse group of participants so that diverse voices and experiences contribute to the goals of the cooperative.

4. **Iterative process:** The research and pilot projects conducted by the cooperatives are based on an iterative process, as they constantly evolve and improve based on community feedback and technical insights. This approach aligns well with the principles of co-creation, with a cycle of development, feedback and refinement.

   However, there is room for improvement in this process as communication between working groups could be better coordinated to avoid unnecessary efforts. There is also a recognised need to improve the management of valuable data, such as energy consumption patterns and community-based solutions, to avoid loss of crucial information. An Alex Energie board member emphasises this point: *'My motto is collaboration. It is inefficient to keep reinventing the wheel.'* So, while the iterative nature of projects shows a commitment to a co-creative approach, the lack of a systematic method for applying feedback and sharing information between different groups limits the full potential of this process.

5. **Value creation:** The process of generating information within cooperatives creates significant value by providing practical solutions that benefit all stakeholders. For example, HWY's research into geothermal energy not only serves the direct goals of the cooperative but is also useful to external partners such as local municipalities and energy suppliers. This is illustrated by an HWY board member: *'Eneco ultimately decides on the energy source, but our technical input is important. We also contributed to a regional vision, which was adopted by Pijnacker-Nootdorp, demonstrating the practical impact of our research.'* This example highlights the role of the cooperative in influencing broader energy strategies and the shared value generated by their information-gathering initiatives.
6. **Mutual learning:** Mutual learning is the last criterion for co-creation activities, with members and stakeholders exchanging knowledge that forms the basis for practical energy solutions tailored to the community. In some cases, however, this learning process seems to be a one-way street. Cooperatives often gather a lot of information and share it with partners, but they sometimes feel that their contributions are not taken as seriously as they should be.

   This perception of one-way learning is illustrated by an experience of an NLS board member about their cooperation with the municipality: *'Being overlooked in decision-making processes feels like being treated as a minor, even if unintentionally. Our insights are vital as we are well aware of the needs of the community.'* This stresses the need for a more balanced and mutual learning environment, where cooperatives' expertise and contributions are equally recognised and valued by all partners.

Overall, information generation is important for developing practical and sustainable energy solutions tailored to community needs. There is significant active participation from all stakeholders, such as cooperative members, local authorities and residents, working together towards this common goal of sustainability. However, while efforts are made to be inclusive, there is a lack of diversity among participants, indicating the need for broader demographic engagement. In addition, although the process is iterative and knowledge is shared, communication and data management could be improved and the process sometimes feels one-sided. Conversely, the information generated is still very important to both cooperatives and external stakeholders, indicating strong alignment on the criterion of value creation. These scores reflect the current state of information generation as a co-creation activity within cooperatives (see Figure 6.2).

6.2.3. Producing renewable energy

Co-creation in energy generation by local energy cooperatives involves collaboration and participation in developing renewable energy generation projects. The collaboration may include the involvement of cooperatives' members and residents and external stakeholders, such as technology suppliers, government agencies and environmental organisations. Partnerships with these external stakeholders provide investments in renewable energy sources, resource sharing and expert knowledge in energy generation. The creation refers to the development and maintenance of renewable energy projects such as solar roof projects or local wind farms.

1. **Shared goals and objectives:** The joint efforts of MRDH's cooperatives in promoting solar energy projects and sustainable heat networks show a strong commitment to shared sustainability and environmental goals. These entities jointly aim to minimise the carbon footprint and promote the use of renewable energy. However, challenges arise when the objectives of other stakeholders vary, especially when their focus is more on the financial aspects of wind farms or the legal details of solar farm development.

   An NLS board member reflects on this complexity: *'In our cooperative projects such as solar rooftops and wind turbines, we have to deal with a wide range of factors, including regulations and municipal politics. Different interests and agendas of different stakeholders are a big challenge to our collective vision.'* Another NLS representative shares a similar experience: *'Sometimes it seems like we are on the same page when working with municipal officials. But then we encounter situations where the focus is not on our local needs but on broader agendas, such as that of Rotterdam.'*

   In addition, there are differences in objectives within the cooperatives themselves. As NLS board members noted, *'Our members have different levels of commitment and goals. Some are more primarily driven by the financial returns from their participation than others'* In this way, paths and priorities differ to achieve the shared vision due to differences in internal interests and focus. However, the underlying goal of a sustainable future remains a common thread connecting all parties.

2. **Active participation:** The involvement of cooperative members, residents and various stakeholders extends from the early planning stages to the final implementation stages, highlighting their active involvement. In this process, the diversity of roles is clear: board members lead the projects and generate local interest, financial participants provide essential funding and energy companies ensure the technical feasibility of energy generation, storage and distribution.

   However, as described above, enthusiasm for active participation sometimes encounters obstacles due to different internal interests and partial alignment on shared goals. Some stakeholders indicate different priorities, leading to less involvement than the cooperative would like. NLS board members have experienced these challenges: *'Working with project developers often results in long processes. They want to get involved in details before fully understanding the scope of the project, causing delays. Bureaucratic barriers with the municipality also further complicate participatory projects. Local energy cooperatives are mainly driven by highly motivated citizens, but the slow pace of progress requires a certain amount of fun in these efforts to maintain motivation.'* This situation reflects the complexity of aligning the interests of different stakeholders and maintaining active involvement throughout the project.

3. **Equality and inclusiveness:** Renewable energy projects within local energy cooperatives strive for equal and inclusive participation. Cooperatives such as Alex Energie, for example, have adapted their participation models to different needs. They understand that busy lifestyles, especially among young families, often prevent active involvement in such projects. To address this, Alex Energie has introduced the collective rooftop solar programme, which makes the financial investment in solar panels easy for people who do not have time, thus lowering the barrier to participation.

   An Alex Energie board member explains: *'When I ask people about their role in the energy transition, the most common answer is 'no' due to lack of time. Our 'PanelDeler' programme solves this by offering them the opportunity to invest in solar panels for as little as €25.'* This initiative offers opportunities for wider community engagement, taking into account different lifestyles and financial capabilities.

4. **Iterative process:** Furthermore, renewable energy projects are an example of the iterative process criterion of co-creation. These projects usually start with an initial planning and pilot phase, in which ideas are tested and refined based on practical experiences. This phase often includes small-scale implementations or pilot projects to assess the feasibility and effectiveness of renewable energy solutions, such as the development of renewable heat networks at HWY.

   As these projects progress, they are continuously evaluated and adapted based on community feedback and technical findings. This feedback comes from cooperative members, residents directly affected by the projects and technical experts who can provide insight into the efficiency and feasibility of the energy solutions.

5. **Value creation:** Renewable energy projects not only align with the cooperatives' commitment to sustainability but also deliver tangible benefits to other stakeholders. For cooperatives, these projects are important in their collective mission for sustainable living. Participants, especially those who invest financially, benefit from lower energy costs, contributing to both personal savings and environmental conservation.

   Moreover, the projects help municipalities meet their environmental targets, playing an important role in national sustainable development efforts. Finally, for energy companies, these projects represent a strategic shift towards renewable energy sources, in line with global trends and consumer demand for cleaner energy solutions.

6. **Mutual learning:** Finally, the renewable energy projects facilitate learning between cooperative members, residents and other stakeholders. Knowledge is exchanged, from technical aspects of renewable energy to insights into consumer energy behaviour. However, as mentioned before, the flow of information is often one-sided, with cooperatives gathering and spreading knowledge without the same input or recognition from other stakeholders. To promote mutual learning, it is essential to encourage more collaboration and create an environment where all parties actively contribute their knowledge and experiences.

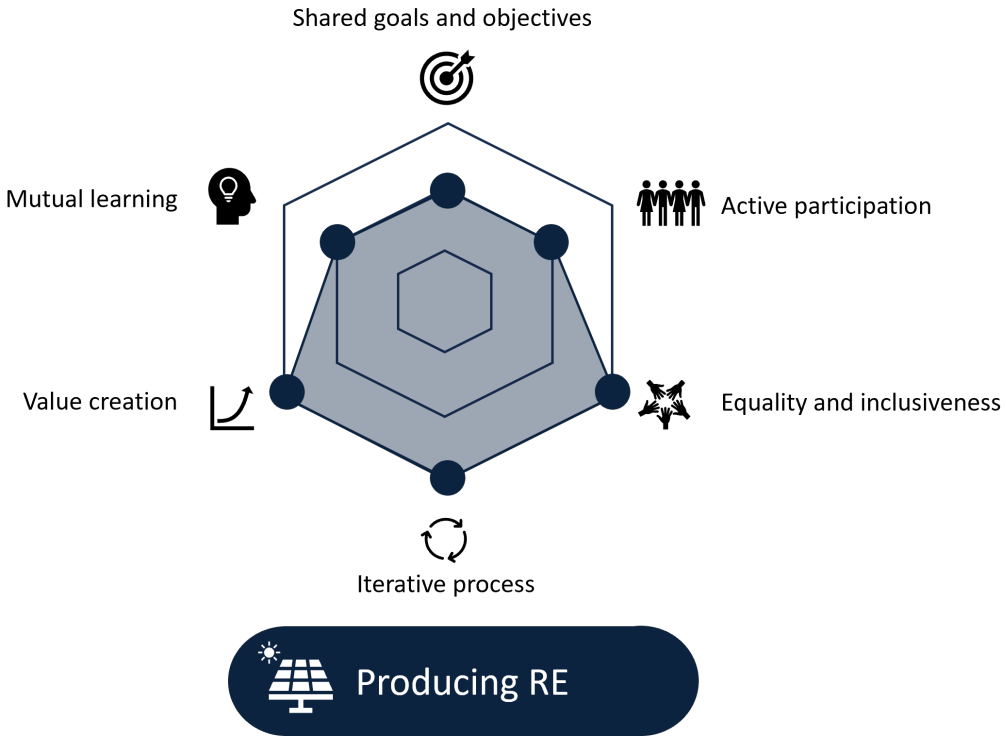

Figure 6.3: Aligning renewable energy production activities with co-creation

Summarising, co-creation in energy generation involves cooperatives contributing to sustainable energy projects such as solar roofs or wind farms. Cooperatives and stakeholders share the same goal of promoting renewable energy, but conflicts arise due to different priorities, such as financial or legal aspects. In addition, members and stakeholders are involved from planning to implementation, but sometimes these different interests hinder active participation. Equality and inclusiveness are important aspects, as different lifestyles and financial capabilities are taken into account. Renewable energy projects also evolve through planning, pilot phases and continuous adaptation based on feedback and result in benefits for all parties as they are aligned with sustainability goals and deliver tangible benefits, such as cost savings. Finally, knowledge sharing is crucial, but sometimes the flow of information is one-sided. More collaboration is needed to promote mutual learning. These elements reflect the complexity of co-creation in renewable energy projects within local cooperatives and are visually represented in Figure 6.3.

6.2.4. Engagement

Co-creation in engagement activities means building relationships and networks that are important to the success of the cooperative. The collaborative aspect emphasises the involvement of new and current members in the cooperative's activities and the relationships with parties outside the cooperative, such as energy companies, local governments, other energy cooperatives, academic institutions and technical experts. What has been created is a sense of community among members and networks outside the cooperative.

1. **Shared goals and objectives:** The efforts of local energy cooperatives to community engagement, as seen in events such as the 'Dag van de Warmte', align with the principle of shared goals and objectives. Aligning these initiatives with the collective goal of renewable energy is crucial for the recruitment of new members. However, achieving effective engagement requires more than alignment, as it also requires a deep, shared commitment to these goals.

The experience of NLS board members illustrates this challenge. Despite the pressure to reduce gas consumption, convincing the community to join the cooperative's sustainability goals proved difficult. They noted: *'In the beginning, when we didn't suffer from high energy tariffs, we really had to motivate people to see the importance of saving energy. We told them that eventually they would have to go without gas, but even that was not enough to make them switch.'* Therefore, the difficulty of convincing the community to adopt sustainability goals shows that deeper engagement is needed.

2. **Active participation:** Active participation within cooperatives is illustrated by the involvement of members, non-members and external stakeholders in decision-making processes and project implementation. Current members show a high level of involvement through their active participation in general meetings and working groups. Nevertheless, it is crucial to maintain this level of involvement and enthusiasm, as one HWY board member stresses, *'It's nice to get people involved in working groups, but it is also important to keep them enthusiastic and engaged by effectively guiding and motivating them.'* This statement shows the ongoing responsibility of the cooperative board not only to engage members but also to continuously inspire them and guide them well in their roles.

   Moreover, potential new members are involved through informative and thematic events and external stakeholders are also encouraged to actively participate in projects. However, enthusiasm for active involvement differs among external stakeholders. As mentioned before, due to different internal interests or problem-solving approaches, organisations often have different priorities and timelines for projects.

   NLS board members share their experiences with the municipality: *'We noticed that the municipality was reluctant to participate in our initiatives, so we considered taking on that role ourselves. Although other municipalities have shown successful cooperative transitions, getting the municipality of Lansingerland involved remains a challenge.'* This variation in engagement levels between stakeholders, often influenced by different problem-solving methods or internal priorities, highlights the complexity of ensuring active participation by all parties.

3. **Equality and inclusiveness:** The principle of equality in cooperatives is reflected in their approach to involving members in decision-making processes. This is illustrated by 'Algemene Leden Vergaderingen' (general membership meetings), where members vote democratically on key issues, ensuring that every voice is heard and valued equally.

   In terms of inclusiveness, this commitment is further illustrated by the various roles accessible to members, such as energy coaches, researchers in working groups and financial contributors. These roles are open to all, regardless of background, demonstrating an inclusive approach that values different perspectives and contributions. This not only promotes diversity within the cooperative but also improves overall effectiveness by using a wide range of skills and experiences.

4. **Iterative process:** The operational structure of the cooperative is illustrated by the ongoing engagement with both current and potential new members and is thus characterised by an iterative approach. This involvement takes different forms, such as neighbourhood events and flyering for new members and organising board meetings and general membership meetings for current members. During board meetings, decisions are not only taken but often reconsidered. This reflects the cooperative's ability to respond to the changing context of its activities. This also takes into account the wishes of residents and external stakeholders, who play a crucial role in the ongoing process of refinement.

5. **Value creation:** The cooperatives' initiatives to engage different groups deliver both tangible and non-tangible value. Tangible results, such as rooftop solar projects, are the result of effective cooperation between members, especially board members and financial contributors, and with energy companies and local authorities. On the intangible side, benefits include improved community relations and increased awareness about sustainability issues. Involving members within the cooperative creates a strong sense of belonging, which is in line with the motivational aspect of community engagement (as discussed in Section 4.4).

6. **Mutual learning:** Collaboration with external stakeholders, including municipalities, energy companies and academic institutions, creates an environment that promotes mutual learning. The interaction with municipalities is mutual: cooperatives benefit from municipalities' experience with project implementation and legal frameworks, while municipalities gain insights from the cooperatives' research through working groups.

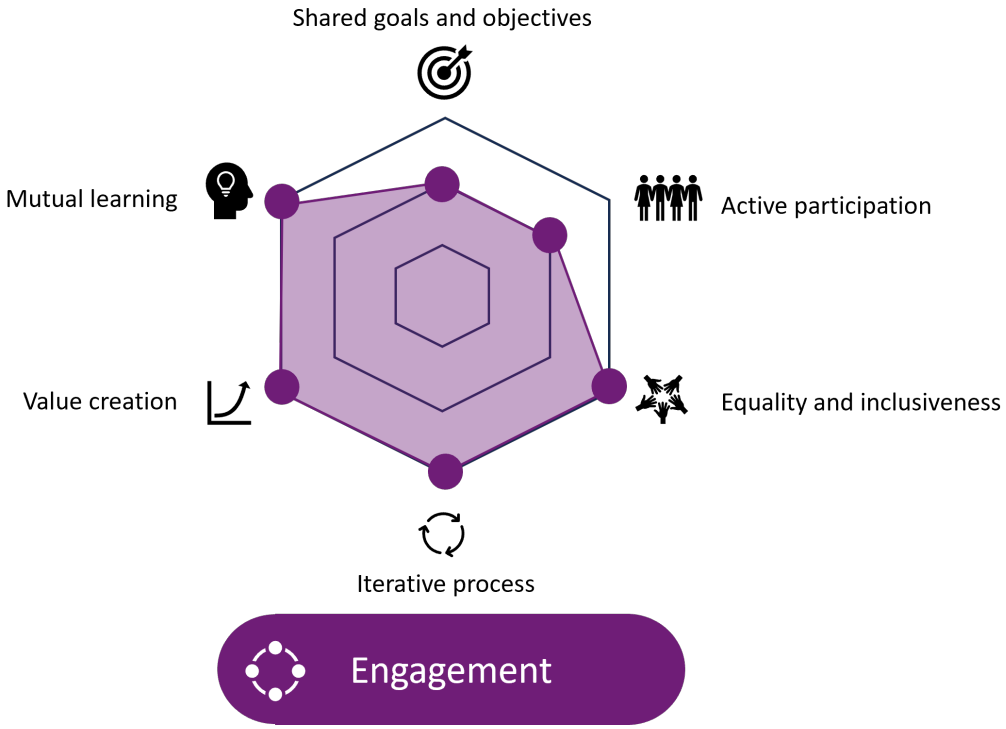

Figure 6.4: Aligning engagement activities with co-creation

The partnership between Eneco and HWY is also a good example of mutual learning, with Eneco contributing technical expertise and HWY offering local, community-based knowledge. In addition, academic collaborations also create a two-way learning process: students analyse data from cooperatives, which improves their academic experience, while cooperatives gain valuable insights from students' research findings. These relationships emphasise the value of mutual learning to improve the effectiveness and reach of cooperative initiatives.

In summary, co-creation in engagement activities involves building relationships and networks that are crucial for success. Challenges include alignment and commitment to shared goals and the varying participation between members and stakeholders. However, the process is inclusive and equal, adapts to changing needs and creates both tangible and intangible benefits. Mutual learning with external stakeholders, such as municipalities and academics, increases the effectiveness of these initiatives. These elements reflect engagement as a co-creation activity within cooperatives and are shown in Figure 6.4.

6.3. Main takeaways

This chapter explores the concept of co-creation within MRDH's local energy cooperatives, using a framework that identifies the key dynamics of co-creation and a framework that evaluates their activities against developed criteria to improve sustainable energy solutions and community engagement. The main conclusions of this chapter are as follows:

- **Dynamics of co-creation:** Co-creation is identified as the preferred model for local energy cooperatives and emphasises the importance of shared goals in sustainability and civic engagement. Co-creation includes both ”making together” and ”learning together”, striving for fossil-free energy and increasing knowledge and networks within the community.
- **Participation structure:** Participation in these cooperatives is divided into three groups: the core group (initiators with formal roles), the inner circle (dedicated volunteers with semi-formal roles) and the outer circle (community members with informal participation). This structure balances formal and informal co-creation processes and combines strategic planning with community engagement.
- **Ownership and inclusiveness:** Ownership initially lies with the core group but extends to volunteers and financial participants. This creates a sense of belonging and contribution to the goals of the cooperative. However, achieving diversity among participants remains a challenge.
- **Motivations for participation:** Participation is driven by both intrinsic motivations (environmental concerns, community involvement, personal interest) and extrinsic motivations (tangible benefits such as cost savings). Balancing these motivations is important to engage a wider community.
- **Spaces and places:** The physical location of cooperatives, such as energy shops, plays an important role in promoting community engagement and supporting co-creation activities. However, not all cooperatives have fixed spaces, which may affect their efforts to reach and engage the community.
- **Evaluation of co-creation activities:** The chapter also evaluates different co-creation activities (advisory services, information generation, renewable energy production and engagement) using six criteria: shared goals, active participation, equality and inclusiveness, iterative processes, value creation and mutual learning. Each activity shows that it is consistent with the concept of co-creation, but also that there are areas for improvement.
- **Challenges and opportunities:** While local energy cooperatives have a strong commitment to sustainability and community engagement, they face challenges in maintaining active and diverse participation, aligning stakeholder interests and using physical spaces for co-creation. There are opportunities to improve the effectiveness and inclusiveness of these practices, which will be explored in subsequent chapters.

7

Discussion

This chapter interprets the findings of the study, compares them with existing literature and translates them into practical insights for local energy cooperatives and policymakers. It also outlines the limitations of the study and concludes with recommendations for future research.

7.1. Interpretation of results

The study examined local energy cooperatives in the MRDH from a co-creation perspective to better understand, refine and improve their activities. To do this, the study conducted a literature review on the conceptualisation of co-creation and a qualitative research method using interviews and direct observations on the practical application of co-creation within local energy cooperatives. This chapter interprets these results.

7.1.1. Refined theoretical framework on co-creation

The literature review conducted outlines the historical evolution of local energy cooperatives, with a specific focus on developments in the Netherlands. This evolution, from small volunteer efforts to more formalised structures, emphasises the growing importance and influence of citizen involvement in sustainable energy efforts. The analysis then explores the concept of co-creation, which is distinguished by its collaborative nature, involving a diverse range of stakeholders and citizens. This approach improves decision-making processes and operational efficiency and creates a sense of shared responsibility. In this context, citizens transform from consumers into proactive participants and co-creators, actively addressing environmental, economic and social challenges.

Furthermore, the literature review presents a framework designed to assess co-creation within the domain of strategic planning (Sillak et al., 2021). Such an assessment is crucial to understand the roles of the different participants, identify the activities that constitute co-creation and measure the impact in terms of effectiveness, efficiency and social acceptance. Nevertheless, this framework is for structured strategic planning contexts, which contrasts with the more organic and localised planning scenarios that characterise local energy cooperatives. This distinction underscores the need to adapt or develop frameworks more suited to the spontaneous and community-oriented nature of local energy cooperative initiatives.

Therefore, the findings of this literature review have been captured in two theoretical frameworks designed to explore co-creation in local energy cooperatives. The first framework contains five elements that clarify the dynamics of co-creation as identified by Puerari et al. (2018). To complement this, the second framework introduces six important criteria essential for the success and effectiveness of co-creation efforts. This framework is based on a thorough literature review and ensures broad academic agreement and contextual relevance for the study of co-creation in local communities. It provides a detailed understanding of the observed activities within local energy cooperatives, addressing both the collaborative dimension and the creative dimension of co-creation.

By using the framework outlined by Puerari et al. (2018) and the tailored framework for this research, the study effectively bridges existing knowledge gaps. This approach facilitates the practical application and improvement of co-creation in diverse local settings and provides an understanding of how co-creation is connected to and supports activities within local energy cooperatives.

7.1.2. Context of local energy cooperatives

The analysis of interviews and direct observations shows that local energy cooperatives in the MRDH have grown from small groups to significant collectives of environmentally conscious citizens. The formation and development of the cooperatives show the power of citizen initiatives in the energy sector. They embody the concept of co-creation, with citizens as co-initiators and co-designers, not just as co-executors. The main motivators for membership in cooperatives are environmental concerns, commitment to sustainability and reducing the ecological footprint, community involvement and sense of belonging, personal interest in sustainable technologies and economic incentives such as energy cost savings.

Crucial to these cooperatives are their external partnerships. They work with other cooperatives to share knowledge and resources which is important for growth and mutual learning; with local governments to influence policy; with energy companies, who provide essential technical and financial assistance; and with specialists and academics who provide technical insights and research data.

Another important aspect in the context of these cooperatives is the observation of development trends. There is a clear shift from scepticism to acceptance of and interest in renewable technologies among community residents, leading to changes in energy consumption patterns. The cooperatives are moving towards more structured and formalised activities, but remain sensitive to external factors such as government policies and global events, which influence their strategies and activities.

7.1.3. Broader dynamics of co-creation in local energy cooperatives

The final section of the results examines two primary aspects of co-creation within local energy cooperatives: an exploration of the broader dynamics of co-creation and a detailed examination of specific co-creation activities undertaken by these cooperatives. The first analysis shows that cooperatives focus both on producing more fossil-free energy and encouraging citizen participation. The distinction between formal and informal processes, together with the involvement of volunteers and financial contributors, democratises the whole process. This approach not only increases ownership outside the core group but also commitment to the cooperative's objectives. Another aspect is diversity in motivations for participation. This diversity is important for developing activities that engage different stakeholders and ensure more inclusive and effective involvement. Regarding the last aspect of using physical spaces, the case of NLS, with its unique approach to maintaining an energy shop, illustrates the useful role of physical locations in these cooperatives. These spaces not only provide a location for informative meetings but also promote interaction and engagement within the community.

7.1.4. Areas for improvement in co-creation activities

A detailed examination of activities within local energy cooperatives shows that their activities include providing advisory services, generating information, producing renewable energy and promoting engagement. This analysis indicates opportunities to increase the level of co-creation in these activities. Therefore, this chapter examines each of the six co-creation criteria for the four core activities, aggregated in Figure 7.1.

Shared goals and objectives

Shared goals and objectives emerge as the first criterion for co-creation. This principle is closely aligned with advisory and information generation activities but shows only moderate consistency with renewable energy production and stakeholder engagement. Although united by sustainability goals, cooperatives often face different stakeholder objectives, with financial and legal challenges sometimes overshadowing sustainability. Therefore, there is a need to unite members around common goals.

Active participation

Active participation, the second criterion for co-creation, is also well represented in advisory and informational activities, but less so in energy production and engagement. The diversity of roles within cooperatives, from leadership to technical expertise, brings challenges because of the different interests and levels of stakeholder involvement. It is crucial to align these interests and maintain enthusiasm, especially when bureaucratic and stakeholder challenges are present.

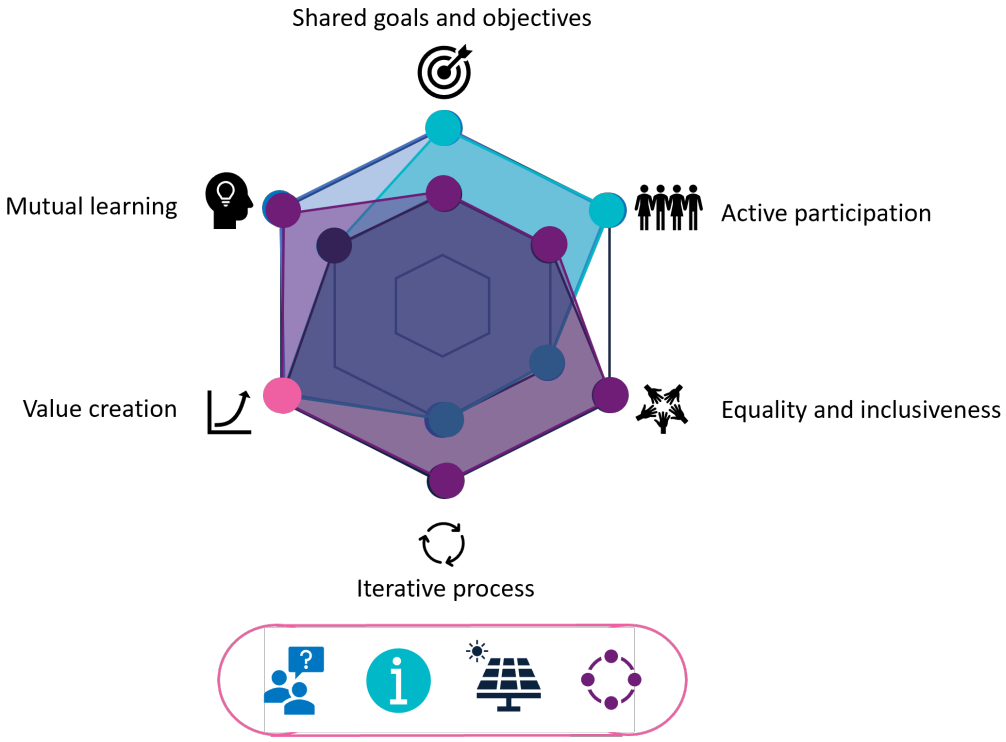

Figure 7.1: Aligning all four activities with co-creation

Equality and inclusiveness

In contrast, the criterion of equality and inclusiveness corresponds to renewable energy production and engagement activities but is less clear in advisory and information services. Despite efforts to involve a wide range of stakeholders, certain groups remain underrepresented. This lack of representation limits the diversity of perspectives needed for broad advisory and information activities and highlights the need for more inclusive participation strategies.

Iterative process

The criterion of the iterative process emphasises the importance of continuous feedback and improvement and fits well with energy production and engagement, but less well with the sharing of advice and information. Despite continuous feedback mechanisms, there is a call for more structured knowledge sharing and data management to improve the efficiency and impact of these processes.

Value creation

The findings, as illustrated in Figure 7.1 (highlighted in pink), identify value creation as a fundamental aspect of co-creation in all four activities. This insight challenges the idea of value creation as a criterion of co-creation, suggesting instead that it is a fundamental aspect, essential to the co-creation process itself. Applying the theoretical framework leads to a rethinking of the role of value creation and highlights its importance as both a driver and a precondition for effective co-creation.

Mutual learning

Finally, mutual learning aligns well with advising and engagement but shows improvement opportunities within information generation and energy production. Knowledge exchange often seems to be one-sided, with cooperatives feeling that their contributions are undervalued. Creating a more mutual learning environment is needed to use collective expertise and insights and stimulate a balanced and productive atmosphere of co-creation.

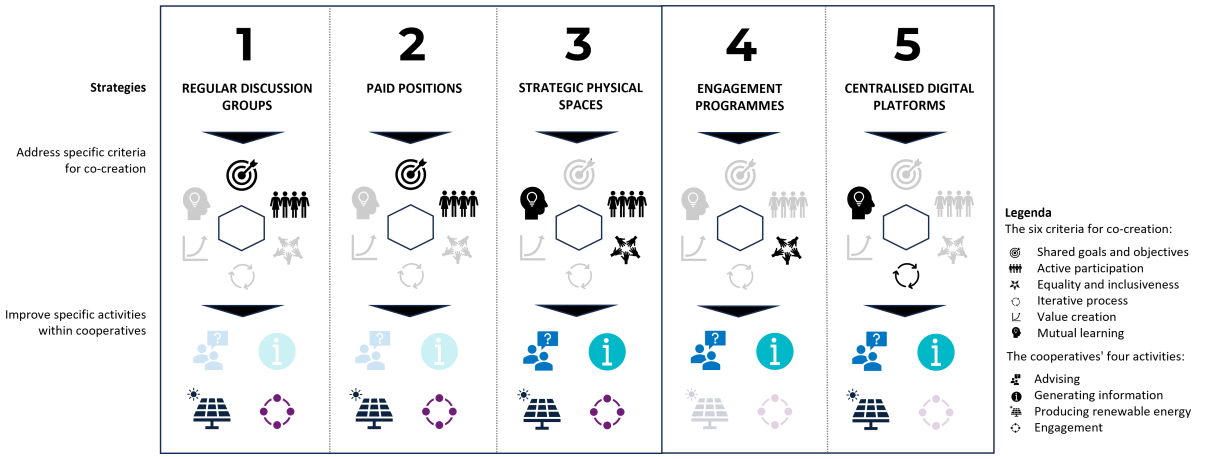

Figure 7.2: Recommendations for local energy cooperatives

7.2. Recommendations and implications

This research aims to increase understanding and efficiency in co-creation activities among local energy cooperatives within the MRDH. Therefore, this chapter discusses the implications of the findings and presents several tools and recommendations for both local energy cooperatives and policy developers.

7.2.1. Implications for local energy cooperatives

The analysis shows that local energy cooperatives have not yet fully realised the potential of co-creation. Based on the challenges identified in Section 7.1.4, five strategic recommendations are given to increase co-creation efforts within these organisations. As the cooperatives' activities are aligned with the co-creation criteria, these recommendations are relevant to those activities. However, while each recommendation focuses on specific co-creation criteria, it is important to recognise that these criteria are interconnected and thus improvements in one area can also benefit other areas. It is therefore reasonable to suggest that while certain recommendations are particularly relevant to specific activities, their applicability extends further, given the interconnection of the co-creation criteria and the cooperatives' overall approach to their activities. Therefore, in Figure 7.2 the recommendations are visualised, highlighting the criteria and activities directly related to them, but also acknowledging their broader relevance.

Three of these strategies have already been successfully implemented by some cooperatives and serve as examples for others. These include facilitating regular stakeholder discussion groups, creating paid positions within cooperatives and using strategic physical spaces. The remaining two recommendations, while not yet adopted by the studied cooperatives in the MRDH, emerge as possible strategies for further improvement. Together, these recommendations offer cooperatives opportunities to improve their co-creation activities and have more impact on their operations.

Regular stakeholder discussion groups

For renewable energy initiatives, it is crucial to align the different interests and priorities of stakeholders. The complexity of the political and regulatory environment often challenges the efforts of local energy cooperatives and is further complicated by the different motivations of community members and external parties involved in projects such as solar rooftop installations. Bridging these interests is important for the success of renewable energy projects and for promoting strong engagement and cooperation between all stakeholder groups. An approach to achieve this is to organise regular discussion groups with all stakeholders involved.

A good example of such forums is HWY's *'triangular meetings'*, which bring together representatives from the municipality and the energy company. These meetings are important to understand the motivations and intentions of each stakeholder. Through negotiation, transparent communication and sometimes redefining project goals, it becomes possible to align different interests with broader sustainability goals and formulate agreements or compromises together.

By setting up these regular discussion groups, also with citizens, cooperatives can align the interests of different stakeholders with shared sustainability goals. This not only promotes active participation but also provides stakeholders with a platform to voice their opinions and contribute to the decision-making process. This strategy thus directly supports the co-creation criteria of shared goals and objectives and active participation, making it particularly beneficial for renewable energy production and stakeholder engagement.

Paid positions

A recurring problem, as revealed in the interviews, is the failure of local municipalities to recognise the crucial role of cooperatives, combined with the limited availability of volunteers within these organisations. This situation can lead to cooperative members dropping out, which can risk the long-term success of renewable energy projects. These projects depend on stakeholders' willingness not only to take the initiative to participate but also to remain actively and consistently involved over time.

To address this challenge, a solution may be to include representatives of the municipality in the structure of the cooperative. This integration ensures constant awareness of local conditions and the changing needs of the municipality, allowing these insights to be shared during regular board meetings. The HWY cooperative is a good example of the benefits of including a paid position for this purpose in the organisation. This position ensures regular attendance at board meetings, keeps the cooperative aware of the latest developments and facilitates ongoing communication with the municipality. Such a position is also important to help members with little time.

Establishing paid positions within cooperatives, in collaboration with local municipalities, thus offers a way to align shared goals and objectives and to address the challenge of maintaining long-term stakeholder engagement. Consequently, this recommendation is useful for improving renewable energy production and promoting greater stakeholder engagement.

Strategic physical spaces

The concept of 'spaces and places' described by Puerari et al. (2018) highlights the important role physical environments play in improving co-creation experiences and outcomes. The NLS energy shop is a good example of how such a space can have a positive impact. This shop not only attracts a wide audience but also encourages a sense of unity and common purpose among both members and the wider community. It not only serves as a centre for gathering but also hosts a range of educational activities, such as workshops and information sessions.

The strategic use of physical spaces offers numerous benefits that align with several key aspects of co-creation: it attracts diverse audiences, promoting equality and inclusiveness; it generates a sense of community and engagement among members and residents, encouraging active participation; and it creates a space for shared learning experiences. This approach thus directly supports all four cooperative activities and stands out as an essential strategy that all cooperatives should consider using physical spaces for better co-creation.

Engagement programmes

Another challenge identified in the activities of cooperatives, as described in Chapter 6, is about increasing diversity and inclusiveness. To address this, cooperatives can implement targeted engagement programmes to involve underrepresented groups. Effective strategies include organising events in culturally diverse neighbourhoods, providing materials in multiple languages to improve accessibility and randomly distributing flyers to look beyond established networks. An initiative by an energy cooperative in Amsterdam Zuidoost is an example of this approach by targeting the Surinamese community. This effort, shared by NLS board members, significantly increased their reach within that community. Inspired by these results, NLS board members sees opportunities for more engagement with the large Moroccan community in Lansingerland.

Engagement programmes are therefore important for including underrepresented groups and support the criterion of equality and inclusiveness. By incorporating a wider range of perspectives, skills and experiences, these programmes not only help generate information but also ensure that cooperative initiatives represent the diverse needs and opinions of the whole community, regardless of age, gender, ethnicity or background. This improves the advisory activities of cooperatives.

Centralised digital platforms

The final recommendation is the creation of a central digital platform for knowledge exchange. This platform would facilitate the exchange of ideas, experiences and best practices between community members and energy coaches and serve as a hub for showcasing new sustainable innovations and discoveries in the cooperatives. It also provides structured opportunities for gathering feedback from residents through regular surveys, meetings and digital forums for comments and suggestions.

Collaboration with Energie Samen, the advocacy organisation for local energy cooperatives, could accelerate the creation of this platform by using their resources and expertise. Implementing such a platform ensures that knowledge sharing remains dynamic and aligned with the changing needs of cooperatives and the communities they support.

Through this centralised digital platform for knowledge, feedback and continuous learning, cooperatives can continuously improve and share insights from different projects. It also allows them to save the insights from technical research and pilot projects in one place. Consequently, this strategy will improve advisory services, information generation and renewable energy production.

7.2.2. Implications for policymakers

The discussion in this section focuses on how policymakers can strengthen local energy cooperatives and thus contribute to the larger goal of transition to sustainable energy systems. These recommendations are based on the dynamic nature of local energy cooperatives, their ability to facilitate sustainable energy transitions and current key trends affecting these initiatives.

Improve recognition and integration of local energy cooperatives

Local energy cooperatives make an important contribution to the energy sector, but their efforts are often undervalued. They can face one-sided interactions with local municipalities, possibly leading to dissatisfaction among members who are usually passionate and committed to their initiatives. To address this, it is important to recognise the contributions of local energy cooperatives more.

Municipalities could highlight successful cooperation projects regularly in public forums, local media or municipal websites. They could also establish awards or recognition programmes to celebrate the achievements of these cooperatives, such as annual awards for innovation, community engagement or environmental impact. In addition, grants could be provided to cooperatives that show exceptional promise or remarkable success with their renewable energy projects. This not only recognises their efforts but also inspires community involvement and improves their projects.

Furthermore, it is important to involve cooperatives more actively in policy discussions so that their views are included in decision-making. This can be done by organising regular meetings so cooperatives can engage directly with policymakers, express their concerns and share valuable insights. It would be useful to expand these dialogues to include multi-stakeholder advisory committees, such as energy companies, grid operators and technical specialists. These committees should play an important role in advising on policy-making, project planning and addressing challenges for the sector.

Improve professional development of local energy cooperatives

Local energy cooperatives, driven by the commitment and dedication of their volunteers, often face constraints due to the part-time nature of these functions. The varying availability of volunteers, who sometimes have to combine work and family responsibilities, can be a barrier to the continuous and consistent commitment needed for the cooperatives' activities. This situation leads to a lack of professional knowledge management and a systematic approach to initiating energy projects. To address this problem, it is recommended that policymakers set up targeted training programmes for cooperative members. These programmes should cover a range of topics, including renewable energy management, financial planning and organisational leadership, to improve professional capabilities within cooperatives.

Moreover, municipalities could provide specific funding for hiring professional staff within cooperatives. Such funding would allow cooperatives to hire project managers, administrative staff or technical experts. These professionals would consistently oversee the cooperatives' operations, which would improve their operational effectiveness and contribute to their overall success and sustainability. This approach not only bridges the professionalisation gap but also ensures that the cooperatives benefit from a mix of enthusiastic volunteers and expert professional management.

Increase flexibility and innovation of local energy cooperatives

In the fast-changing world of renewable energy, local energy cooperatives need to be flexible and creative, especially when it comes to the key trends mentioned in Section 4.5. Policymakers need to help these cooperatives stay up-to-date and adapt to new developments in politics, economics and technology. They could provide regular updates on, for example, shifts in government policy, energy regulations and market trends so that cooperatives stay informed of national and local progress on sustainability.

Encouraging partnerships between cooperatives, research institutions, technology companies and other renewable energy R&D players can also be important. Such partnerships would give cooperatives access to new knowledge and technologies. Moreover, local governments can work with cooperatives to set up projects that make the community more resistant to future challenges such as energy price fluctuations and energy supply disruptions. The aim is to create an environment where cooperatives are consistently informed, flexible and proactive.

Table 7.1: Comparing cooperative activities with activities from the literature

Source	Activities
Sillak et al. (2021)	Expectation alignment, social learning, resource acquisition, assessment and evaluation
This study	Advisory services, information generation, renewable energy production, engagement

7.3. Comparison with the existing literature

The study's findings are compared with existing literature to identify both parallels and differences.

7.3.1. Local energy cooperatives

This research confirms the findings of existing studies on the development of local energy cooperatives and their growth from voluntary efforts to more structured and formal organisations. This highlights the increasing role and impact of citizen participation in promoting sustainable energy practices. The literature also emphasises the important role of collaboration with external stakeholders to increase the effectiveness and reach of energy cooperatives. In the MRDH context, there is a similar trend towards stakeholder cooperation. However, this research looks deeper into the unique operational dynamics, organisational frameworks and motivations of members within MRDH cooperatives and provides a more detailed perspective compared to the broader analysis of trends and dynamics in Dutch cooperatives found in the existing literature.

7.3.2. The concept of co-creation

The existing literature characterises co-creation as a collaborative process in which multiple stakeholders work together towards common goals and emphasises the crucial aspects of collaboration, active participation and generation of shared value. Important to this concept is the involvement of multiple stakeholders and the initiating role of citizens. The findings of this study are in line with this definition, but further explore the practical implications and specific criteria relevant to co-creation. This is done using the five elements that outline the dynamics of co-creation, as described by Puerari et al. (2018), combined with the six established criteria for co-creation from various existing academic sources. This research applies these elements and criteria in a practical setting, specifically within local energy cooperatives, and offers insight into how these theoretical principles manifest in a real-world context. This research thus offers a more detailed, practical analysis of co-creation within local energy cooperatives, while the academic literature mainly focuses on a theoretical exploration of co-creation in different sectors.

7.3.3. Co-creation activities

Sillak et al. (2021) highlights the role of co-creation in strategic planning for urban energy transitions, focusing on activities such as aligning expectations, promoting social learning, resource acquisition and conducting assessments and evaluations. This study identifies parallel co-creation activities within local energy cooperatives, namely advice, information gathering, renewable energy production and engagement, described in Table 7.1. Comparing these activities with those described by Sillak et al. (2021) reveals some similarities and differences.

A key similarity is the focus on engaging a wide range of stakeholders in moving towards common goals, as reflected in the alignment of expectations in strategic planning and the involvement of stakeholders in local projects. Moreover, the notion by Sillak et al. (2021) of social learning mirrors the advisory and information services in this study, highlighting the importance of knowledge sharing and development to promote innovation and support informed decisions.

However, there are differences in the focus and methods of these activities. The approach of Sillak et al. (2021) is characterised by a strategic emphasis on long-term planning and overarching strategy, in contrast to the more direct, hands-on activities observed in this study in the context of local energy cooperatives. Thus, the framework by Sillak et al. (2021) is more strategic and evaluation-oriented, while local cooperatives focus more on direct community involvement and practical initiatives.

7.4. Research limitations and validity

This research provides valuable insights into co-creation processes within local energy cooperatives. Still, it is important to recognise the limitations for a full understanding of the context and implications of the study.

7.4.1. General limitations

The study's focus on four specific local energy cooperatives in the MRDH region limits its scope and does not cover other cooperative models or organisations, such as urban living labs. As a result, broader trends in the local energy sector may be missed. Moreover, the unique regional characteristics of MRDH, such as local government policies and geographical features, may not reflect the reality of other regions with different economic and industrial landscapes, limiting the generalisability of the findings.

The time frame for data collection, from October to December, limited the number of interviews and meetings. This may have excluded valuable insights from other cooperative members, representatives of local municipalities or cooperating energy companies. This made it also difficult to assess variations in the frequency of co-creation activities between different cooperatives. Moreover, the duration of the project may have limited the completeness of the literature review, missing potentially relevant studies and theories.

Furthermore, the dynamic nature of the sustainability and technology landscape in the energy sector poses a challenge, as research findings can quickly become outdated due to new technological developments, policy shifts or socio-economic changes.

Finally, the study's recommendations for local energy cooperatives and policymakers have not been validated against existing literature or stakeholder feedback, limiting their applicability. Municipalities may have varying degrees of success with these strategies and some may have already implemented similar approaches. This also applies to the motivations behind co-creation participation, as the study is mainly based on interviews and observations rather than a thorough literature review of the motivations behind co-creation participation.

7.4.2. Research method limitations

The systematic PRISMA and snowball methods used in the literature review provided a wide range of existing research. However, the study's methodical literature selection process may have missed important works on co-creation or local energy cooperatives, as the latest or emerging concepts in the field may not have been uploaded or certain articles may not have included specific keywords.

In addition, although the case study method is suitable for in-depth analysis of complex phenomena such as co-creation in energy cooperatives, it carries the risk of subjective biases among the interview respondents. The perspectives of interviewees, who participated voluntarily, may not cover the full spectrum of opinions within the broader cooperative membership. Therefore, excluding the opinions of less active or former members may result in a somewhat incomplete picture.

Moreover, compliance with ethical standards, including GDPR and HREC approval, contributed to the credibility of the study. However, the use of interviews with only one board member from both EnergieC and Alex Energie cooperatives says little about the different perspectives within these organisations. Also, the interviews and data analysis were originally conducted in Dutch and then translated into English for inclusion in this article. Although care was taken during the translation process to maintain the integrity of the content, there may still be differences in terminology.

Lastly, the combination of inductive and deductive data analysis improves the analytical accuracy of the study, but the coding process of the interview data is still subject to the researcher's biases and interpretations. This can lead to ignoring certain perspectives or issues that do not match the identified categories.

7.5. Future research recommendations

This chapter makes several recommendations for future research designed to address the limitations of the current study. These suggestions are intended to focus future research on obtaining a more extensive and representative understanding of co-creation processes within local energy cooperatives.

First of all, it is recommended that future studies expand their geographical scope beyond the MRDH and examine regions with varied economic and industrial profiles. This broader scope would explore how regional differences have an impact on cooperative practices and challenges, such as different levels of municipal support for local energy cooperatives. In addition, it would be useful to include more diversity and different incomes in the research scope, including a wider range of community backgrounds.

To reduce biases coming from the focus on cooperative members, future research should aim to include a more diverse range of stakeholders. This should include not only active members but also less active or former members, financial contributors, representatives of local municipalities and participating energy companies. Such inclusiveness would provide alternative perspectives on collaboration in solar rooftop projects, as opposed to the viewpoint mainly explored in this study. To address other limitations relating to the qualitative research method, future studies could use mixed methods, integrating quantitative data to increase generalisability and complement qualitative insights. This mix could help counter these subjective biases. For more objective data analysis, using transparent coding methods and involving multiple researchers in the coding process could help neutralise individual biases.

Moreover, future studies could benefit from a longer research period to allow for a more thorough literature review. Research could focus on evaluating the co-creation criteria developed in this study in other sectors or cooperative organisations. This could provide a more robust theoretical framework useful for evaluating co-creation in its practical application. Extending the data collection phase would also allow wider involvement in direct observations, including attending more cooperative meetings, participating in summer events or attending the launch of solar rooftop projects. Such an approach would make it possible to discover significant differences in the pattern and frequency of cooperative activities.

Finally, the validation and applicability of the recommendations in this study should be confirmed by extensive literature review or stakeholder feedback. Future research should evaluate the feasibility and implementation of these recommendations in different municipal settings, looking at their current application or necessary adaptations for different communities.

8

Conclusion

This chapter summarises the findings related to the research objectives and questions. It concludes the study by highlighting the important role of co-creation in contributing to global efforts to combat climate change.

8.1. Research objectives

The main objective of this research was to conduct a critical analysis of co-creation practices within the framework of local energy cooperatives in the MRDH. The specific objectives below illustrate how this research contributes to achieving the sub-objectives:

1. **Theoretical and practical analysis of co-creation:** This study explored the conceptual foundations of co-creation within the energy transition context, based on an in-depth review of academic literature. It discovered the framework by Puerari et al. (2018), which explores the overall dynamics of co-creation and led to the creation of a new refined framework consisting of six criteria, which provides a systematic approach to assessing co-creation in local communities. Using both frameworks, the qualitative research, conducted through interviews and observations, focused on the manifestation of co-creation in local energy initiatives. This approach was in line with investigating the practical implementation of co-creation concepts, highlighting the important role of individuals as active co-creators. By examining the various activities of cooperatives, ranging from renewable energy production to providing advisory services, the study shows specific examples of communities' involvement in co-creation. This linked theoretical concepts with practical applications and provided insights to address the challenges of the energy transition.
2. **Citizen roles in local energy cooperatives:** This research also contributes to the second objective by illustrating citizens as proactive co-designers and initiators. It shows the transformation of local energy initiatives into more formalised organisations, driven by citizens' environmental concerns, community engagement, interest in sustainable technologies and the search for cost savings. These insights, drawn from interviews and observations, highlight the central role of citizens in guiding the development and implementation of energy projects. Moreover, the research focuses on broader trends within local energy initiatives, especially growing technology awareness among consumers, behavioural changes and the professionalisation of cooperatives. As a result, the greater involvement of citizens highlights their crucial role as co-creators, which is important for the success of energy initiatives.
3. **Evaluating the sustainability effects of co-creation:** Finally, this study not only presents successful examples of co-creation but also identifies challenges and potential areas for improvement in the co-creation efforts of local energy cooperatives. The recommendations highlight the importance of the six criteria for co-creation and provide insightful guidelines for addressing obstacles and refining co-creation practices within energy communities.

8.2. Research questions

To achieve the research objectives, four different sub-questions were formulated to enable deeper analyses. This chapter answers both the sub-questions and the main research question.

8.2.1. Sub-question 1

By exploring how academics conceptualise co-creation in the context of the energy transition, the first research question can be answered:

"How is co-creation conceptualised in the academic literature within the context of energy transition?"

Co-creation is defined as a collaborative process in which different stakeholders, including citizens, actively contribute to improving decision-making, efficiency and shared responsibility. Co-creation originally came from the corporate sector to involve end users, but it has evolved into a process of public engagement and cross-sector collaboration for various projects. Today, co-creation is applied in different contexts, from consumer engagement in the private sector to organisational transformation in the public sector. In the field of energy, it plays an important role in encouraging citizens to participate in sustainable energy practices and in helping the transition to low-carbon energy solutions.

Furthermore, the academic literature distinguishes co-creation from co-design and co-production. While co-design, a component of co-creation, focuses only on the collaborative design process, co-production is more focused on the user-centred production of services. Co-creation, on the other hand, includes a broader spectrum of collaboration between multiple actors aimed at creating innovative solutions in public contexts. In particular, the term 'co-creation' emphasises the initiating role of citizens, referring to scenarios involving citizens as co-initiators or co-designers.

In addition, the academic literature review presents a theoretical framework of Puerari et al. (2018) to clarify the dynamics of co-creation in different communities. This framework highlights elements such as the intended purpose, formal versus informal processes, ownership dynamics, motivations and incentives, and the importance of spaces and places to enable co-creation. In addition to these elements, the study identifies six criteria for effective and impactful co-creation activities: shared goals and objectives, active participation, equality and inclusiveness, an iterative process, value creation and mutual learning. These criteria appear to be crucial for understanding and improving the implementation of co-creation in local energy environments.

8.2.2. Sub-question 2

Since local energy cooperatives naturally emerge from citizens' initiatives, their connection with the concept of co-creation is clear. This analysis focuses on the second research question:

"How does co-creation take place in practice within local energy cooperatives in the MRDH, and how does it relate to the local context?"

In the MRDH, co-creation within local energy cooperatives takes place through partnerships between community members and external stakeholders. The cooperatives have emerged from small initiatives and developed into more formalised organisations, highlighting the important role of citizen involvement and the need for collaboration with external stakeholders - peer cooperatives, municipalities, energy companies and educational institutions - to increase their influence and reach.

The operationalisation of co-creation in these cooperatives is examined using the framework of Puerari et al. (2018) and summarised in Figure 8.1. There is a dual focus on increasing fossil-free energy production and promoting citizen participation. This implies an organisational structure with a balance between informal community involvement and formal business activities. Different roles within cooperatives - board members, volunteers and financial contributors - each make unique contributions and lead to a shared sense of ownership over the cooperative's efforts. Moreover, individuals' motivations for joining these cooperatives - ranging from environmental concerns to a desire for financial savings - reflect a mix of intrinsic and extrinsic motivations, which drive the co-creation process forward. In addition, the importance of 'spaces and places' in facilitating co-creation activities highlights the role of physical environments in promoting community engagement and the visibility of cooperatives.

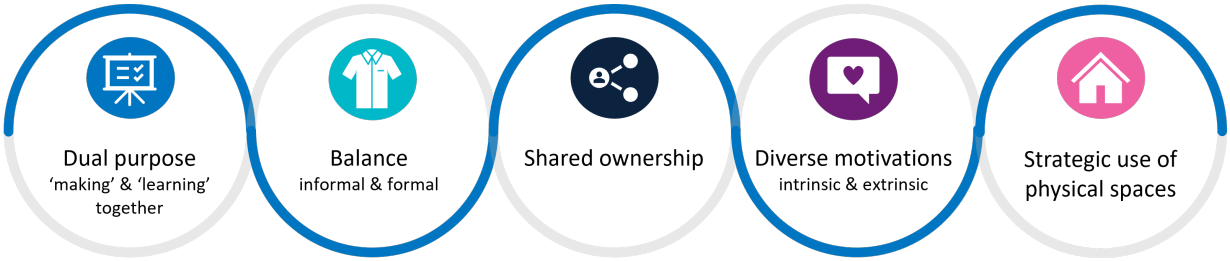

Figure 8.1: Co-creation dynamics within MRDH's local energy cooperatives

Co-creation practices are also shaped by emerging trends that reflect the changing nature of cooperatives and their adaptability to the local environment. These trends include the increased adoption of renewable energy technologies, behavioural changes among members, professionalisation of cooperatives and the influence of socio-political, economic and global factors.

8.2.3. Sub-question 3

The third research question examines the specific co-creation activities of local energy communities within the MRDH:

"What are the current activities of local energy cooperatives in the MRDH?"

The study identifies four main activities currently carried out by the cooperatives. The first concerns advisory services, including personal home visits by energy coaches, group initiatives such as "heat safaris", and educational and thematic events. Secondly, the cooperatives are involved in generating information through pilot projects and collecting local energy data, giving them a better understanding of local energy needs. The third activity is renewable energy production, with investments in solar installations and renewable heat networks. Engagement is the last activity. This is achieved through a combination of community meetings and campaigns aimed at broadening the membership base and partnering with various external stakeholders to increase their impact. All in all, these activities highlight not only the cooperatives' commitment to renewable energy production but also their dedication to educating and engaging the community in sustainable initiatives.

8.2.4. Sub-question 4

The exploration of the activities within the local energy cooperatives of the MRDH shows significant alignment with the principles of co-creation, thus answering the fourth research question:

"To what extent do the activities within local energy cooperatives in the MRDH align with co-creation and what are the opportunities to improve these activities?"

The following is a detailed assessment of cooperative activities using co-creation criteria and possible areas for improvement:

1. **Advising:** Advisory services show a strong alignment with shared goals and objectives, active participation and value creation. However, there is a need for more equality and inclusiveness, as some groups are underrepresented. Moreover, while the process is iterative, it lacks a consistent method for sharing knowledge.
2. **Generating information:** This activity scores high on shared goals, active participation and value creation, showing strong stakeholder engagement and practical benefits. However, it scores moderately on equality and inclusiveness, iterative processes and mutual learning, indicating room for improvement in diversity and knowledge sharing.
3. **Producing renewable energy:** This activity meets criteria such as equality and inclusiveness, iterative processes and value creation well. However, they face challenges in aligning shared goals and maintaining active participation due to different stakeholder interests. Mutual learning can also be improved to ensure a more balanced exchange of knowledge.
4. **Engagement:** Engagement activities show that equality and inclusiveness, iterative processes, value creation and mutual learning are highly valued. Yet, they fall short when it comes to fully aligning with shared goals and ensuring consistent active participation by all stakeholder groups.

Although MRDH's local energy cooperatives are committed to co-creation through their activities, they encounter barriers that prevent the full realisation of the potential of co-creation. Key opportunities for improvement include organising regular stakeholder discussion groups, adopting professional roles through paid positions, using physical spaces for community interaction, implementing targeted engagement programmes to involve underrepresented groups and developing centralised digital platforms for effective knowledge sharing. For policy developers, it is important to focus on improving support for these cooperatives, recognising their contributions and facilitating a more favourable environment for their activities and co-creation. By addressing these opportunities, local energy cooperatives can significantly improve their operational effectiveness and promote a more inclusive and collaborative approach to sustainable energy projects.

8.2.5. Main research question

The thesis investigates the concept of co-creation within local energy cooperatives in the MRDH and shows how these organisations integrate co-creation into practice. Central to this study is the main research question:

"In what ways does co-creation manifest within local energy cooperatives in the Metropolitan Region Rotterdam The Hague?"

In this context, co-creation is described as a process in which citizens act as active co-initiators and co-designers. Local energy cooperatives, mainly citizen-initiated, are therefore naturally co-created, evolving from small groups to more structured organisations committed to renewable energy and stakeholder cooperation.

Co-creation within local energy cooperatives in the MRDH is manifested in the following four main activities:

1. **Advising:**
    - **Co:** Energy coaches, cooperative members and the community actively share knowledge and experiences during home visits, at events and through both physical and digital platforms.
    - **Creation:** The result is a set of recommendations and strategies tailored to individual and community needs. These recommendations may include reducing energy consumption, investing in renewable resources and implementing energy efficiency measures.
2. **Generating information:**
    - **Co:** This activity brings together expertise and insights from different stakeholders, including cooperative members, local networks and technical experts. Together, they carry out pilot projects and technical research within working groups.
    - **Creation:** The result of the generation of crucial data on energy consumption patterns and the development of effective energy strategies.
3. **Producing renewable energy:**
    - **Co:** In renewable energy production, co-creation involves the active participation of cooperative members, financial participants and external entities such as energy suppliers and municipalities.
    - **Creation:** The concrete result is the creation and maintenance of renewable energy projects, including rooftops for solar energy, wind farms, and renewable heat networks.
4. **Engagement:**
    - **Co:** Engagement with both new and existing members, alongside collaboration with external parties such as energy companies and academic institutions, emphasises a collaborative approach to achieving the cooperative's goals.
    - **Creation:** A community of members and networks outside the cooperative is created. These networks play an important role in facilitating knowledge exchange, sharing resources and increasing the impact of the cooperative.

In conclusion, the findings show that local energy cooperatives align with the concept of co-creation, incorporating both collaborative ('co') and creative ('-creation') elements into their activities. By better aligning their activities with the criteria of co-creation, local energy cooperatives can significantly improve their positive impact on the region's environmental goals. This important step not only boosts their efforts to make the region more sustainable but also highlights the key role of the community in moving towards cleaner energy solutions.

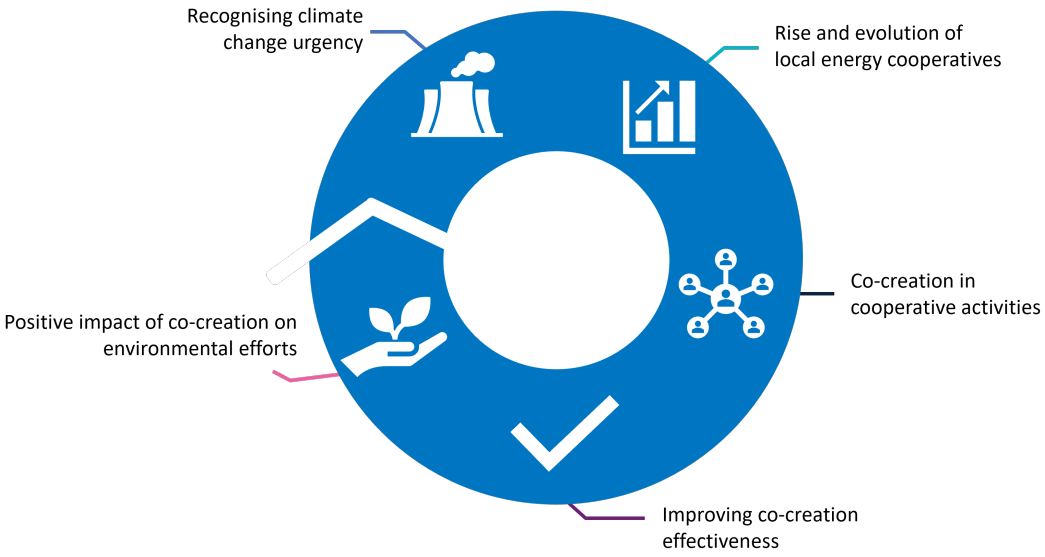

Figure 8.2: Research contributions

8.3. Research contributions

This thesis examined four local energy cooperatives in the MRDH through the lens of co-creation, bridging the gap between theoretical understanding and practical application in sustainable energy initiatives. It highlighted the growing relevance of co-creation within these communities and introduced a comprehensive theoretical framework designed to guide future research in this area and specifically addressed the gaps in current knowledge. This framework aims to deepen our understanding of the role and impact of co-creation in the energy sector, particularly in the context of local energy cooperatives.

A key focus of this research was to explore how effectively integrating co-creation principles within local energy cooperatives can improve their ability to achieve environmental goals. This alignment with co-creation improves the management of these cooperatives and contributes to broader efforts to combat climate change. The research findings and proposed framework provide valuable insights and useful guidelines for shaping and refining renewable energy policies and practices in the future.

The central role of co-creation in achieving the goals of local energy cooperatives is summarised in Figure 8.2. It stresses its importance in the bigger picture of environmental sustainability and in the global effort to combat climate change. This research has led to a better understanding of the practical applications and benefits of co-creation in the energy sector and increased the potential of co-creation as an important tool for achieving sustainable environmental outcomes.

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A

Interview protocol

A.1. Interviewees

The interviewees selected for this study are actively involved in local energy cooperatives in the Metropolitan Region Rotterdam The Hague. These individuals have different roles within their cooperatives, contributing to a rich diversity of perspectives and experiences. The paths through which they got to know these cooperatives are as varied as the duration of their involvement, ranging from recent joiners to long-standing members. Despite these differences, they have one thing in common: their active participation and strong motivation to make a significant contribution to their cooperative. Moreover, each of these individuals engages with the concept of co-creation in their cooperative efforts, giving them unique insights into this collaborative process. A detailed overview of the interview participants, with general descriptions of their roles and the cooperatives they are members of, is shown in Table A.1 and Table A.2. Please note that for confidentiality reasons, names and job titles are not mentioned and information on cooperatives and interviewees has been separated to preserve anonymity.

A.2. Introduction

The interviews began with an introduction of all participants present. Then a short introduction about the researcher and the research topic is given:

Hello, my name is Fleur and I am currently working on my master's thesis for the MSc in Complex Systems Engineering and Management at TU Delft. My research focuses on the concept of co-creation, specifically its implementation in local energy cooperatives in the Rotterdam Den Haag Metropolitan Region. In addition, I am interested in the involvement of citizens as initiators in these organisations. For this research, I am conducting interviews with members of these cooperatives to learn about their current activities, projects and their connection to the concept of co-creation.

I invite you to share your thoughts freely and honestly as all input is valuable to me. This interview will take place in a semi-structured format, giving you enough freedom to express your ideas openly, in an environment without judgement. Your answers will be treated with discretion, ensuring anonymity and confidentiality. If at any point during our conversation you feel uncomfortable or decide you want to stop the interview, feel free to tell me. Remember that you have complete freedom to interrupt or end the interview at any time. May I ask your permission to record this interview? It is purely for my research. With your permission, I will start recording immediately.

A.3. Interview scripts

After the introduction and the outlining of the research context, the semi-structured interview began. It is important to note that the interview script provided here is a broad overview of the main questions, systematically aligned and organised by the conceptual framework of co-creation criteria described in Chapter 2. Nevertheless, it is important to stress that these questions serve mainly as guidance. The flexible and adaptive nature of the semi-structured interview format allows for adjustments and spontaneous development of questions adapted to the unique perspectives and responses of each interviewee. This approach allows for a more dynamic and responsive interaction, enabling a deeper and more nuanced examination of the topic.

Introduction questions

- About the interviewee:
  - Can you tell me something about yourself?
  - What role do you play within the cooperative?
  - Why are you involved in the cooperative?
- About the cooperative:
  - Can you briefly describe your local energy cooperative?
  - What do you see as the main objective(s) of your local energy cooperative?
  - How did the cooperative come into being?
- What activities or projects are carried out within the energy cooperative? (Energy coaching, information evenings, joint solar projects, etc.)

Questions for each activity

1. Purpose and rationale of the activity
   - Can you explain the main **purpose** of this activity? Why was this activity initiated?
   - How does this activity contribute to creating **value** for the cooperative and its members?
2. Details and structure of the activity
   - Describe what this activity or project entails. How is it implemented?
   - Can you elaborate on the aspects of **cooperation** and possible **iterative processes** involved in this activity?
3. Involvement and diversity in the activity
   - Who are the key people involved in the different phases of this activity (from initiative and design to implementation)?
   - To what extent does this activity include **diversity and inclusiveness** among the participants?
   - How would you describe the **active participation** and involvement of these people?
4. Role and motivation of the participants
   - What specific roles do participants play in this activity? What motivates them to be involved?
   - Does this activity focus on promoting **fair decision-making** and **mutual benefits** for the participants?
5. Evaluating the success of the activity
   - How successful has this activity been, taking into account the intended goals?
   - Can you comment on the performance and effectiveness of this activity in achieving the goals?
6. Challenges related to the activity
   - What challenges or obstacles did you encounter with this activity?
   - Are there any specific problems or difficulties that occurred during the implementation or execution of this activity?

Table A.1: List of interviewees

Interviewees	Role in cooperative	Date interview
1	Secretary	7-11-2023
2	Chairman	7-11-2023
3	Secretary	7-11-2023
4	Administration and events	7-11-2023
5	Energy coach	14-11-2023
6	Secretary	14-11-2023
7	Board member	15-11-2023
8	Energy coach	20-11-2023
9	Energy coaches coordinator	24-11-2023
10	Secretary	24-11-2023

Table A.2: List of cooperatives

Cooperatives interviewed	Nr. interviews
Hernieuwbare Warmte Ypenburg	5
Nieuwe Lansinger Stroom	3
EnergieC Midden-Delfland	1
Alex Energie	1

B

Observations protocol

The series of information evenings, as described in Section 5.1.2, organised in several cities serves as another important data collection method in the research on local energy initiatives. These events in the Metropolitan Region Rotterdam The Hague provide a platform for collecting qualitative data through direct interaction with residents, energy experts and stakeholders involved in the energy transition. Each event, focusing on specific topics such as energy sharing, the use of heat pumps, neighbourhood heating solutions, renewable heating technologies and energy-saving measures, offers a lot of information. These sessions are not only educational but also serve as forums for open discussion, feedback and first-hand experiences from participants. An overview of the information sessions attended for this interview can be found in Table B.1.

Table B.1: List of observations

Meetings	Name	Energy co-operative	Location	Topic	Date
1	Informative evening	Sterk op Stroom	The Hague	An engaging information session to provide information on the concept of energy sharing. The event addressed all questions and showed how residents can work together to promote energy transition in their neighbourhood.	9-10-2023
2	Themed evening	Nieuwe Lansinger Stroom	Berkel en Rodenrijs	A themed evening focused on heat pumps, offering guidance on optimal steps and choices for homes. Energy coaches, together with industry experts and suppliers, were available for personal advice and questions.	16-10-2023
3	Residents' evening	Warm in de Wijk	The Hague	Titled "Residents' evening: From neighbourhood initiative to business", this meeting provided valuable insights and stimulated discussion on the future direction of the local heat grid.	25-10-2023
4	Informative evening	Hernieuwbare Warmte Ypenburg	The Hague	A big session for Ypenburg residents focusing on various energy-saving methods. The event covered topics such as upgrading ventilation systems, heat pumps, insulation, solar panels and how to access subsidies, all aimed at reducing energy costs.	7-11-2023
5	Energy coach workshop	-	Delft	An interactive workshop led by a technical specialist, demonstrating practical skills such as applying draught strips and window film. This event was especially for energy coaches and highlights practical techniques to improve energy efficiency in homes.	14-11-2023

C

Research methodology

C.1. Literature review

Figure C.1 shows a flowchart of the literature search as described in Chapter 3. It is used to ensure transparency and replication in the literature search process and shows how the final set of papers was determined for inclusion. Here is an explanation of each step:

1. Identification
    - Keywords used in the search were ”local”, ”energy”, ”communities” and ”co-creation”. The term ”ener” was used as a constraint to further filter the search results.
    - The Scopus database was searched, including 28 articles.
2. Screening
    - Of the initially 28 papers found, a screening process was carried out, reducing the number to 18 papers. This process consisted of reviewing titles, abstracts and full texts to determine their relevance to the research questions.
3. Exclusion
    - A dotted line indicates reports that were excluded from the review. Reasons for exclusion include overlapping content (meaning they provide the same information as other sources) and content not relevant to the research objectives.
4. Inclusion
    - After screening, 15 papers were considered relevant and included in the review for further analysis.
5. Citation analysis
    - The purple box indicates that citation analysis was performed on the included papers, with a number (N = 18) indicating an additional number of papers identified through citation tracking. The citation analysis has been guided by the snowball method, which uses the reference lists of the selected articles to find more relevant literature.

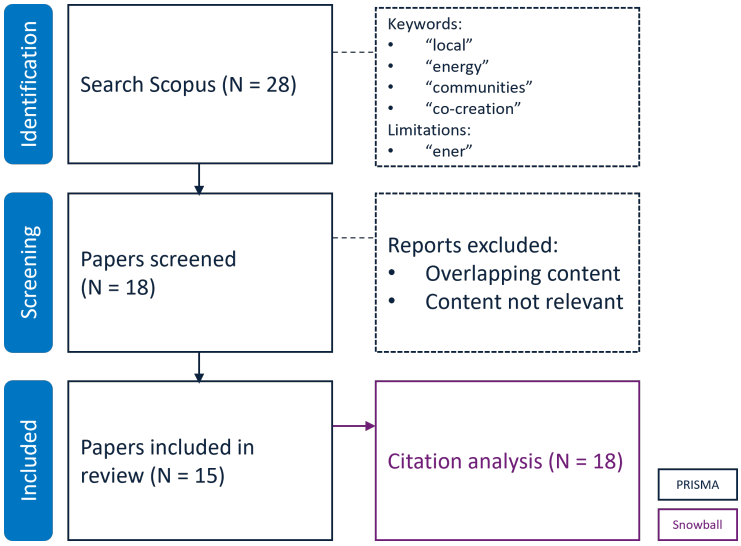

Figure C.1: Selection process

C.2. Case selection

The methodology and criteria for selecting the local energy cooperatives are shown in Figure C.2. The 'seven cooperative principles' defined by Energie Samen, which distinguish cooperatives from other entities, were the foundation for creating a list of citizen collectives in 2022, as documented on the Local Energy Monitor website (Energie Samen and Klimaatstichting HIER, 2023). This list, which includes 705 citizen energy collectives, both cooperatives and foundations, was used to make an initial selection of case studies. It facilitated the identification of specific case studies for the current study, which then led to the start of desk research. Given the research's geographic focus on the Metropolitan region Rotterdam The Hague, the first round of selection was limited to the 21 municipalities within this region (MRDH, n.d.-a).

Consequently, 36 collectives within this area were identified for the research's focus and were examined through their websites. However, some of the cooperatives listed on the Local Energy Monitor website did not have an online presence, which posed challenges in terms of accessing information about their organisation. Therefore, more detailed desk research was undertaken for the 26 out of 36 cooperatives that did have an online website.

Among these 26 cooperatives, notable variations in their activities were observed. Some of them offered their members access to energy coaches with certification to guide sustainable home improvements. Others took the initiative to organise informative meetings, keeping their members informed of the latest developments in the energy sector and ongoing cooperative projects. These meetings also served the purpose of attracting new individuals to join their community. A third distinct activity observed among these cooperatives was their engagement in collective energy generation. This involved the collaborative establishment of shared solar roofs, allowing all cooperative members to participate. For instance, "Sterk op Stroom" serves as an illustrative case, having installed its first solar roof at the Aikdo school in The Hague. When selecting case studies, the emphasis was placed on identifying cooperatives that actively participated in all four of these activities. This approach was taken to ensure that the chosen case studies included some form of co-creation and is shown in Figure C.3.

The final selection of the chosen energy communities was influenced by multiple considerations. Firstly, within the research timeframe that included interviews and on-site observations, data collection was possible for only a few of these communities as they conducted their informational meetings between October and December. Secondly, the research methodology, which involves interviews and direct observations, relies on the willingness of individuals to participate. The selection of these cases was thus influenced by the practical constraints of time and willingness to participate. Additionally, the communities chosen in the final selection are in different municipalities. This diversity is important, as municipal policies differ and these differences can significantly influence and promote support for energy communities.

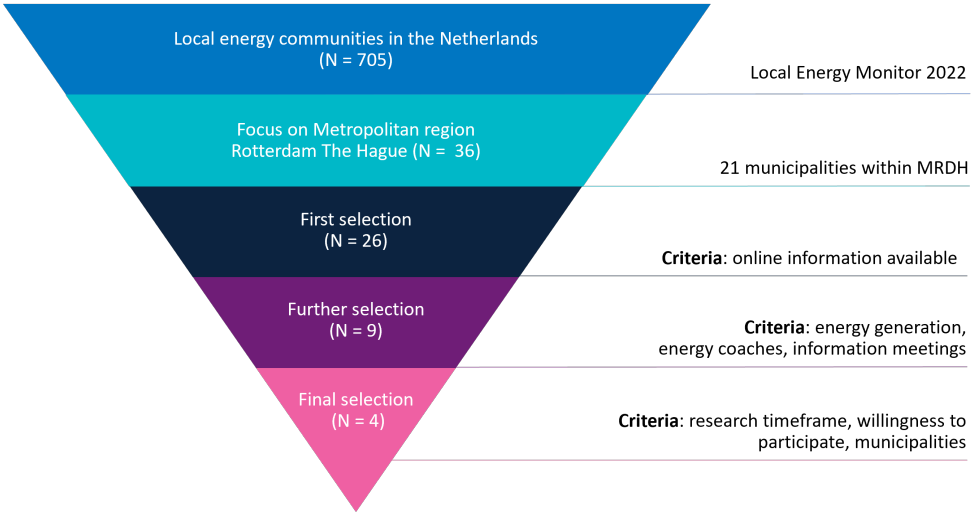

Figure C.2: Case Study Selection

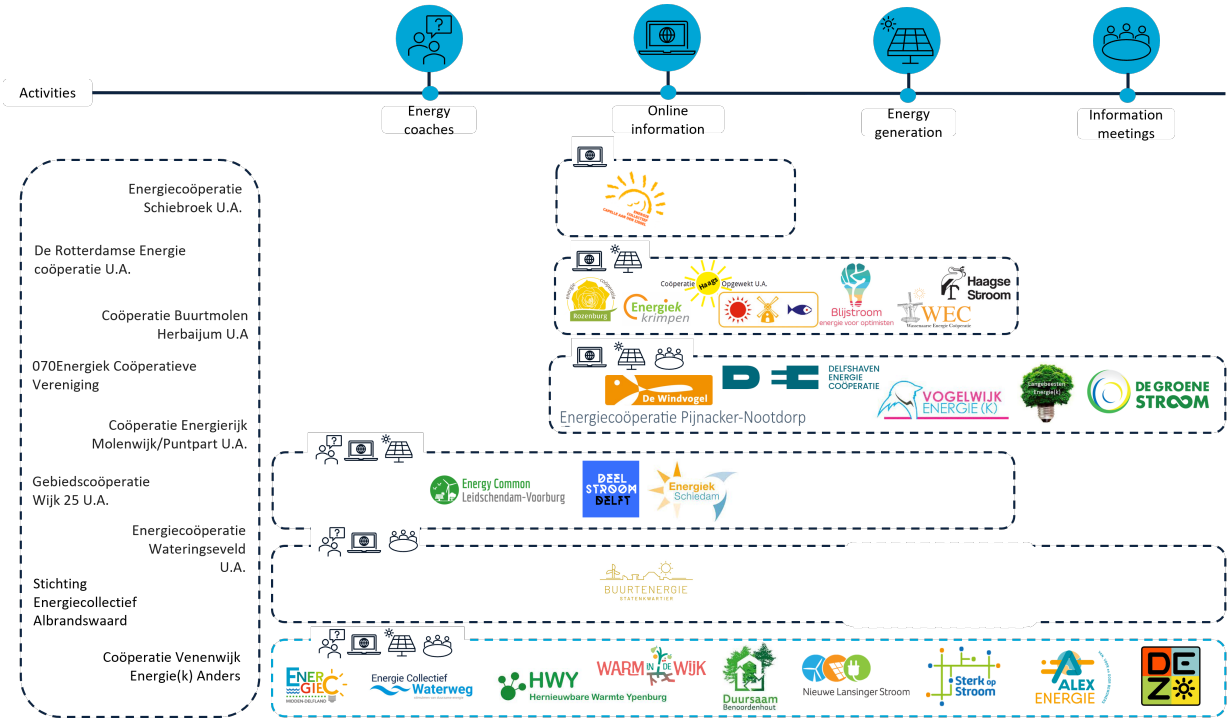

Figure C.3: Activity selection among cooperatives

D

Coding phase

In this study, ATLAS.ti, an advanced tool for qualitative data analysis, was used to develop a coding strategy. The coding process took place in several steps. First, all interviews were reviewed to understand participants' motivations, the different activities the cooperatives undertook and the challenges they faced. This fundamental step was crucial to becoming familiar with the data and discovering overarching themes.

These themes were then converted into preliminary codes using an inductive approach, where codes emerged organically from the data and avoided pre-conceived categories. Through this lens of analysis, a multitude of themes became clear, revealing four predominant activities (each with its own set of barriers), developments, collaborations and several other significant elements that shaped the cooperative experience. These findings laid the foundation for the analysis that followed.

Guided by these categories, a second, more detailed examination of the documents was conducted. In this phase, particular attention was paid to ensuring that the statements matched the identified categories. Following this detailed examination, relevant quotes were merged under their respective codes, summarising the identified activities, motivations, developments and other categories. Each quote was thus assigned a 'code' that reflected its essence, grounded in the previously identified themes.

As the analysis progressed, the coding scheme was refined, with codes being merged, segmented or modified to more faithfully reflect the nuances of the data. The final step involved a thorough review of the coded data to ensure consistent coding and confirm that the coded data were consistent. The final coding scheme used to analyse the results is shown in Table D.1.

Table D.1: Final coding scheme

Category	Codes	Subcodes	Grounded	Comment
Activiteiten			*167*	
	Consulting		65	Merged with ”Activiteiten: energie coaches, energieloket, energiewinkel, warmtescan, advies gesprekken, bespreking van problemen of wensen, demonstratiemateriaal”
	Energy generation		19	Merged with ”Energie projecten”
	Engagement		49	Merged with ”Activiteiten: information meetings, marketing, meetings members, nieuwsbrief, overtuigen”
	Research/pilots		54	Merged with ”Activiteiten: gasvrije woningen, warmtenet, data-analyse, informatie”
Barriers			*95*	
	Engagement	External stakeholders	36	Merged with ”Barriers: traagheid, bureaucratie, data-uitwisseling”
		Members	8	Merged with ”Barriers: verbondenheid”
		New members	23	Merged with ”Barriers: inclusiviteit, niet-divers, bereik vergroten”
	None		1	
	Generating energy		20	Merged with ”Barriers: technisch, belofte niet nagekomen, burgers, commerciële ontwikkelaars”
	Giving advice		3	Merged with ”Barriers: geld, onzekerheden”
	Overview		1	
	Time		8	
Criteria co-creation			*12*	
	Collaboration		3	
	Diverse inclusiveness		5	
	Equitable decision-making		1	
	Transparency		3	
Diverse			*15*	
	Male/female		6	
	Education		4	
	Solutions for more diverse		6	
Energy cooperatives			*131*	
	Goals		13	
	Organisation		118	Merged with ”Organisatie: bestuur, energiebesparing, ontstaan, onafhankelijkheid, kostenbewustzijn, kosten, invloed, verbinding, wie zijn het”
Motivation			*73*	
	Community involvement		23	Merged with ”Motivatie: Community involvement, pensioen”
	Cost saving		27	Merged with ”Motivatie: energiebesparing, comfort, kosten, prijsplafond”
	Environmental concerns		5	Merged with ”Motivatie: ontevredenheid overheid”
	Technological interest		23	Merged with ”Motivatie: experiment/kennis opdoen, personal interest (hobby)”
Origin			*11*	
	Municipal presence		4	
	Kitchen table		7	
Developments			*34*	
	Attitude of residents		13	Merged with ”Ontwikkelingen: bewustwording”
	Politics		8	Merged with ”Ontwikkelingen: gasprijzen”
	Professionalisation		8	
	Technology		5	
Partners			*49*	
	Energy companies		16	
	Manufacturers		2	
	Municipality		17	
	Installers		1	
	Others		17	
Research limitations			*3*	*Merged with ”Further research”*
Conditions			63	
	Paid force		2	
	Budget		12	Merged with ”Voorwaarden: vergoedingen”
	Continuity		6	
	Good cooperation		6	
	Knowledge		21	
	Motivation		1	
	Partnerships/network		16	
	Team composition		3	
	Time		3	