"EMPOWERING ENERGY COMMUNITY NICHE IN FLANDERS: A STUDY ON SOCIAL INNOVATION, AND TRANSITION STRATEGIES"

MASTER THESIS
COMPLEX SYSTEMS ENGINEERING AND MANAGEMENT-
(ENERGY TRACK)

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TUDelft

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Acknowledgement

Embarking on the journey towards a Master of Science degree is a transformative experience, marked by challenges, growth, and invaluable learning. As I reflect upon my academic odyssey, I am compelled to express my gratitude to those who have played pivotal roles in shaping this chapter of my life.

My academic journey began at Tehran Polytechnic in Iran, where I earned my Bachelor's degree in Energy and Industrial Engineering. My passion for exploring the complexities of energy systems led me to pursue the Complex Systems Engineering and Management program at TU Delft in the Netherlands. This program not only promised academic excellence but also challenges and opportunities.

During my two-year stay in the Netherlands, I had diverse experiences that broadened my perspectives. I served as the Public Relations Manager at TU Delft Energy Club, which helped me improve my soft skills. Additionally, I participated in a joint interdisciplinary project on grid congestion management at Stedin, which provided me with invaluable hands-on experience.

The idea for my Master's thesis came during the "Sustainable Energy Innovation and Transition" course, led by Dr. Linda Kamp. The course introduced me to the captivating realm of social innovation within the energy sector. Choosing to explore this domain for my thesis was a significant departure from my technical comfort zone. However, under the guidance of my supervisors, Dr. Thomas Hoppe and Dr. Linda Kamp, I navigated this uncharted territory with enthusiasm and purpose. I am grateful to them for their professional and responsible assistance throughout my thesis project.

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To my family, the bedrock of my aspirations, I owe the deepest gratitude. My parents and brother have been unwavering pillars of support, making it possible for me to realize my dreams. Their encouragement has been a driving force, propelling me to the privilege of studying at the prestigious TU Delft and immersing myself in the vibrant culture of the Netherlands—an experience truly for a lifetime.

In conclusion, this Master's thesis is a testament to the collaborative efforts, mentorship, and support that have shaped my academic pursuit. As I write these words in November 2023, in the picturesque city of Delft, South Holland, Netherlands, I express my sincere appreciation to all those who have made this journey possible.

Sincerely,

Parisa Alipanahi

November 2023 Delft, South Holland, Netherlands

Summary

The global shift towards sustainable and renewable energy sources is an undeniable necessity. Energy communities, grounded in principles of community participation and environmental sustainability, are emerging as key players in driving this transformation. Flanders, a region in Belgium, has witnessed the rise of energy communities as they take on the challenges and uncertainties inherent to their mission. This thesis embarks on a journey to uncover the dynamics, challenges, and opportunities that these energy communities in Flanders face in their quest to facilitate the energy transition.

While energy communities have garnered attention as a social innovation, there remains a need to explore the specific context of Flanders, its niche development, and up-scaling patterns. To address this gap, our research focuses on understanding the unique characteristics and challenges of energy communities in Flanders and their role in shaping the regional energy landscape. This study seeks to answer the following main research question:

"What are the characteristics, challenges, and scaling patterns of energy communities in Flanders, Belgium, and how do these communities contribute to the energy transition?"

To address the research question, a qualitative data analysis with a case study approach was adopted. Qualitative data collection methods, such as stakeholder interviews, were utilized to gain insights from the local actors involved in the energy community niche. Additionally, the Strategic Niche Management (SNM) framework was applied to assess the development and scaling of these energy communities. The analysis considered various factors, including expectations, network formation, and key learning processes within the niche. Also, the concept of Scaling the Community Energy niche was analysed based on the qualitative data collected from the semi-structured interviews and the different typology patterns of scaling this niche innovation in the Flanders region have been displayed. Moreover, the concept of shielding and nurturing the community energy niche and their future perspective in the Flanders area is discussed on.

The study uncovered a series of insights regarding energy communities in Flanders:

1. Common Challenges for Energy Communities: Energy communities in Flanders face complex regulatory environments, competition for land, and the need to enhance public awareness and business case viability. They also grapple with legislative variations, participant knowledge gaps, administrative burdens, and the need for clarity in objectives and definitions. Adapting to evolving legislation and managing transaction costs are additional challenges.

2. Challenges Specific to DSO and VEKA: Distribution system operators (DSOs) like Fluvius must reduce grid fees fairly to avoid burdening non-participants. Flemish Energy and Climate Agency (VEKA) should ensure a comprehensive understanding of complex legislation and manage administrative complexity.

3. Niche Characteristics and Processes: The research identified three critical attributes of the community energy niche in Flanders, including dynamics of expectations, network formation, and essential learning processes. These aspects were elaborated upon, providing a comprehensive understanding of the niche dynamics in the region.

The study significantly contributes to several academic debates:

1. Strategic Niche Management (SNM): The application of the SNM framework to analyze Flanders' energy communities enriches the understanding of how these communities conform to or challenge niche management processes. It confirms the adaptability of SNM in assessing their development.

2. Empowerment of Community Energy Niches: By exploring empowerment strategies used by Flanders' energy communities, the study aligns with debates on empowerment and adaptation in community energy niches.

3. Up-Scaling Patterns in Flanders: The research identified different up-scaling patterns, confirming the relevance of various strategies within the region.

4. Stakeholder Involvement: The study complements other research by providing insights into how stakeholders operate and coordinate within Flanders' energy communities.

5. Investments in Renewable Energy Initiatives: In addition to investigating determinants of investments, the study also explores economic factors like job creation, local economic stimulus, and property values.

6. Community-Based Governance and Sustainable Energy Usage: The research expands the focus on up-scaling patterns and empowerment strategies driving sustainable energy behaviour within Flanders energy communities.

Additionally, The study offers several recommendations for policymakers to support energy communities in Flanders:

- Standardize and harmonize energy community regulations across different Belgian regions to reduce complexity and uncertainty.
- Introduce participative criteria in tenders for renewable energy projects to enable energy communities to compete fairly.
- Support targeted public awareness campaigns to bridge the gap between energy communities and the broader public.
- Explore financial incentives tailored to the Belgian context to establish a compelling business case for energy community participation.
- Invest in educational and training programs to bridge the knowledge gap among participants.
- Streamline registration processes and regulatory compliance to reduce the administrative burden.
- Provide clear definitions and objectives for energy communities within the Belgian context.
- Stay responsive to changing regulations to enable energy communities to thrive.
- Encourage collaboration, knowledge sharing, and advocacy efforts within the Flanders energy community niche.

In conclusion, this research contributes to a better understanding of energy communities in Flanders, offering insights for policymakers and energy communities. It emphasizes the importance of empowering these communities to accelerate the energy transition and achieve lasting benefits for society and the environment in the region.

Contents

1 | Introduction

1.1. Energy Communities

Energy is no longer a simple measure of transporting energy for electricity and heating. Energy has become a central part of current-day societies and is seen as a necessity of life. Heffron (2022) states that energy justice is becoming a popular research topic. Furthermore, Heffron (2022) shows that energy justice encompasses the equal division of energy amongst various actors in a just social and economic way. However, when looking at current days, policy favours an exclusive energy system, facilitating energy injustice (Heldeweg & Saintier, 2020). Energy communities are a potential solution when looking at options for mitigating these injustices. The bottom-up approach of energy communities battle the currently hierarchical, unjust structure and largely centralized energy system (Heldeweg & Saintier, 2020).

Energy communities are one of the critical elements for achieving the EU's energy transition by 2050; half of Europe's citizens could be producing up to half of the EU's renewable energy (Kampman et al., 2016). Recognizing the critical role of local actors in the energy transition process – citizens in particular – the EU's Clean Energy Package since 2019 includes provisions to help local communities take ownership of the energy transition through the concept of energy communities (Nouicer et al., 2020)

According to EU laws, energy communities can take any form of a legal entity, such as an association, a cooperative, a partnership, a non-profit organization, or a limited liability company. It makes it easier for its citizens and other market players to team up and jointly invest in energy assets. This, in turn, helps contribute to a more decarbonized and flexible energy system, as the energy communities can act as one entity and access all suitable energy markets on a level playing field with other market actors. (Kampman et al., 2016)

The question remains: what precisely are the energy communities? In short, energy communities (ECs) strive to combine the efforts of multiple local households and companies to become more sustainable and adaptable. Renewable energy communities (RECs) are prominent initiatives to provide end consumers with an active role in the energy sector, raise awareness of the importance of renewable energy (RE) technologies and increase their share in the energy system, thus reducing greenhouse gas (GHG) emissions (Felice et al., 2022). Moreover, as stated by the European Commission, the legal definition of energy communities is a legal entity based on voluntary and open participation, effectively controlled by shareholders or members who are natural persons, local authorities, including municipalities, small enterprises, and micro-enterprises. The primary purpose of it is to provide environmental, economic or social community benefits for its members or the local areas where it operates rather than financial profits (Kampman et al., 2016).

Furthermore, an energy community can be engaged in electricity generation, distribution and supply, consumption, aggregation, storage or energy efficiency services, generation of renewable electricity, charging services for electric vehicles or providing other energy services to its shareholders or members (Reijnders et al., 2020). The European Commission (n.d.) present the following benefits of the implementation of energy communities: Energy communities offer a means to restructure the energy systems by harnessing energy, allowing citizens to participate actively in the energy transition, and providing direct potential benefits to citizens such as:

- Decreasing the energy costs
- Keeping money in the local economy and keeping individual investment affordable

- Decreasing carbon emission on a local level
- Fostering the local acceptance of renewable energy
- Increasing the energy efficiency
- Benefiting the local community's economy by creating local job opportunities

Despite the mentioned benefits, ECs have not yet become mature and developed enough. This is because there are still barriers to overcome for ECs. For instance, keeping a community enthusiastic after the first initiative can be difficult. Moreover, it can be not easy to save money within the project. The other barrier is that the legislation still lacks behind the implementation of energy communities (Reijnders et al., 2020).

How this niche innovation will impact the existing energy landscape is not yet known. So, the question arises of how this niche innovation can be effectively implemented in a country's energy system and what this would imply for the current energy system. Researchers are interested in the expanding trend of civil society involvement in producing renewable energy (De Nigris & Giuliano, 2021). Nevertheless, little is known about how a diversified and smaller sector like the energy community might grow and encourage a shift in energy production. To better understand this problem, this research also requires using and implementing theoretical frameworks such as the Strategic Niche Management (SNM) framework to investigate the transition and scaling of the energy communities.

This chapter further elaborates on the concept of Energy Communities, followed by the definition of Scaling regarding energy communities. Afterwards, the academic knowledge gap, research questions and the thesis outline are provided.

1.1.1. Definition and conceptualisation

In this section, more in-depth background knowledge of energy communities, how they prosper and scale, and what barriers and opportunities they encounter is presented:

As mentioned previously, energy communities refer to organizations or initiatives in which citizens collaborate to bring about sustainable energy transitions at the local level or even on a broader scale by changing current energy systems and institutions. These communities operate based on the concept of social innovation, which involves new ideas and approaches that meet social goals and address societal challenges. Unlike traditional forms of innovation driven by financial motives, social innovation focuses on the well-being of people, communities, and society. (Hoppe et al., 2023)

Energy communities prosper and scale by mobilizing citizens, promoting democratic decision-making processes, and implementing innovative strategies for sustainable energy practices. They engage in various activities such as installing renewable energy plants, promoting energy efficiency, addressing energy poverty, and working towards energy democracy. These initiatives rely on local social relations, forming spaces of dependence where they raise funds, gain participants, and establish community support. The most common form of organization for energy communities is the cooperative, which emphasizes member involvement, democratic decision-making, and the equitable distribution of profits. (Elena & Andreas, 2020)

Some barriers and opportunities that are encountered by energy communities include:

- **1. Policy and regulatory frameworks:** Supportive policies and institutional arrangements, such as feed-in-tariff schemes, subsidies, and tax exemptions, can enable the emergence and development of energy communities. However, inconsistent or unfavourable policies can hinder their growth.(Hampl & Poliak, 2019)
- **2. Financial considerations:** Access to financing and investment opportunities is crucial for energy community initiatives. Lack of financial resources and limited Access to capital can challenge their development and expansion.(Jin et al., 2020)

- **3. Technological advancements:** Energy communities must keep up with technological developments in renewable energy generation and storage. Embracing new technologies and integrating them effectively can enhance their operations and scalability.(Monstadt & Truffer, 2018)
- **4. Social acceptance and engagement:** Building trust, fostering community engagement, and addressing potential conflicts of interest are essential for the success of energy communities. Overcoming resistance and gaining social acceptance can be a barrier in some cases.(Pijush & Siddiki, 2019)
- **5. Knowledge and capacity building:** Energy communities require knowledge and expertise in various areas, including project development, energy management, legal frameworks, and financial planning. Access to relevant information, training, and capacity-building programs can support their growth.(Schäfer & Hills, 2017)
- **6. Collaboration and partnerships:** Energy communities can benefit from collaborations with other stakeholders, including local authorities, businesses, research institutions, and community organizations. Building strategic partnerships can provide additional resources, expertise, and support.(Nadaud & Bressanelli, 2019)

Overall, energy communities face a mix of challenges and opportunities in their pursuit of sustainable energy transitions. Overcoming barriers and capitalizing on opportunities often requires a supportive policy environment, financial resources, technological innovation, community engagement, and collaboration with diverse stakeholders.

1.2. Scaling

In energy communities, scaling refers to expanding a community-based energy initiative's size, scope, or impact. Energy communities are typically local or regional groups of individuals, businesses, or organizations that work together to generate, distribute, or manage energy resources in a more sustainable and community-oriented manner. More details about the Scaling of Niche Innovations, particularly the energy community Niche, are provided in chapter 2. Scaling can involve several aspects:

- **1. Size**: Scaling can involve increasing an energy project's physical size or capacity of an energy project. For example, if a community solar installation initially serves a small neighbourhood, scaling might involve expanding it to cover a larger area or generate more electricity.
- **2. Scope**: It can also involve broadening the scope of activities within the energy community. For instance, a community might start focusing on rooftop solar installations but later incorporate energy storage, energy efficiency programs, or electric vehicle charging infrastructure into their initiatives.
- **3. Impact**: Scaling can be about increasing the overall impact of the energy community. This might involve reaching more people with affordable renewable energy, reducing carbon emissions by a larger amount, or contributing more significantly to the local economy.
- **4. Replication**: In some cases, scaling can also refer to replicating successful energy community models in other locations. For example, if a community successfully establishes a community-owned wind farm, it might seek to replicate this model in nearby towns or regions.
- **5. Integration**: Scaling can involve integrating with larger energy systems. For instance, an energy community that operates in isolation may later seek to connect with the broader grid or participate in energy trading with neighbouring communities.
- **6. Policy and Regulation**: Scaling often involves engaging with policy and regulatory frameworks to create an environment supporting energy communities' growth and sustainability. This may include advocating for changes in laws or regulations to facilitate community energy projects.

Scaling in energy communities is essential for achieving broader sustainability goals, increasing energy resilience, and making renewable energy accessible to a more significant portion of the population. However, it can also come with challenges, such as securing additional funding, navigating regulatory hurdles, and maintaining community engagement and support as initiatives grow.

1.3. Academic knowledge gap

Conducting a review on the existing literature among renewable energy communities in European Union (Seyfang & Haxeltine, 2012) shows that studies have been done in identifying initiatives that may contribute to expanding the community energy sector. However, there is still an academic knowledge gap in addressing how to involve unwilling community energy actors in the scaling-up process. Also, how to deal with conflicting expectations, especially in regions with multiple pilots of evolving energy communities (Hoppe et al., 2023).

Furthermore, energy communities are becoming popular in some countries like Belgium (Felice et al., 2022) while declining in some other locations like Germany (Broska et al., 2022), and there is a need to understand the factors that influence their success to scale up their potential impact on the regional energy transition (Verbeeck et al., 2019). However, there is still a lack of knowledge about the conditions under which energy communities can thrive in various regions, which makes it difficult for policymakers and stakeholders to support their development, growth, and scaling effectively. The potential of energy communities to contribute to the regional energy transitions may be significant, and understanding the factors that influence their success can help maximize their impact and accelerate the growth of a sustainable energy system.

The literature review of the articles published in recent years collectively contributes to the understanding of energy communities, their governance, typologies, and the factors that influence their success or hinder their scaling. They address various aspects of energy community development, offering valuable insights into the academic knowledge gap in strategic niche management analysis for scaling energy communities in different pilots. For instance, (Verbeeck et al., 2021) focuses on developing a typology of renewable energy communities in Flanders, Belgium. It examines different types of energy communities and their characteristics, contributing to understanding the region's diverse landscape of energy communities.

Moreover, (Verbong & Loorbach, 2012) discusses the governance of the energy transition and explores the realities, illusions, and necessities associated with it. It highlights the importance of effective governance strategies to facilitate the growth of sustainable energy systems. (Mancini et al., 2020) examines the governance and regulation aspects of the energy transition, mainly focusing on grassroots initiatives. It explores the role of local, community-led energy initiatives in driving sustainable energy transitions and discusses the challenges and opportunities associated with their governance. Finally, (De Groote et al., 2020) investigates the drivers and barriers to implementing renewable energy communities. It synthesizes existing research to identify the key factors influencing the establishment and operation of energy communities, shedding light on their challenges and opportunities.

In conclusion, the need for studying the scaling of energy communities with a strategic niche management approach can be justified based on several reasons:

1. **Knowledge Gap**: There is still a lack of comprehensive understanding of the factors influencing the successful niche development and up-scaling of energy communities in various regions. The existing literature provides limited insights into the specific dynamics and challenges energy communities face in some areas. Therefore, conducting a kind of transition governance analysis (SNM theoretical framework) can help bridge this knowledge gap by exploring a case study's unique context and research conditions and identifying the key factors contributing to the success and scaling of energy communities in that area.
2. **Policy and Decision-Making**: Strategic niche management analysis informs policymakers and decision-makers on strategies, policies, and support mechanisms to foster energy community growth. This analysis guides targeted policies aligned with regional characteristics.
3. **Practical Implications**: Transition governance analysis, particularly strategic niche management theoretical framework, provides practical guidance for energy community practitioners, stakeholders, and investors. It identifies best practices, coordination mechanisms, and learning processes for successful scaling and transfer ability to other regions.
4. **Transition to Sustainable Energy Systems**: Energy communities are vital for transition-

ing to sustainable energy systems. Mainstreaming energy communities analysis evaluates energy community dynamics, stakeholder interactions, and scaling conditions. Therefore, findings contribute to effective strategies and policies integrating energy communities into the broader energy system of a country.

Thoroughly, The scaling of energy communities is considered desirable because it can lead to several benefits. Firstly, it can increase the share of renewable energy in the energy mix, which can help to reduce greenhouse gas emissions and mitigate climate change. Secondly, it can increase energy security by reducing dependence on fossil fuels and centralized energy systems. Thirdly, it can create economic opportunities and local jobs, particularly in rural areas. Finally, it can increase social cohesion and community engagement by involving citizens in the production and consumption of energy (Fina et al., 2022). Moreover, It is crucial to analyze the energy community niche based on location, considering each area or country's geopolitical, social, and economic situation. It is necessary to study the scaling of the energy community niche, customized to the location and case study, to understand better the current situation, challenges, barriers, and opportunities. By doing so, The challenges can be addressed by considering different levels and perspectives of various stakeholders. This will ensure that the policy and regulatory environment is suitable for empowering energy communities towards the goal of energy transition and sustainable development.

In summary, studying the scaling of energy communities in some case studies with a strategic niche management approach is necessary to assist with the knowledge mentioned above, inform policy and decision-making, provide practical guidance, and advance the transition to sustainable energy systems. In the following chapters, the theoretical frameworks, research approach and methodologies that assist us in conducting this study are provided.

1.3.1. Research questions

After considering all the aforementioned factors and identifying gaps in the field of energy innovation, the primary question of this research and its subsequent sub-questions can now be addressed. The main research question can be formulated as below:

"What factors influence the successful niche development of energy communities in Flanders, Belgium, and how can this inform strategies for scaling up their potential impact on the regional energy transition?"

For answering the above-mentioned main research question, the following sub-questions must be answered in this study. These sub-questions are as follows:

1. *What is the concept of energy community, and what does scaling mean in that regard?*
2. *What are the roles, influences, and coordination mechanisms of relevant stakeholders in the implementation and scaling of energy communities in Flanders?*
3. *What are the current challenges for the Flanders region's energy communities, and how have they responded to them?*
4. *What are the current niche characteristics of Flanders' energy communities regarding learning processes, network formation and dynamics of expectations?*
5. *What future strategies can be advised for shielding and nurturing energy communities niche in Flanders, and what insights are needed to develop those strategies?*

The knowledge gap addressed by the research questions is the lack of comprehensive understanding regarding the factors that influence the successful niche development of energy communities in the selected pilots and the strategies that can be employed to scale up their potential impact on the regional energy transition. The research questions aim to fill this gap by investigating various aspects of energy communities, stakeholder roles and influences, coordination mechanisms, current challenges, niche characteristics, and future strategies. By answering these sub-questions, the study seeks to provide valuable insights and knowledge to inform the development and scaling of energy communities.

1.4. Thesis outline

As outlined in the flowchart of Figure 1.1, this thesis project begins with an Introduction that defines energy communities, discusses scaling, identifies academic knowledge gaps, and presents the research questions. The next chapter, Theoretical Framework, provides a description and conceptualization of the Multi-Level Perspective (MLP) and the Strategic Niche Management framework (SNM).

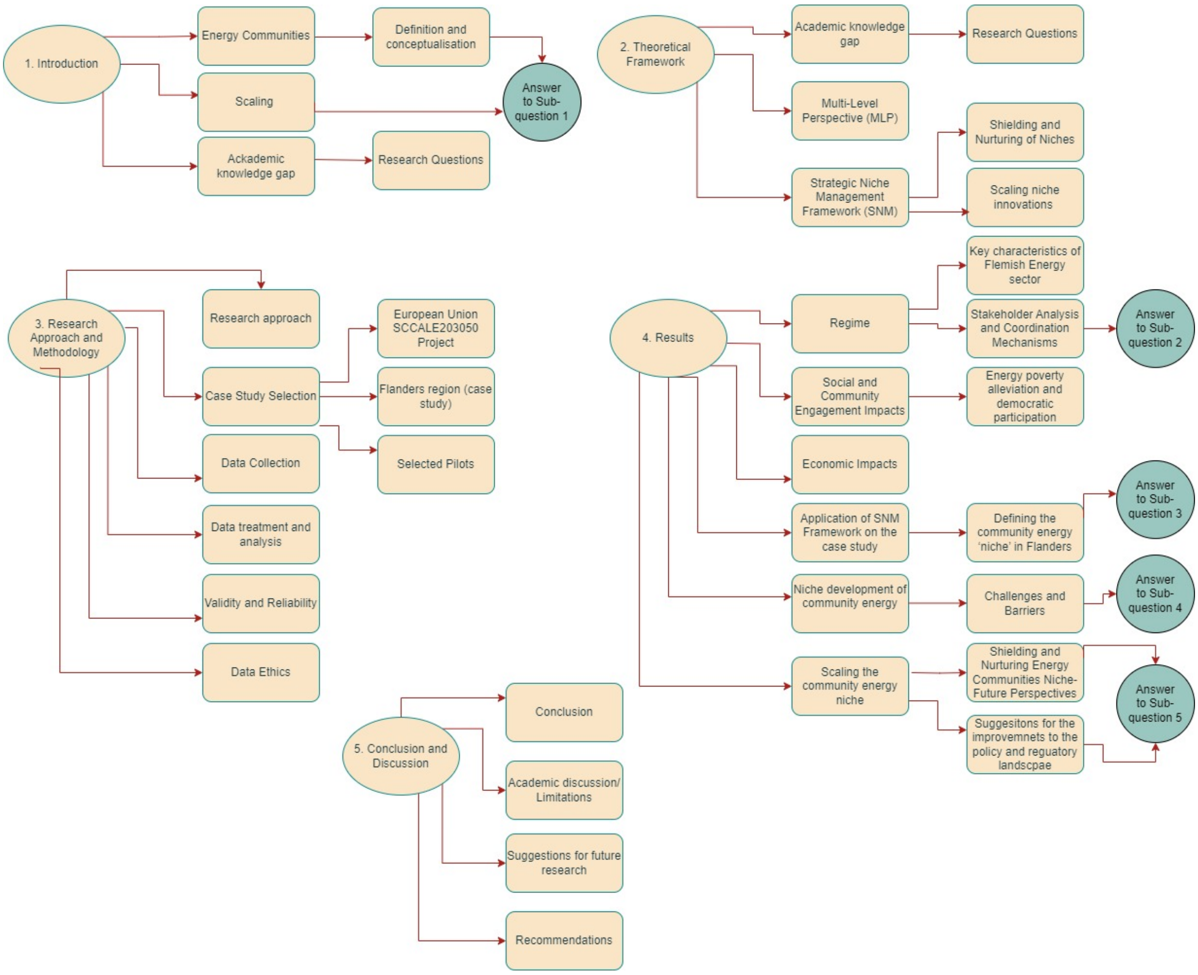

Figure 1.1: Thesis Outline Flowchart

The Research Approach and Methodology chapter follows, which includes the selection of case studies, an overview of the EU SCCALE 203050 Project and the selected pilots, information on data collection procedures, data treatment and analysis, validity and reliability, and data ethics.

Chapter 4 presents the Results. This chapter begins with a description of the regime, which includes the key characteristics of the Flemish energy sector, stakeholder analysis, and coordination mechanisms. It then explores the social, community engagement, and economic benefits of energy communities. Section 4.4 focuses on the application of the SNM framework to the case study. Finally, this chapter concludes by examining the development of energy communities, their challenges, and the shielding, nurturing, and future perspectives of community energy niches in the selected region.

The Conclusion and Discussion chapter concludes the thesis report. It provides answers to the research questions, academic discussion, limitations of the study, suggestions for future research, and recommendations.

Additionally, the appendixes include the Questionnaire for Semi-Structured Interviews, the Informed

Consent Form, the Data Management Plan, and the Checklist for Human Research Ethics.

As previously mentioned in subsection 1.3.1, the research sub-questions can be answered by referring to Figure 1.1. This figure shows the routes that will be taken to answer each sub-question. The first sub-question, which pertains to the definition and conceptualization of energy communities and scaling meaning, will be answered through the literature review, desk research, and analysis of available publications. The second sub-question will be answered through stakeholder analysis and coordination mechanisms presented in chapter 4. The third and fourth sub-questions, which are concerned with grading the niche characteristics of energy communities in Flanders and the challenges and barriers they face, will be addressed by applying the Strategic Niche Management Framework detailed in chapter 2. Lastly, the answer to the fifth and final sub-question will be extracted by analysing the shielding and nurturing energy community niche, their future prospects, and recommendations for improving the policy and regulatory environment.

2 | Theoretical Framework

This section will provide a detailed description of the Theoretical Framework employed in the methodology of this study. Firstly, the concept of energy communities as a social innovation has been elaborated. Afterwards, the basis of frameworks and perspectives that will be used as the theoretical backbone of this study will be presented. To do so, the Multi-Level Perspective (MLP) will be expounded upon, followed by the Strategic Niche Management Framework (SNM). This chapter will be pursued further by clarifying the concept of scaling niche innovations and scaling of community energy as social innovation. It is imperative to establish a thorough understanding of these frameworks to analyse the qualitative data accurately and effectively in the following steps.

2.1. Energy Communities As Social Innovation

Defining ”Social Innovation” is crucial in understanding its significance. Social innovation refers to the creation and implementation of new solutions, strategies, or initiatives that aim to address societal challenges or needs, with a primary focus on generating positive social and environmental impacts. This approach involves rethinking and transforming existing practices, systems, or structures within a community or society, often through collaborative and participatory methods. The ultimate goal of social innovation is to bring about positive change, improve well-being, and promote social equity by introducing innovative, sustainable, and inclusive methods and models that can be scaled and replicated. Social innovation encompasses various activities, from grassroots initiatives to institutional reforms. It is driven by a commitment to addressing complex social issues and fostering positive social change, (Wyman, 2015). In a nutshell, as (Mulgan, 2007) has mentioned, social innovation can be roughly defined as ”New ideas that work in meeting social goals”.

When it comes to the concept of Energy communities, there is a combination of energy transition and social innovation. They are decentralized and renewable energy projects that promote sustainable energy production and consumption practices. These initiatives empower consumers and encourage community-driven behaviour. Energy communities have the potential to bring about a significant shift in consumer behaviour, turning the traditionally passive consumer into an energy ”prosumer” who co-owns renewable energy facilities and participates in community energy projects, (Van Der Schoor et al., 2016).

Energy communities are crucial in reinforcing social solid norms and encouraging citizens' involvement in the energy system. In accordance with EU regulations, their primary objective is to promote social innovation by engaging in economic activities that go beyond profit-making ("REScoop EU", 2021). These community energy initiatives can be seen as a form of grassroots or niche innovation, which can go through learning processes within the socio-technical landscape (Geels et al., 2017). These initiatives share common characteristics, including a solid commitment to a specific locality or area, as well as active community participation in both the processes and outcomes (Gui & MacGill, 2018).

The complexity of grassroots innovations is closely connected with various local factors such as culture, democracy, social norms, and values, including local resistance to renewable energy (Geels et al., 2017). Scholarly research identifies two dimensions of community energy: the 'process,' which deals with the extent of local community involvement, and the outcomes,' which focuses on how benefits are distributed within the community (Walker & Devine□Wright, 2008).

Communities are further categorized into 'communities of place,' where residents run projects for the collective benefit of the local area, and 'communities of interest,' which are not bound by geographical location but share a common interest (e.g., green energy) (Bauwens, 2016). An ideal energy community should combine a high level of local participation and control with a significant degree of benefit sharing.

Energy communities may take on utility-like activities, such as selling electricity and providing energy efficiency services. However, even when involved in commercial energy activities, a cooperative business model differs from traditional utilities, as depicted in Figure 2.1. For instance, in a cooperative, the goal is not to maximize profits but to reinvest in the community and offer services to its members. Any income redistribution, usually linked to the return on capital shares, is subject to a cap (Bauwens, 2016). Organizations like Ecopower view this cap, limiting the interest returned to members at 6%, as a financial opportunity to further invest in renewable projects ("Ecopower", 2021). Moreover, the cooperative is owned by the community and/or citizens rather than external investors.

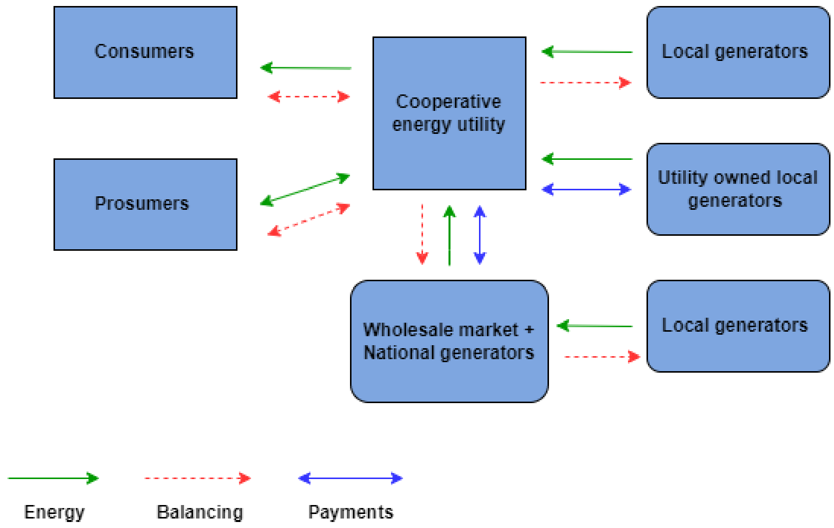

Figure 2.1: The cooperative energy utility business model adapted from Bryant et al. (2018)

Overall, the governance of energy cooperatives is guided by a set of well-established governing principles. The International Cooperative Alliance has defined values such as self-help, self-responsibility, democracy, equality, equity, and solidarity as foundational principles. Cooperatives commit to promoting equality, fairness, and social responsibility. These principles may not be as applicable to other types of energy communities to the same extent (International Cooperative Alliance).

From a socio-technical perspective, communities can offer the following advantages:

1. Local Value: Energy communities can facilitate the implementation of local sustainability projects, leading to energy self-sufficiency, reduced carbon emissions, and fuel poverty mitigation. Additionally, they contribute to the local economy by generating jobs and preventing the outflow of financial resources from the region (Kunze & Becker, 2015).

2. Energy Citizenship and Democracy: Citizens gain democratic control over energy investments by becoming co-owners of renewable installations, typically following the principle of one member, one vote. Participation in renewable ownership and decision-making can take a direct form, where members approve decisions in assembly meetings and determine surplus distribution (Hanna, 2017). Alternatively, it can involve indirect participation through a board of directors.

3. Generating Financial Returns for the Community: Community assets like wind turbines and solar panels are utilized to generate profits locally within the community. Members have local control over financial resources and share in the profits. Surpluses can be reinvested in community benefit funds and other activities. Co-investments also contribute to creating local jobs and providing stable returns for investors, ("European Commission", 2022).

4. Education and Mobilization of Citizens: Empowering citizens to take collective action in the fight against climate change in collaboration with municipalities and local authorities, ("The Social Impact of Energy Communities- REScoop", 2023).

5. Social Cohesion: Fostering a sense of community and building trust among community members, (Lode et al., 2022).

The active involvement of citizens and community co-ownership schemes are increasingly playing a significant societal role. They encourage citizen participation in energy-related matters and contribute to greater acceptance of renewable energy. These initiatives can bring substantial advantages to individuals and communities, bringing them closer to the energy transition and helping Europe achieve its decarbonization objectives, (Kalkbrenner & Roosen, 2016).

Energy communities demonstrate a dual commitment – one to a specific place by delivering benefits to local communities and another to a common interest that connects people. Unlike commercial enterprises, their primary aim is to maximize benefits for the community rather than profits. Collective energy projects focused on renewable energy can generate local income and investments while retaining financial benefits derived from local resources within the community, ("The Social Impact of Energy Communities- REScoop", 2023).

Energy communities represent a form of social innovation that can promote fairer models of energy consumption and production. They enhance democratic decision-making and control over renewable energy, placing this control in the hands of communities and individuals. However, there is a potential risk that energy communities could create social inequalities, as their members are more likely to come from moderate to higher-income households. At the same time, other customers with fewer financial resources might bear a greater burden of energy policy costs and grid fees. Nevertheless, they can give consumers more options to participate in electricity markets, including those with lower incomes who might not otherwise afford participation, (Caramizaru & Uihlein, 2020).

Several case studies demonstrate projects that address energy poverty, such as reducing energy bills and collaborating with local authorities to enhance social conditions. A comprehensive EU-wide study would be valuable to evaluate the potential of energy communities in reducing energy poverty, including the opportunities and barriers to the involvement of socially vulnerable and energy-poor households in such initiatives. Additionally, assessing the impact of community-based projects on individual and collective behaviours can offer valuable insights for future policy initiatives on sustainable energy practices, (Diestelmeier, 2021).

Regarding energy provisions, members of an energy community can enjoy financial benefits through reduced grid fees and energy costs on their energy bills. However, there is a need for greater clarity on how these benefits are distributed among community members and the broader system users. Cost allocation rules should consider real-cost savings in the system and ensure equitable distribution of gains among all users' ("Empowering People – The role of Local energy Communities - IEA", 2023).

In the previous section, the concept of energy communities and how they can benefit society from a socio-economic standpoint was discussed. Moving forward, academic tools such as theories and frameworks will be employed to analyze the qualitative data that has been collected.

2.2. Multi-Level Perspective (MLP)

The Multi-Level Perspective (MLP) is a widely-used framework in sustainability research that helps to analyze socio-technical transitions (Geels, 2011). This framework comprises three levels - the landscape, the socio-technical regime, and niche innovations. Let's start by exploring the landscape in greater detail. The socio-technical landscape, as explained by Geels (2004), refers to the external environment that falls beyond the influence of actors. This includes aspects such as material environments, cultural beliefs, symbols, and values, all of which are components of the socio-technical landscape. It's important to note that the landscape is constantly changing, and as an actor, you must adapt to the ever-evolving environment in which you operate.

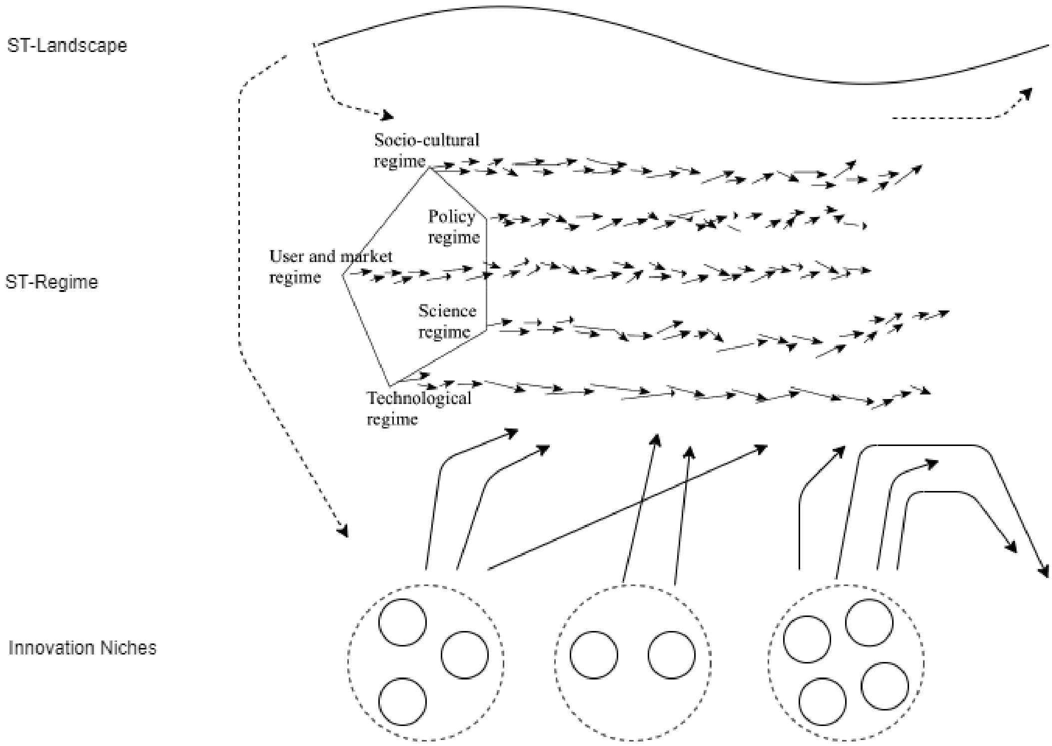

Figure 2.2: The multi-level perspective adapted from Geels (2004, 2011)

When examining the more minor details, one can discern the existence of a socio-technical regime. A technical regime encompasses a set of guidelines that are ingrained in specific procedures. This set of guidelines represents the fundamental principles for intricate processes without considering the social implications of a transition. To address this issue, Geels (2004) introduced the concept of socio-technical regimes (ST-regimes), comprising regulations established by social groups. ST regimes are not a conglomeration of all other regimes but rather a collective set of rules shared between them.

ST regimes consist of interconnected rules from various regimes and are subject to change as they are within the realm of influence for different actors. The energy system regime is the relevant ST regime for this report. The energy system is highly intertwined with other governments and is currently dominated by fossil fuel generators in the Netherlands. While renewable energy sources such as solar PV and wind energy have made headway in the energy system regime, other technologies have not been able to do so. This underscores the interconnections within the point ST regime, made possible by shared energy supply rules.

At the lowest level of the MLP, niches can be found. Niches can be seen as protected environments where innovation can grow without being hindered by large markets (Geels, 2004). This means niches are technological innovations that are not yet implemented in current practices of regimes. Here, technologies can develop and grow to become ready to infiltrate a regime with its accompanying market. Geels (2004) shows that the importance of niches can be found in their role in learning. Niches "provide locations for learning processes, e.g. about technical specifications, user preferences, public policies, symbolic meanings." (Geels, 2004). Innovations can develop without adhering to regimes, thus defying rules widely used to aid radical development.

The MLP combines the three levels, as mentioned earlier, into a comprehensive framework. Figure 2.2 presents a modified version of the MLP proposed by Geels (2004, 2011). The figure shows that innovation niches affect various ST regimes, with some places influencing them earlier than others, while some cavities never penetrate the ST regimes. The ST regimes, in turn, influence the landscape, which sets the precedent for the ST regimes and innovation niches. The entire framework demonstrates that multiple interactions occur between the levels, making predicting whether a place will thrive in changing the regime challenging. As a result, this framework is valuable for analysing the current socio-technical transition status and its past and future influences. It enables estimating the impact of niches.

To better understand the different levels and deep dive into each, the following sub-sections will outline the main characteristics of regime, niche, and landscape levels.

2.2.1. Regime Level

In accordance with(Geels, 2011), the main focus within the multi-level perspective is on the socio-technical regime level, considering the niche and landscape levels as concepts derived from and defined concerning the regime. The socio-technical regime represents the intermediate level in the multi-level perspective (MLP) and is comprised of three interconnected dimensions, as illustrated in Figure 2.3: (a) a network of actors and social groups; (b) the formal, normative, and cognitive rules that guide the actions of these actors; and (c) the material and technical elements that constitute the technological system (Geels, 2005a).

The technical and material components form a coherent arrangement of diverse elements, such as technology, material resources, and infrastructure. However, it's essential to note that these elements in socio-technical transitions don't function independently; they result from the actions of specific actors (Geels, 2005b). The interdependencies among various groups of actors lead to the coordination and alignment of elements and connections within socio-technical systems.

Additionally, human actors, organizations, and social groups are not entirely free to act according to their individual preferences. Their perceptions and actions are shaped and guided by institutions, which can be of a regulative, normative, or cognitive nature (Geels, 2005b). Regulative rules entail explicit,

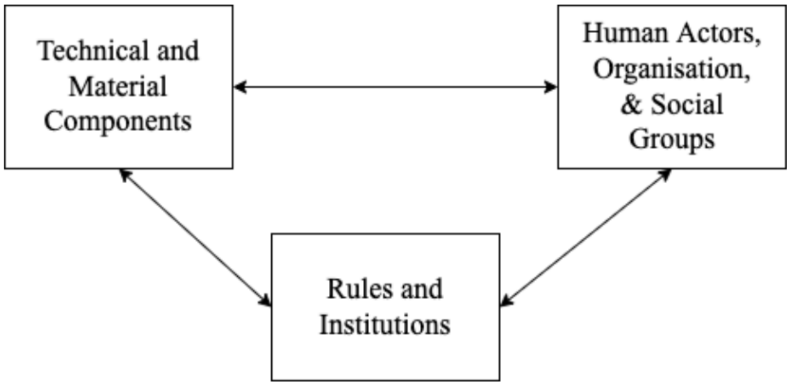

Figure 2.3: Three interrelated dimensions of the regime from Geels (2005a)

formal regulations that limit behaviour and regulate interactions; normative rules encompass values, norms, role expectations, duties, rights, and responsibilities, while cognitive rules determine the nature of reality and the frameworks through which meaning and understanding are established (Geels, 2004).

At each of these three dimensions, stabilizing mechanisms are in place, leading to path dependence and lock-ins at the regime level (Verbong & Loorbach, 2012). (Geels, 2004) explains that (a) actors resist significant changes due to vested interests in the current system, arising from their interconnected relationships with other actors and the development of cultural patterns, norms, and ideologies over time. Rules and institutions (b) are also established and rigid; cognitive routines can narrow actors' perception of developments outside their focus, normative rules can generate mutual role expectations and notions of appropriate behaviour among actors, and regulative rules may stabilize the system through legally binding contracts. Finally, existing machinery and infrastructure (c) involve substantial investments and economies of scale. There are also interdependencies between components and subsystems, creating a significant source of inertia in complex technologies and systems. Material artefacts are stabilized because they are deeply integrated into society, resulting in people adapting their lifestyles to these artefacts (Geels, 2004).

In summary, within a robust and stable socio-technical regime, radical innovations face significant challenges in spreading beyond the niche level. Breakthroughs may occur when the regime weakens, triggering a transition process that leads to a shift in the regime's configuration, including changes in technologies, technical tools, user practices, policies, markets, industrial structures, supporting infrastructures, and more (Geels, 2002).

2.2.2. Niche Level

Niches represent the smallest scale in the multi-level perspective (MLP) and serve as the localized context within the innovation process. It is within niches that the initial groundwork for any groundbreaking innovation within the socio-technical system is laid. These innovations in niches are developed based on knowledge and capabilities, specifically tailored to address the challenges within existing systems (Geels, 2002). Key processes occurring within niches include the establishment of social networks, learning endeavours, and the articulation of expectations that guide these learning processes (Geels, 2011).

(Geels, 2004) outlined some uncertainties inherent in the niche level. These uncertainties are associated with technical design principles, search strategies, user preferences, behavioural patterns, and public policies. Furthermore, uncertainties may arise from the social network within niches, with unclear role relationships, interdependent connections, and normative regulations (Geels, 2004). Geels further explained that the socio-technical framework in niches tends to be dynamic. In essence, the rules within technological niches are not as well-defined, and activities are less structured. Consequently, niche actors must invest significant effort into sustaining the niche, refining rules and social networks, and forging new pathways.

On a related note, niches are often described as secure environments or incubation spaces. The idea of protection is crucial here because innovations in niches typically constitute initially unstable socio-technical setups with a low price-to-performance ratio (Verbong & Loorbach, 2012). Thus, at the niche level, new technologies or socio-technical practices emerge and evolve in isolation from the competitive pressures of mainstream markets or established systems.

According to (Geels, 2011), niches have the potential to gain momentum under three key conditions: (a) when expectations become more defined and gain broader acceptance, (b) when various learning processes align to establish a stable configuration or a ”dominant design,” and (c) when networks expand to involve influential actors capable of conferring legitimacy and resources to niche innovations.

2.2.3. Landscape Level

The socio-technical landscape constitutes the highest level within the multi-level perspective (MLP). (Geels, 2002) employs the metaphor of a 'landscape' due to its connotation of being relatively 'hard' and having a tangible, societal context. The landscape represents an external environment that lies beyond the direct influence of actors within niches and regimes (Geels & Schot, 2007). It is characterized by a range of diverse factors, as categorized by (Van Driel & Schot, 2005) into three distinct types: (1) factors that exhibit little to no change or change very slowly, such as climate; (2) long-term transformations, like the industrialization of Europe in the late 19th century; and (3) rapid external disruptions, such as wars or fluctuations in oil prices. As depicted in Figure 2.4, socio-technical landscapes exert even greater influence on structuring activities compared to regimes and undergo slower changes, often taking decades (Geels & Schot, 2007).

Despite its rigid structure, sudden shifts at the landscape level can lead to significant environmental alterations that shape the regime. These changes can weaken and destabilize a regime by disrupting the coherence of its components. This, in turn, creates windows of opportunity for innovation to emerge from its niche and surprise established companies (Geels, 2002). While radical innovations face difficulties diffusing beyond the niche level in the presence of a strong and stable regime, they may ultimately break through when the landscape weakens the regime and opens a window of opportunity. However, for this to happen, niche ideas must be fully developed; otherwise, they might not be able to take advantage of this opportunity, which could also close in the future (Geels & Schot, 2007).

In essence, the fundamental concept underlying the MLP is that niche innovations gain momentum through internal learning processes, improvements in price-performance ratios, and the endorsement of influential groups. Changes occurring at the landscape level exert pressure on the regime, and regime destabilization creates opportunities for well-developed niche innovations to diffuse.

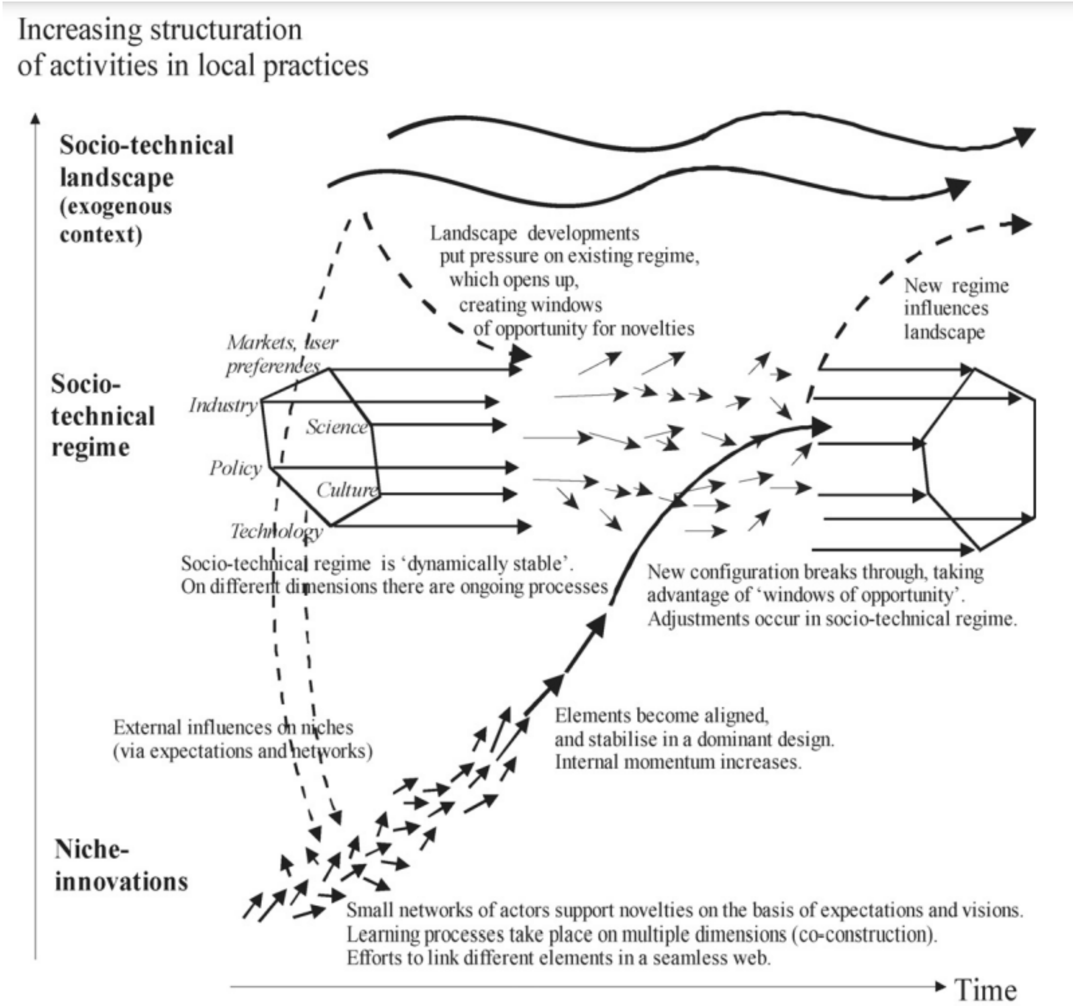

Figure 2.4: The multi-level perspective on transitions (Geels & Schot, 2007)

2.3. Strategic Niche Management Framework (SNM)

Utilizing transition frameworks to examine innovative case studies is essential for gaining deeper insights into the transition process of specialized technologies. The primary theoretical framework for this particular research will be Strategic Niche Management (SNM). SNM aims to advance the emergence and proliferation of sustainable innovations by offering a secure space, or "niche," for the exploration and experimentation of novel concepts. SNM is widely recognized in sustainable energy transitions to promote the acceptance and dissemination of new, Eco-friendly energy technologies. (Kemp et al., 2000)

Several scholars have investigated more precisely how the experimental introduction of sustainable innovations in niche markets can benefit the further diffusion of innovation. This research, SNM research, emerged from the observation that many sustainable technologies never leave the laboratory or showroom. The SNM framework has been applied, verified and improved with various case studies in sustainable technologies such as wind turbines (Kemp et al., 2000). Many scholars question why a specific innovation trajectory was a success or a failure. Many scholars explain success and failure by analysing the interaction between what has been labelled 'three internal niche processes' (Raven, 2007).

SNM has been prominent in analysing niche experiments as a strategy for policy-driven regime transition (Kemp et al., 1998). The SNM framework complements traditional technology diffusion methods, prioritising existing technologies' spread and widespread use. By fostering a secure space for innovative ideas, the SNM framework can accelerate the development and distribution of sustainable technologies and practices and tackle any barriers that could hinder their acceptance in the broader market. (Geels, 2011). The core assumption of SNM is that "sustainable innovation journeys can be facilitated by modulating of technological niches" (Geels, 2004), whereas niches are the locus of innovations at the micro-level acting as incubation rooms for novelties and providing locations for learning processes (Geels, 2011)

The SNM framework has four main components (Raven, 2007):

- Articulation of expectations and visions. Firms, users, policymakers, entrepreneurs and other relevant actors participate in projects based on expectations.
- The establishment of networks and partnerships with other stakeholders, such as investors, policymakers, and consumers, to build support for the innovation.
- The development of a learning process that allows for continuous feedback and improvement of the innovation.
- Influence of the established regime and landscape as an explanatory variable, following (van der Laak et al., 2007).

To better understand the position where the SNM framework can facilitate the transition of niches, Figure 2.5 has been presented. The multi-level Perspective (MLP), in which the regime and landscape concepts and places are rooted, is visible in Figure 2.5. Landscape refers to material and immaterial factors at the macro level, such as political culture and coalitions, social values, worldviews and paradigms, the macro-economy, and the natural environment, among others (Nill & Kemp, 2009). In contrast, the regime is the conceptualization of "semi-coherent" constellations of technological artefacts, infrastructures, rules, and user practices (Geels, 2011), it "forms the 'deep structure' that accounts for the stability of an existing socio-technical system" and it is subject to the transition (Suurs & Roelofs, 2014). Nevertheless, this study will not delve into an exhaustive examination of the regime and the landscape. Instead, our primary objective is to evaluate the adoption of energy communities by scrutinizing the first three procedures of strategic niche management across various case studies. the aim here is to extract valuable insights into the spatial aspect of strategic niche management and its capacity to facilitate the development of energy communities.

The Strategic Niche Management (SNM) framework comprises critical processes that can significantly impact the success or failure of sustainable technology implementation. These processes are crucial in comprehending and overseeing innovation in niche environments.

The first process is centred around expressing and moulding expectations. This involves the participation of various actors, including firms, users, policymakers, entrepreneurs, and other relevant stakeholders, who contribute their expectations to the project. It is crucial to articulate these expectations as it helps to garner attention, resources, and new actors to the project. This is especially vital during the initial stages of technology development, when the innovation's functionality and performance may still be indeterminate. By voicing and moulding expectations, niche projects can establish a shared vision and gain support for innovation. (Raven, 2007)

The second process is the building of social networks. During the early phases of an innovation's life cycle, the social network supporting it is often fragile and needs to be nurtured. Experimentation in niche markets allows different actors to come together and form new social networks. These networks are vital in knowledge exchange, collaboration, and resource mobilization. They facilitate learning, trust-building, and sharing experiences among actors involved in the niche, ultimately enhancing the chances of successful innovation. (Smith et al., 2005)

The third process identified in the SNM framework is a good learning process. Learning is imperative for successful innovation as it allows for the customization of technology and its societal embedding.

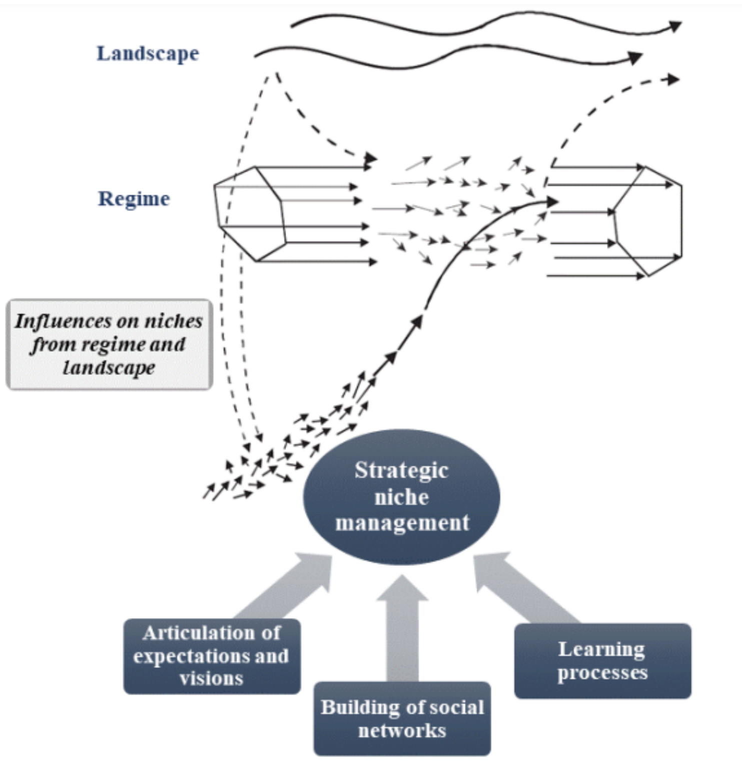

Figure 2.5: Processes for successful strategic niche management (Susur et al., 2015) based on (Geels, 2011), (Kemp et al., 1998),(van der Laak et al., 2007)

Learning by doing and experimenting in a local project context is critical in the case of ”configurational technologies,” such as energy technologies, where multiple components have to work together effectively. By following this process, actors within the niche gain valuable insights, acquire technical know-how, and refine the innovation to increase its chances of successful diffusion. (van der Laak et al., 2007)

The interaction and interplay between the above-mentioned processes; voicing and shaping expectations, building social networks, and fostering a good learning process—form the basis of the SNM framework. By understanding how these processes influence each other and contribute to the success or failure of sustainable technology introduction, stakeholders can better manage and support innovation in niche contexts. This framework provides insights into the dynamics and mechanisms that drive sustainable technology transitions, helping policymakers, researchers, and practitioners navigate the complexities of introducing and scaling up sustainable innovations. This understanding of the SNM framework and its constituent processes is derived from various scholarly works and research papers related to strategic niche management and sustainable technology innovation, which mainly consists of conducted studies by (van der Laak et al., 2007), (Raven, 2007), (Geels, 2011),(Kemp et al., 1998) and (Smith & Stirling, 2010).

Based on the arguments presented above, it can be inferred that the Strategic Niche Management (SNM) framework is an effective analytical tool for developing strategies to promote the adoption and growth of energy communities in various regions. The SNM framework includes critical processes such as voicing and shaping expectations, building social networks, and fostering a good learning process, which is crucial for successfully introducing and diffusing sustainable technologies. By applying the SNM framework, stakeholders in the energy community sector can gain valuable insights into articulating expectations, establishing strong social networks, and facilitating learning and adaptation, thereby increasing the likelihood of successful uptake and scaling of energy communities in their countries.

In order to gain a more in-depth understanding of the different types of niche processes, a reference could be made to a publication by (Kamp & Vanheule, 2015). The author has presented a well-defined table that outlines the three niche processes and their respective indicators. By utilizing this classification, each category of niche processes and their typology/indicators can be better analysed. This categorization of niche processes indicators is displayed in Figure 2.6:

Niche process	Indicator	Analysis of
Expectations	Internal expectations	Quality, robustness, and specification of expectations of current actors in the niche
	External expectations	Awareness and confidence level of actors outside the niche
	Exogenous expectations	Expectations originating from external developments (landscape, regime factors, other niches)
	Endogenous expectations	Expectations originating from learning experiences and network composition within the niche
Network Formation	Network composition	Desired network composition and network completeness
	Quality of the sub networks	The extent to which actor groups contribute to niche development
	Network interactions	How and to what degree network actors interact
	Network alignment	Degree to which actors' vision, expectations, and strategies align with niche development
Learning Processes	Technical development and infrastructure	Learning about design specifications, complementary technology, and required infrastructure for technology dissemination
	Industrial development	Learning about production and maintenance network needed for broader technology dissemination
	Social and environmental impact	Learning about technology's impact on safety, energy, and the environment
	Development of the user context	Learning about end-user characteristics, their requirements, barriers to technology adoption, and the meanings they attach to a new technology
	Government policy and regulatory framework	Learning about institutional structures and legislation relevant for dissemination and incentives for adoption
	Appropriate business models	Learning about business models enabling successful market penetration

Figure 2.6: The three niche processes and their indicators. adopted from (Kamp & Vanheule, 2015)

As part of the SNM framework application, certain indicators illustrated at Figure 2.6 will be used (adapted from (Kamp & Vanheule, 2015)) to categorize better each niche process extracted through the qualitative data analysis conducted in this research. In chapter 4, a subsection on the application of the SNM framework and defining the community energy 'niche' in Flanders provides an in-depth analysis of niche processes and dynamics. This includes an indicator analysis of each niche characteristic for the energy community niche in Flanders.

2.3.1. Shielding and Nurturing of Niches

Niches (illustrated as a closed sphere in Figure 2.7) are especially valuable for transformations because they provide spaces for building alternative practices from which new rules and systems can emerge. They are seedbeds, harbours and battlegrounds for transformation (Torrens et al., 2019). The conceptualisation of this process is based on strategic niche management theory by(Kemp et al., 1998) and (Raven, 2007).

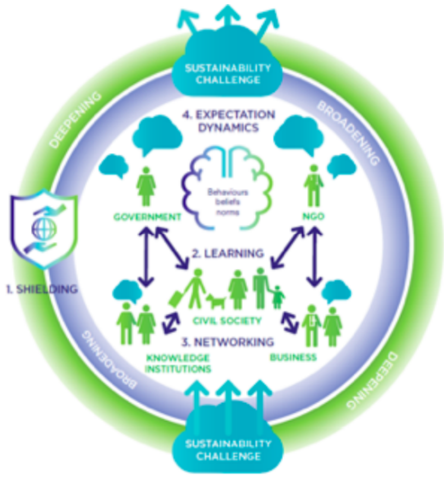

Figure 2.7: Transformative outcomes in niche building and nurturing process (Ghosh, 2020)

The transition literature emphasises the role of niches, a protective space for path-breaking innovations. Based on the analysis by (Smith & Raven, 2012), it identifies adequate protection as having three properties in broader transition processes: shielding, nurturing and empowerment. In the SNM (Strategic Niche Management) framework, shielding refers to protecting path-breaking innovations from mainstream selection pressures, while nurturing involves supporting the development of these innovations within passive and active shielded spaces through the development of shared, positive expectations, social learning and actor-network building (SNM). Shielding involves holding off selection pressures in the context of multi-dimensional selection environments, nurturing consists in supporting the development of path-breaking innovations within passive and active shielded spaces, and empowerment involves making niche innovations competitive within unchanged selection environments or contributing to changes in mainstream selection environments in ways favourable to a path-breaking niche innovation.

In this study, the concepts of shielding and nurturing will be utilised as presented in the SNM framework. Our objective is to apply these concepts to the energy community niche. This study is crucial because the act of shielding and nurturing energy community niches is significant. These niches contribute immensely to the success of the energy transition process. They promote community engagement, drive innovation, provide social and economic benefits, protect the environment, and enhance grid stability. Energy community niches are essential components of a more sustainable, equitable, and resilient energy future. The results of this application with a more detailed explanation are displayed in chapter 4.

2.3.2. Scaling niche innovations

As stated by the (SCCALE203050.eu, 2021), In the context of Strategic Niche Management (SNM), ”scaling up” refers to the process of transitioning from experimental sustainable practices to the mainstream (van den Bosch & Rotmans, 2008). This process involves building a niche from local projects to a global level (Geels & Raven, 2006), which emerges as local experiments accumulate over time (Geels & Raven, 2006) and interact with each other by sharing cognitive rules (Schot & Geels, 2008). However, this interaction requires active promotion by dedicated intermediary agents(Geels & Raven, 2006).

In this scaling process, intermediary agents play a crucial role in encouraging networking and knowledge aggregation. These agents, whether individuals or organizations translate outcomes and insights from local experimental projects into more general knowledge, which can be used to coordinate among a larger set of local projects (Geels & Raven, 2006). This is also known as ”broadening” (van den Bosch & Rotmans, 2008) or ”accumulation” (Naber et al., 2017), and it refers to the idea of repeating a sustainability experiment in new contexts and linking it to other domains. Scaling-up, therefore, is the process by which practices developed in niches are translated (Negro et al., 2007) or embedded (Rotmans et al., 2001)) into regime structures and institutions. This is closely related to the concept of mainstreaming, in which scaling is perceived as the societal embedding of experiments. However, (Ruggiero et al., 2018) found that the up-scaling of community energy experimentation failed due to intermediary organizations' inability to aggregate local experiences into more abstract knowledge (e.g., good practices, tool-kits, business models).

Regarding scaling, niche empowerment is a crucial aspect (Smith & Raven, 2012). This process involves activities that enable niche innovation to compete with an established regime. Creating powerful narratives is crucial to niche empowerment as it is a political device.

According to (Smith & Raven, 2012), there are two strategies for niche empowerment: (a) fit and conform, and (b) stretch and transform. The first one aims to demonstrate that niche innovation can be integrated into existing regime structures and institutions (R. Raven et al., 2016). The second strategy is more controversial and involves changing the ”rules of the game” by reforming institutions and setting new norms (Smith & Raven, 2012). In both strategies, narratives are used as political tools to promote sustainable transition goals and visions and have them adopted in public policy-making processes, such as community energy.

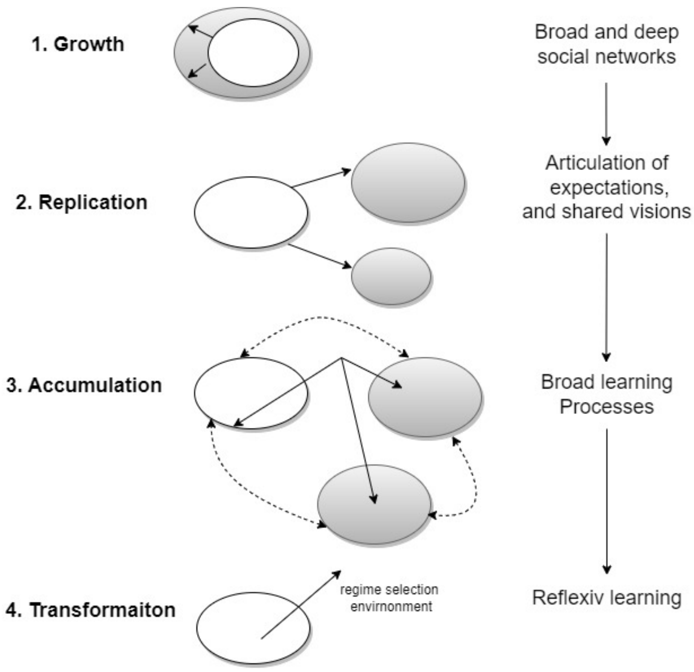

Figure 2.8: Patterns of up-scaling and relations with strategic niche management processes, adapted from (Naber et al., 2017)

Furthermore, based on a study conducted by (Naber et al., 2017), they show that although SNM was already well-suited to analyze internal niche dynamics, they suggest that SNM can also, to some extent, account for the up-scaling performance of experiments. The research reveals that well-managed experiments in terms of SNM processes tend to be more successful in up-scaling their activities. Specifically, their findings indicate the existence of specific relationships between internal niche processes and various up-scaling patterns, as is well depicted by (Naber et al., 2017) in Figure 2.8. Establishing a social network is particularly important for growth and replication, articulating expectations is especially crucial for replication, and learning processes play a significant role in transformation and replication.

This typology of patterns through which experiments can scale up and diffuse innovative solutions Based on previous SNM studies has been proposed by (Naber et al., 2017), based on a study conducted by (Geels & Raven, 2006). Up-scaling of experiments is important: when activities increase, experiments can add to an emerging field at the 'global' niche level. When local experiments are compared, and lessons aggregated, the rules at the global niche level become more articulated, stable and specific. This increases the potential of the niche to influence the current regime and eventually achieve a transition (Schot & Geels, 2008). Figure 2.9, clearly elaborates on the mentioned typology of up-scaling.

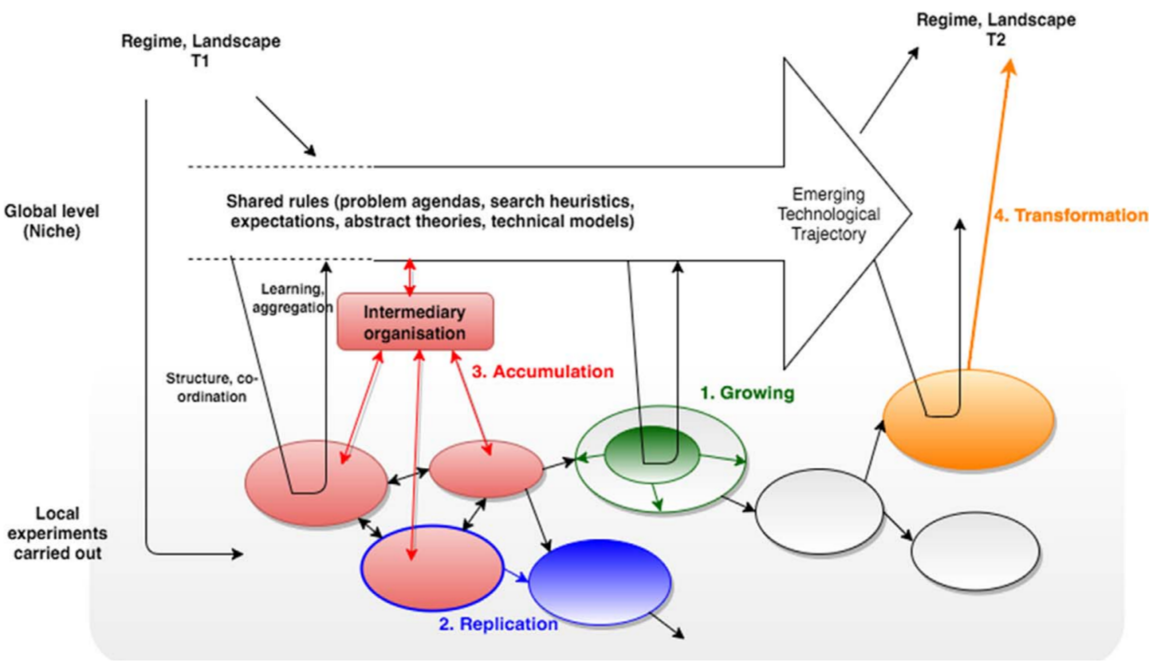

Figure 2.9: Patterns of up-scaling and the emerging technological trajectory, adapted from (Naber et al., 2017) and (Geels & Raven, 2006)

The description of each of the following up-scaling patterns is presented in Figure 2.10.

During this subsection, the different vision towards the typologies of scaling up was discussed. The first was the approach of (Smith & Raven, 2012), which saw niche empowerment as a crucial aspect of Scaling the niches with the two strategies of (a) fit and conform and (b) stretch and transform. The second was the approach adapted from (Naber et al., 2017), with the 4 main typologies of up-scaling patterns: Growing (The experiment continues and more actors participate, or the scale at which technologies are used increases), Replication (The main concept of the experiment is replicated in other locations or contexts), Accumulation (Experiments are linked to other initiatives), and Transformation (The experiment shapes wider institutional change in the regime selection environment). During the course of this study, these approaches and concepts of scaling the energy community niche will be applied in case studies, which are mentioned in section 2.4. The results of this analysis are displayed in chapter 4.

Up-Scaling Typology	Description
Growing	Growing refers to a dynamic in which an experiment continues and more actors participate in the experiment or market demand increases – the experiment grows in size or activity.
Replication	Replication takes place when the main concept of an experiment is used in other locations. When the experiment is replicated in other geographical locations or contexts, (local) knowledge of the initial experiments can be used in other locations.
Accumulation	An experiment becomes accumulated when it is connected to other experiments. Intermediary organisations are crucial in this process because they allow concurrent experiments to engage with one another (Hargreaves et al., 2013; Kivimaa, 2014). This is significant because experiments conducted in various areas might contribute to a more stable technological trajectory at the global niche level by comparing and aggregating the lessons learnt from those trials (Geels and Deuten, 2006).
Transformation	This pattern pertains to the MLP levels rather than geographical or physical scaling (Raven et al., 2010). This indicates that the experiment influences more significant institutional change in the regime choice context (Smith and Raven, 2012).

Figure 2.10: Overview of Typology of up-scaling patterns, adapted from (Naber et al., 2017)

2.4. Conclusion

To wrap up this chapter, in conclusion, it can be stated that the concept of energy communities represents a remarkable manifestation of social innovation, aligning energy transition with societal progress. These community-driven, decentralized, and renewable energy initiatives empower individuals to participate in sustainable energy practices actively, challenging traditional energy consumption norms. Their commitment to social innovation, driven by a focus on community engagement and positive societal and environmental impacts, reflects a transformative approach to energy.

Energy communities, guided by principles of democracy, equality, and social responsibility, offer various benefits to both local communities and the broader energy landscape. They promote local sustainability, reduce carbon emissions, mitigate fuel poverty, and contribute to economic growth by creating jobs and retaining financial resources within the region. Moreover, they grant citizens democratic control over energy investments, encouraging active participation and financial returns sharing. These initiatives also serve as educational and mobilization platforms, fostering social cohesion and trust among community members.

The synergy between energy communities and social innovation has the potential to accelerate the energy transition, make renewable energy more accessible, and promote fairer models of energy production and consumption. However, it is important to consider potential challenges, such as social inequalities and the equitable distribution of benefits. Evaluating the impact of community-based projects on both individual and collective behaviours can provide valuable insights for future sustainable energy policies.

Additionally, in this chapter, two theoretical frameworks utilized in this study were discussed: the Multi-Level Perspective (MLP) and the Strategic Niche Management Framework (SNM). In summary, MLP is a structured framework that evaluates socio-technical transitions in sustainability research, consisting of three levels: the landscape, socio-technical regimes, and innovation niches. The interactions between these levels can impact the adoption and impact of innovations, making MLP a valuable tool for assessing socio-technical transitions.

On the other hand, SNM focuses on cultivating sustainable innovations within protected niches. SNM prioritizes processes such as articulating expectations, building social networks, and fostering learning to shape the success or failure of innovative technologies. By providing a structured approach to supporting innovation in niche contexts, SNM complements traditional diffusion approaches and accelerates the adoption of sustainable technologies.

Additionally, the SNM framework is an effective analytical tool that can help in the growth of energy communities. By using the processes of SNM, stakeholders can set expectations, build strong social networks, and facilitate learning and adaptation. This can ultimately improve the chances of successfully implementing and scaling energy communities in different regions. Additionally, it is crucial to consider the protection and nurturing of the community energy niche when designing policies and institutional frameworks. This helps in establishing and maintaining energy communities and aids in their growth.

Eventually, the scaling of niche innovation was discussed in this chapter. In the mentioned subsection, different perspectives on the typologies of scaling up were explored. The first approach, as proposed by (Smith & Raven, 2012), emphasized niche empowerment and introduced two strategies: ”fit and conform” and ”stretch and transform.” The second approach, influenced by (Naber et al., 2017), presented four key typologies of up-scaling patterns: ”Growing,” where the experiment expands with more actors or increased technology use; ”Replication,” involving the replication of the experiment’s core concept in different locations or contexts; ”Accumulation,” where experiments are interconnected with other initiatives; and ”Transformation,” where in the experiment instigates broader institutional changes within the regulatory and selection environment. These varying viewpoints provide valuable insights into the diverse strategies and dynamics of scaling up, contributing to a comprehensive understanding of the process.

3 | Research Approach and Methodology

This chapter describes the research approach and methodology used for conducting this study, followed by the case study selection, some information about the Flanders region, and selected pilots in Flanders. Afterwards, the data collection steps have been explained, plus the validity, reliability and data ethics of this thesis.

3.1. Research approach

The core research methodology for this thesis combines a case study and Strategic Niche Management analysis with a general qualitative approach. The research approach consists mainly of a case study approach. As stated by (Yin, 2003), the case study research approach is a comprehensive and systematic method of conducting empirical investigations focusing on a particular phenomenon within its real-life context. It involves in-depth exploration and analysis of a single case or a small number of cases to understand complex social phenomena. (Yin, 2003) emphasized that case study research is beneficial when the research questions are ”how” and ”why” in nature and when the researcher has little control over the context being studied. It involves collecting multiple data types, such as interviews, observations, documents, and artefacts, to provide a holistic understanding of the case.

The case study research approach allows for an in-depth examination of the context, processes, and dynamics surrounding the phenomenon under investigation. It involves careful planning, data collection, analysis, and interpretation, emphasising the richness and depth of the data rather than generalizability to a larger population. Overall, case study research provides a framework for conducting rigorous and detailed investigations that contribute to theory development, offer insights into complex phenomena, and generate practical implications for real-world settings.

Furthermore, the most suitable research approach which can lead us to answer each of the sub-questions mentioned above is as follows: A literature review would be an appropriate research approach for providing a precise and concise description of energy communities and scaling in that regard. It would involve searching for relevant academic articles, reports, and policy documents that have covered and explained the concept of energy communities and scaling. This would help establish a clear understanding of the key terms and concepts relevant to this research.

To clarify the coordination among related stakeholders, it is required to do semi-structured interviews with experts and associated stakeholders. These methods can help to identify the key stakeholders involved in the process and their roles, perspectives, and influences. For researching the current challenges of energy communities in the selected pilots, semi-structured interviews (with the responsible sectors) are required (then the qualitative output of those interviews should be analysed). Moreover, using the data of already conducted surveys on the members of the communities can better clarify the challenges of currently established ECs and how they react to those issues. This research approach can help to identify the most pressing challenges faced by energy communities and the strategies they have used to overcome them.

Eventually, for acquiring the main niche characteristics of energy communities in selected case studies, which contain their learning processes, network formation and dynamics of expectations, an extensive Strategic Niche Management (SNM) analysis would be implemented on the data which has been gathered from the previous sub-questions. The answers to each sub-question mostly rely on the answers to their last questions (a step-wise process). Finally, from the outcomes of the SNM application, the insights and strategies for developing energy communities in the selected region would be achieved.

3.2. Case Study Selection

This study was initially undertaken with the primary objective of supporting a pilot initiative within the SC-CALE203050 project. This section provides a brief exposition of the SCCALE203050 project, followed by an examination of the selected geographical area. Subsequently, the focus narrows to specific pilot programs and energy communities within the region above, which are the exclusive subjects of investigation within the scope of this thesis.

3.2.1. European Union SCCALE203050 Project

Sustainable Collective Citizen Action for a Local Europe (SCCALE) 203050 intends to bring Europe closer to its citizens by fostering the creation of energy communities, taking full advantage of the favourable EU legal framework on citizen energy. This project has received funding from the European Union's Horizon 2020 research and innovation program. The main objective of this project is to build at least 26 energy communities, trigger the creation of 34 community projects, and develop a comprehensive methodology for creating energy communities that can be replicated in Europe and beyond. Their methods will be tested and validated in 5 pilot communities. ("SCCALE 203050", 2023). The five pilot communities in the SCCALE project are located in the following countries: Netherlands, Belgium, France, Greece and Croatia. These pilots encompass various activities, such as renewable energy production, district heating, building renovation, and behavioural change.

In this thesis, however, the selected region is Belgium and, more specifically, the Flanders region of Belgium. The reason behind this choice has been elaborated in the following subsection.

3.2.2. Flanders region (case study)

The Flemish Region of Belgium (or Flanders) is a Dutch-speaking area in the country's north and one of 3 Belgian regions. The national capital, Brussels, considered its region, lies near Flanders' southern edge. It borders the French department of Nord to the south-west near the coast, the Dutch provinces of Zeeland, North Brabant and Limburg to the north and east, and the Walloon provinces of Hainaut, Walloon Brabant and Liège to the south. Despite accounting for only 45% of Belgium's territory, it holds the country's largest population, with 6,653,062 (or 57%) out of 11,431,406 Belgian inhabitants living there. Much of Flanders is agriculturally fertile and densely populated at 483/km2 (1,250/sq mi). In Figure 3.1, the map of Flanders and its major cities and provinces is presented. Not including Brussels, there are five present-day Flemish provinces: Antwerp, East Flanders, Flemish Brabant, Limburg and West Flanders. The Flemish Region is largely responsible for territorial issues in a broad sense, including economy, employment, agriculture, water policy, housing, public works, energy, transport, the environment, town and country planning, nature conservation, credit, and foreign trade. It supervises the provinces, municipalities, and inter-communal utility companies. ("Metadata: Bebouwde oppervlakte", 2017)

Belgium, specifically the Flanders region, presents a compelling case for studying the scaling and development of energy communities. The selection of Belgium, particularly Flanders, was motivated by its participation as one of the countries involved in the SCCALE 203050 project. Notably, Belgium hosts one of the critical pilot projects, the Licht Leuven pilot, which focuses on various aspects, including photovoltaic (PV) production, wind power, sustainable heating, and energy efficiency (SCCALE203050.eu, 2021). Notably, most energy communities in Belgium are concentrated in the Flanders region, predominantly inhabited by Dutch-speaking communities.

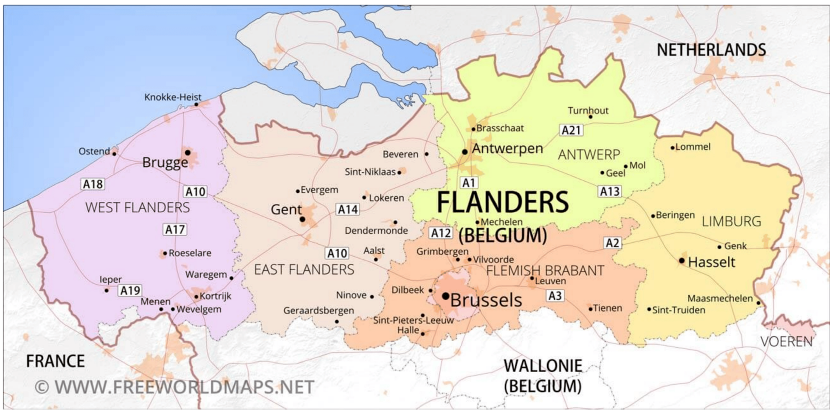

Figure 3.1: Map of Flanders showing the regions and major cities
(Chapman et al., 2020)

Furthermore, here are some other factors that make Belgium and Flanders region an attractive area for conducting such research:

- **Proactive Energy Policies:** Belgium has implemented renewable energy targets and supportive measures to drive the transition to cleaner energy systems. The Flanders region has specifically incentivized energy community development, providing an ideal environment for studying their scaling (“Renewable Energy in Flanders: Targets and Incentives”, 2021).
- **Strong Commitment to Energy Transition:** Belgium, including Flanders, is committed to low-carbon and sustainable energy systems, evident in international agreements like the Paris Agreement and national strategies. Researching energy communities in Flanders contributes to assessing the effectiveness of these efforts (“Belgium and the Paris Agreement”, 2020).
- **Collaborative Governance Structures:** Flanders adopts a collaborative governance approach involving stakeholders such as communities, cooperatives, and policymakers. Studying energy communities in Flanders sheds light on the dynamics and roles of different stakeholders in the energy transition (Van den Brande & Van Rijswick, 2017).
- **Diverse Energy Landscape:** Flanders encompasses diverse urban and rural areas, energy consumers, and renewable energy resources. This diversity enables exploring scalable models and tailored strategies for energy communities (“Regional Energy and Climate Plans: Belgium - Flanders”, 2019).
- **Demonstrated Success of Energy Community Initiatives:** Flanders has witnessed successful energy community initiatives that showcase local engagement and integration of renewables. Researching these cases helps identify contributing factors, assess scalability, and extract best practices (Bauwens et al., 2021).

The combination of the factors mentioned above makes Flanders an attractive research area. Insights gained can inform policy, improve practices, and contribute to sustainable and decentralized energy systems.

3.2.3. Selected Pilots

Energy communities in Belgium are citizens, businesses, and organizations working together to produce, store, and distribute energy locally. They aim to promote sustainable and renewable energy sources and reduce the reliance on fossil fuels. Several types of energy communities exist in Belgium, including renewable energy cooperatives, energy efficiency cooperatives, citizen energy communities, and energy service companies. These communities operate at different scales, from small neighbourhoods to entire cities.

The Belgian government has been actively promoting the development of energy communities through various policy initiatives and financial incentives. For example, the government provides financial support for installing renewable energy systems and offers tax benefits for citizens who invest in energy cooperatives. Additionally, the government has set a target of achieving a 13% share of renewable energy in the final energy consumption by 2020 and 18.3% by 2030. (of Finance, n.d.)

Several energy communities have already been established in Belgium, including Eco-power, Licht Leuven, Klimaan and Zwevegem. These communities operate on different renewable technologies like wind turbines, solar panels, and biogas installations and have been successful in reducing CO2 emissions and creating local jobs. (F. E. Agency, 2020)

According to (Wierling et al., 2023), a Europe-wide inventory of citizen-led energy action, Belgium is one of the European countries with the best coverage and initiative of energy communities in the EU. Therefore, it can be considered a pioneer in this niche innovation. Belgium has 112 numbers of industries with a total number of 162,905 people involved. The renewable capacities installed there are between 156–566 MW. The REScoop Flanders website ("Mapping the social impact of Energy Communities", n.d.) reports, as of 11/02/2022, 24 member cooperatives. Rescoop is a federation of citizen energy cooperatives in Europe, and they have several member cooperatives in the Flanders region of Belgium.

Below is a map of energy communities that are a member of REScoop Vaalnderen (the Flanders branch of REScoop EU) is provided:

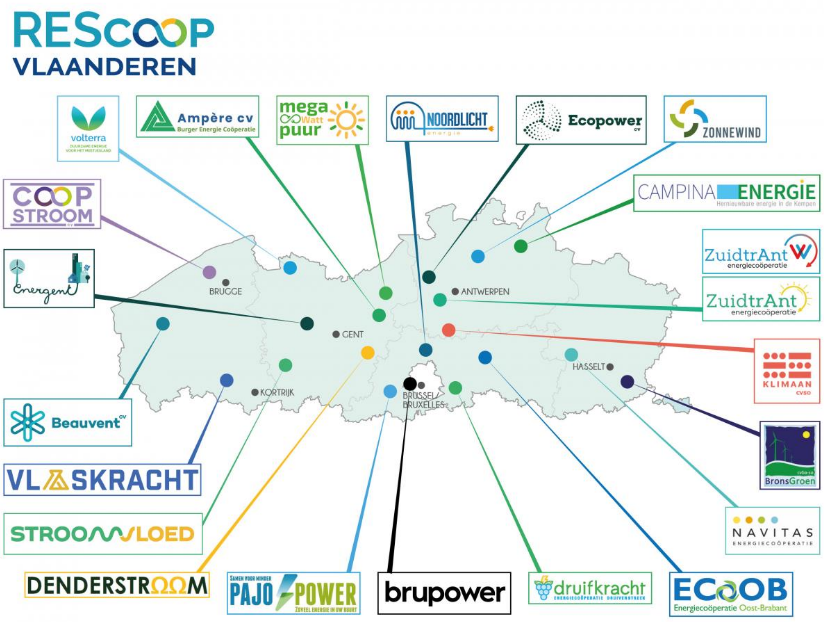

Figure 3.2: Map of energy communities in Flanders (members of REScoop Vlaanderen) ("Leden | REScoop Vlaanderen", n.d.)

For conducting this research, multiple pilots (energy communities) in the Flanders region had to be studied. During the selection procedure, various factors have been considered to have an inclusive set of energy communities from significant to small size and from distinct areas within Flanders and with different technology focus. Below, the list of these energy communities that have been exclusively studied for this thesis is provided:

- **Ecopower:** EcoPower is a renewable energy cooperative founded in Belgium in 1991. It consists of over 50,000 members who collectively own and operate renewable energy installations such as wind turbines, solar panels, and hydroelectric power plants. The cooperative aims to promote sustainable energy production and consumption while ensuring democratic decision-making and fair profits for its members. EcoPower offers various energy-related services to its members, including advice on energy efficiency, green energy supply, and investment opportunities in renewable energy projects. Their headquarters is located in Antwerp.(Lokhoff & Verbong, 2019).

- **Klimaan:** Klimaan is a citizen-led energy cooperative located in Mechelen, Belgium. The cooperative aims to accelerate the energy transition in the region by developing and investing in renewable energy projects and promoting energy efficiency measures. Klimaan focuses on community-owned renewable energy projects, such as solar panel installations on public buildings, private homes, and community centres. They also provide energy advice to individuals and organizations and organize events and workshops to raise awareness about sustainable energy and promote energy transition. Klimaan's vision is to create a community-driven, sustainable energy system that serves the common good while ensuring that the benefits of the energy transition are shared equally among all members of society. (Van den Bossche et al., 2019)
- **Beauvent:** Beauvent raises funds to invest in wind energy, solar panels and energy-efficient applications such as cogeneration and heat networks. In this way, the increasing damage to the environment would be encountered. Beauvent applies the cooperative principle to create social support for renewable energy in which as many people as possible participate and have a say. The cooperative currently unites more than 8,000 equal cooperators who help build local, sustainable energy projects and enjoy the proceeds. Their headquarters is located in Ostend, Flanders. ("Over ons | Beauvent", 2021)
- **EcoOB:** ECoOB (EnergieCoopratie Oost-Brabant) unburdens schools, companies, non-profits and the public sector for the production of energy from the sun, heat or wind: a technically perfect file, conclusive agreements, 100% ECoOB financing of the installation (installation, maintenance and insurance). In the meantime, the customer can concentrate on its core tasks while ECoOB operates the installation. During this period, the customer enjoys an affordable and predictable electricity price, after which the installation is transferred to the owner free of charge. Related technologies are also discussed: batteries, charging stations, heat pumps, etc. ECoOB CV was founded by several residents of Herent and the surrounding area who spontaneously found each other in their concern for the environment for current and future generations. ("VISIE | ECOOB", 2022)
- **ZonneWind** Zonnewind is a cooperative company in the Voorkempen to organize activities that contribute to reducing CO2 emissions, promoting rational energy consumption and locally generating renewable energy. Zonnewind is the passion project of a group of committed people from Zandhoven who, in addition to their daily work and worries, want to commit themselves to a better and greener planet. With the energy cooperative, they want to actively contribute to achieving the climate objectives and invite everyone to take matters into their own hands.("Over ons - Zonnewind", 2023)

The cases mentioned above and some other similar energy communities would be the focus of the case study for this research. The methodologies that are mentioned previously are going to be implemented in these case studies.

3.3. Data Collection

The data collection procedure for this study was mainly based on two sources qualitative data sets.

The data required for this research depends on the research design and methods chosen to answer the sub-questions. Here are the sources of data that have been used while conducting this research:

- **Data from the literature review:** A review of existing literature on energy communities and current running pilots in the Flanders region could provide valuable insights and inform the research questions. For instance, using text documents from the internet, energy cooperatives, and policy documents.

- **Qualitative data from semi-structured interviews:** The core collection of data that have been used and analyzed to answer the research questions were based on the outcomes from the conducted interviews with relevant stakeholders such as energy community organizers, government officials, energy experts, Distribution System Operator and community members. These interviews consisted of detailed information about each stakeholder's roles and positions, organization activities and responsibilities, and their experiences, perceptions, and attitudes towards energy communities in Flanders. Moreover, these semi-structured interviews with open questionnaires (that also required descriptive arguments) helped understand the pilots' main challenges. More details about the list of these stakeholders, the questionnaire provided, and the procedure of these interviews are presented in the next section of data treatment and analysis.

  Secondary data: Secondary data sources such as policy documents and statistical reports could provide contextual information and support the analysis of the research questions. These data might also include the annual supply and demand of energy in the selected pilots of energy communities.

3.4. Data treatment and analysis

This study involved conducting interviews with several stakeholders who have played crucial roles in energy community projects. The interview process was carried out through a series of distinct steps.

Initially, we conducted a stakeholder analysis through a comprehensive review of relevant literature and desk research. This helped us to identify the stakeholders most pertinent to the study. We then developed tailored questionnaires based on the research inquiries, incorporating the Strategic Niche Management (SNM) framework. These questionnaires were then distributed to the identified stakeholders. The questionnaire can be found in the Appendix A.

Subsequently, we engaged with the stakeholders, which led to the organization of semi-structured interviews. We contacted 48 individuals and organizations in the Flanders region via email. These contacts comprised various energy communities in Flanders (all members of REScoop Vlaanderen), governmental and public authorities, energy service companies, and electricity grid operators. After conducting all the communications, we were able to arrange and complete a total of 14 interviews. These interviews featured individuals and organizations representing diverse aspects of the energy community landscape.

The semi-structured interviews were conducted to explore various aspects of the energy community projects. We focused on understanding the stakeholders' perspectives regarding the development and implementation of the energy community projects. The interviews were designed to be interactive and flexible, allowing the participants to express their opinions freely.

Data collected from the interviews were analyzed using thematic analysis. The themes that emerged from the interviews were used to identify the study's key findings, (Lochmiller, 2021). The study's findings are discussed in detail in the subsequent sections of this report.

Overall, the stakeholder engagement process was crucial to the success of this study. The insights and opinions of the stakeholders were vital in gaining a comprehensive understanding of the energy community projects. The semi-structured interviews provided a platform for the stakeholders to express their perspectives and opinions, facilitating a more nuanced understanding of the subject matter.

The list of the stakeholders that finally participated in interviews is as follows:

- 1. Ecopower - Energy Cooperative
- 2. Klimaan - Mechelen City Energy Community
- 3. REScoop Vlaanderen (General Coordinator- the Flanders branch of REScoop)
- 4. Flux 50 (Flanders Smart Energy Accelerator) - Business Development Manager
- 5. EcoOB - Energy Cooperative in Oost Brabant
- 6. Fluvius (Flanders Distribution System Operator)
- 7. Zonnewind - Energy Cooperative in Voorkempen
- 8. VEKA (Flemish Energy and Climate Agency)
- 9. Quares - Quality Real Estate Services
- 10. REScoop EU (European federation of citizen energy cooperatives)
- 11. Zwevegem Energy Community - Flux 50 Project Coordinator
- 12. VVSG - Association of Flemish Cities and Municipalities
- 13. Beauvent - Energy Cooperative in Ostend
- 14. Flemish Government (Advisor of Energy and European Policy at Cabinet Vice Minister-President)

A more detailed stakeholder analysis is presented in subsection 4.1.3, including their coordination mechanisms, the position of each actor, and their power-interest grid.

All the interviews mentioned above were conducted on the Microsoft Teams platform, a widely used communication and collaboration tool. The interviews had a duration of 40 to 80 minutes, during which the interviewer asked a set of questions that were shared beforehand with the interviewees to give them an idea of what would be asked and discussed during the meeting. The questionnaire consisted of 10 main questions with some sub-questions in between. It covered a range of topics related to energy communities in Flanders, such as the stakeholders' introduction, their coordination mechanisms with other actors, critical challenges, niche characteristics, their vision regarding the future perspective of energy communities, policy and regulatory environment, possible changes that could be adapted, and the social and economic impact of energy communities. The complete list of questions is provided in Appendix A.

Before conducting the interviews, the interviewees were asked to confirm the meeting recording and transcription of the discussion via the Teams platform. This was done to ensure that the interviewer had accurate and complete information to analyze and draw conclusions from.

Following the interviews, the transcripts were edited, corrected, and meticulously analyzed to derive the final results in alignment with the research objectives. The answers of each interviewee were analyzed and clarified to ensure that the interviewer had a clear understanding of the interviewee's responses. Then, the outcomes for each question were merged and refined to provide solid answers to the desired research questions, along with some valuable and remarkable information for better conclusions of this study.

Overall, the interviews provided a rich source of data for this research study, enabling us to gain insights into the perspectives and experiences of key stakeholders in the energy community in Flanders. The data collected through these interviews has been analyzed and synthesized to provide a comprehensive understanding of the issues and challenges facing this sector, as well as potential solutions and opportunities for future growth and development. The mentioned results are presented in chapter 4, "Results".

3.4.1. Qualitative Data Analysis and Abductive coding

In this research, the data analysis approach abductive coding structure was meticulously structured to extract valuable insights from the qualitative data collected through semi-structured interviews with multiple stakeholders in the energy sector of the Flanders region in Belgium. The analysis process involved several key steps aimed at addressing distinct aspects of the research questions.

The first step involved transcribing and clarifying the interview transcripts. Each transcript was scrutinized for information related to the definition of the interviewee's organization and their coordination mechanisms with other stakeholders. This preliminary stage was instrumental in constructing stakeholder analyses, coordination mechanisms (stakeholder maps), and determining the power-interest positions of the stakeholders.

Next, specific questions related to the challenges faced by each organization (actor) were analyzed. The responses were merged to identify commonalities and differences in the issues encountered by these organizations. The Strategic Niche Management (SNM) framework was applied to the data collected from questions pertaining to niche processes, offering valuable insights into the niche dynamics within the energy sector.

Additionally, questions exploring the future perspectives of the energy community niche in Flanders were designed to link with the shielding, nurturing, and empowerment of this niche within the region. These responses provided a forward-looking perspective on the research area.

To comprehensively analyze the regime level from a multi-level perspective approach, questions with codes related to social and economic impact and energy poverty alleviation were utilized. This enabled a thorough examination of the broader context in which the energy community niche operates.

Furthermore, questions incorporating codes related to the policy and regulatory environment were employed to address different typologies of scaling the niche and formulate future strategies and recommendations for the Flemish energy sector. This strategic insight aimed to empower energy community projects to surmount current challenges and leverage opportunities effectively. The procedure of abductive coding for the qualitative data analysis was done based on the methodologies provided by (Linneberg & Korsgaard, 2019).

Once the data had been meticulously categorized, the next step involved a comparative analysis. Differences, similarities, and overlaps in the responses were identified to provide comprehensive answers to each research sub-question. In this endeavour, advanced natural language processing tools played a crucial role. These tools assisted in the refinement and synthesis of answers, enhancing the overall data organization process.

The collaborative synergy between technology and human intelligence ensured a thorough examination of the research questions, allowing for extracting meaningful insights from the qualitative data. Thematic analysis was employed as the guiding methodology, enabling the identification of prominent themes and patterns that underpinned the data collected during the interviews. These key findings are elaborated upon in subsequent sections of this report, contributing to a comprehensive understanding of the research area.

3.5. Validity and Reliability

In the pursuit of conducting a comprehensive and robust analysis for this research, the validation and reliability of the data collected through semi-structured interviews played a pivotal role. However, constraints such as infrastructure limitations and timing constraints rendered the organization of a seminar with all participating stakeholders an ambitious undertaking. As a result, alternative methods were employed to ensure the validity and reliability of the qualitative data analysis.

Validation through Cross-Checking: To compensate for the unavailability of a stakeholder seminar, an alternative validation approach was employed. The findings derived from the semi-structured interviews were rigorously cross-checked with existing data in related literature and analogous practices within the energy community niche studies, particularly focusing on the Flanders region. This cross-referencing served as a safeguard against potential biases or misinterpretations, adding a layer of external validation to the research, (Nowell et al., 2017).

This cross-checking approach was pivotal in ensuring that the data analysis remained anchored in established knowledge and well-documented precedents. By aligning the research findings with the existing body of knowledge, it established a foundation of credibility and validity for the study's outcomes, (Nowell et al., 2017).

Feedback from Stakeholders: To further enhance the reliability of the study, a feedback mechanism involving the stakeholders who actively participated in the interviews was implemented. The research outcomes were shared with these stakeholders, and their insights and feedback were actively sought. This iterative process allowed the stakeholders to validate the findings and contribute their perspectives, ensuring that the research remains true to their experiences and insights.

This engagement with the stakeholders serves a dual purpose. Firstly, it reinforces the reliability of the research findings, as the participants' feedback corroborates the analysis and conclusions. Secondly, it fosters a sense of ownership among the stakeholders, assuring that their viewpoints are accurately represented in the research, (Hayashi et al., 2019), (Boaz et al., 2018).

In sum, while the initial plan to organize a seminar with stakeholders faced logistical constraints, the validation and reliability of this research were meticulously upheld through cross-checking against related literature and active engagement with the participating stakeholders. These steps ensured that the research outcomes are not only accurate but also aligned with the experiences and insights of the key actors within the energy community niche in the Flanders region.

3.6. Data ethics

The process of conducting a research study involves several steps, the first of which is to ensure that the investigation is conducted ethically and in compliance with the relevant guidelines. Before starting our research, we took all necessary steps to ensure that the study met the Human Research Ethics Committee (HREC) standards of the Delft University of Technology. We submitted a comprehensive application to HREC, which included the Informed Consent Form, Data Management Plan, and Checklist for Human Research Ethics. We provided detailed information regarding the study's purpose, the data collection process, and the protection of participants' privacy. The HREC conducted a rigorous evaluation of our application and authorized us to proceed with the research only after ensuring that all ethical and regulatory standards were met.

In terms of data collection, we took great care to ensure that the participants fully understood the purpose of the study and how their data would be used. We provided them with an info consent form, which they read and signed before each interview. This form detailed the study's purpose, the data collection process, and the participants' rights. Participants also agreed to have their interviews recorded and transcribed through the MS Teams platform. All interviews were securely stored on a surf-drive platform, and we will terminate the stored data after the thesis defence.

We took great care to ensure confidentiality throughout the study. We kept the interviewees' names and other identifying information confidential as anyone who assisted in this study. We also confirmed that the data was accessible only to authorized personnel and that all data handling procedures complied with the relevant regulations and guidelines.

We also had a data management plan to ensure the data was managed appropriately throughout the research process. This plan included the procedures for data collection, storage, and disposal. We ensured that all data was stored securely and that access was restricted only to authorized personnel. We also planned to dispose of the data appropriately after the thesis defence.

To ensure that we complied with the relevant regulations and guidelines, we conducted a Human Research Checklist, which included the necessary steps to ensure that the study was conducted ethically and in compliance with the relevant guidelines. The checklist included obtaining informed consent, ensuring confidentiality, and disposing of the data appropriately.

In summary, great care was taken to ensure that the research study was conducted ethically and complied with all relevant regulations and guidelines.. All necessary approvals were obtained before starting the study, took great care to ensure confidentiality throughout the study, and had procedures to manage the data appropriately. A Human Research Checklist was conducted to ensure the ethical conduct of the study. For more information regarding our informed consent form, data management plan and human research ethics checklists, please refer to Appendix B, Appendix C, and Appendix D, respectively.

3.7. Conclusion

In conclusion, this chapter has provided a thorough and detailed account of the research approach and methodology utilized in this study. The choice of a case study method, combined with Strategic Niche Management (SNM) analysis and a qualitative approach, has allowed for a comprehensive exploration of energy communities in the Flanders region. The selection of diverse energy community pilots within the area has provided valuable insights into the energy transition and the factors contributing to its success.

The selected case study for this research focuses on the SCCALE203050 project, which aims to create energy communities in Europe. The project has received funding from the European Union's Horizon 2020 program and aims to build at least 26 energy communities, trigger the creation of 34 community projects, and develop a methodology for creating energy communities that can be replicated. The five pilot communities are located in the Netherlands, Belgium, France, Greece, and Croatia, with this research specifically focusing on the Flanders region of Belgium. Belgium, and Flanders in particular, is an attractive area for this research due to proactive energy policies, a strong commitment to energy transition, collaborative governance structures, a diverse energy landscape, and demonstrated success in energy community initiatives. The case study includes the examination of various energy communities in the Flanders region, such as Ecopower, Klimaan, Beauvent, EcoOB, and ZonneWind, to gain insights into their development and scalability within the context of the SCCALE203050 project.

The data collection process, which included a literature review, semi-structured interviews, and secondary data, has been carefully planned and executed to ensure the validity and reliability of the findings. Ethical considerations have also been given utmost importance, with measures such as informed consent, confidentiality, and appropriate data management being put in place.

Moreover, this chapter describes the data treatment and analysis process used in the research. The study involved conducting interviews with various stakeholders involved in energy community projects. The process began with a stakeholder analysis, which identified the key stakeholders. Questionnaires were developed based on the research inquiries and distributed to these stakeholders. Subsequently, semi-structured interviews were conducted with a total of 14 participants representing different aspects of the energy community landscape.

Data collected from the interviews were analyzed using thematic analysis to identify key findings, and these findings are discussed in detail in the report. The list of stakeholders who participated in the interviews is provided, and the interview process is explained, including the use of questionnaires and the involvement of various stakeholders.

A thorough explanation of the qualitative data analysis process and abductive coding is presented. The data analysis process involved several key steps, such as transcribing and clarifying interview transcripts, analyzing challenges faced by organizations, examining future perspectives, and analyzing the policy and regulatory environment. The chapter also covers the validation and reliability of the research findings, including validation through cross-checking with existing literature and stakeholder feedback. Data ethics are emphasized, highlighting the steps to ensure ethical research conduct. This includes obtaining informed consent from participants, ensuring confidentiality, and detailing data management procedures.

Overall, this section provides a comprehensive overview of the data treatment and analysis methodology used in the research, ensuring the validity and reliability of the findings.

Eventually, this chapter lays the groundwork for the subsequent chapters of this study, where the findings and insights derived from the data will be presented. The approach and methodology adopted in this study have been carefully considered, and the results are expected to contribute to the growing body of knowledge on energy communities.

4 | Results

In this chapter, the main results and findings of the study are presented. The chapter starts with the Regime section, which outlines the key characteristics of the energy sector in Flanders, the stakeholders involved, and their coordination mechanisms.

Next, the SNM framework is applied to the case study, defining the energy community niche in Flanders and examining its main characteristics and dynamics. The social, community engagement, and financial impacts of energy community development are analyzed. Additionally, the development of the energy community niche in Flanders is discussed, along with strategies for nurturing and protecting this niche.

Finally, the potential for scaling the community energy niche and its future prospects in the Flanders region are explored, and suggestions and recommendations are provided for the policy and regulatory environment of the energy community niche in Flanders.

4.1. Regime

This section has been designed based on the Multi-Level perspective, which was elaborated on chapter 2. First, the Regime section consists of general information on facts and figures of the Belgian energy sector, followed by the key characteristics of the Flemish energy sector. Plus a detailed stakeholder analysis. Afterwards, the SNM framework was applied to the collected data from the interviews, literature and desk research, consisting of the niche characteristics of energy communities in Flanders. Moreover, the social and community engagement impacts follow this chapter and the financial implications of the energy communities in the selected pilots. This chapter will eventually elaborate on the niche development and scaling of energy communities and will provide some perspective for the future vision of energy communities in the Flanders region.

4.1.1. Facts and Figure of Belgian Energy sector

The main goals of Belgium's energy strategy are to move the country towards a low-carbon economy while maintaining supply security, cutting consumer prices, boosting market competitiveness, and advancing the country's integration with the European energy system. In an effort to guarantee the security of the electrical supply, the federal government has created a capacity remuneration mechanism and is committed to gradually eliminating the majority of nuclear power generation by 2025. The federal government decided in March 2022 to take the necessary steps to extend 2 GW of nuclear capacity by ten years and introduced a EUR 1.2 billion package to accelerate the energy transition and protect consumers from high energy prices in light of the Russian invasion of Ukraine and goals to reduce dependency on fossil fuels, (I. E. Agency, 2022).

The majority of Belgium's coal consumption is met by the industry sector, which is primarily dependent on electricity (18%), natural gas (29%) and oil (40%). Figure 4.1. The least diversified industry is transportation, where 89% of demand is met by oil. Biofuels (8%), electricity (2%), and natural gas (1%), in smaller amounts, round out the top five. Natural gas (40%), electricity (27%) and oil (27%) account for the majority of construction energy consumption; biomass (5%) and district heating (0.6%) are used sparingly. Compared to the IEA average of 8%, Belgium's building energy demand in 2019 had the fifth-highest percentage of oil (24%) of any country, (I. E. Agency, 2022). In Belgium, 18% of TFC (Total Final Consumption) had access to electricity in 2019, which is less than the IEA average of 22%. Nuclear power will account for 39% of Belgium's electricity generation in 2020, with natural gas coming in second at 30% and renewable energy at 26.5%, mostly from solar PV, wind and biomass. The final coal-fired power station in Belgium closed its doors in 2016. However, one industrial facility that mostly utilises coal for heating also generates a tiny amount of energy (2% in 2020), ("World Energy Balances 2022- IEA", 2022).

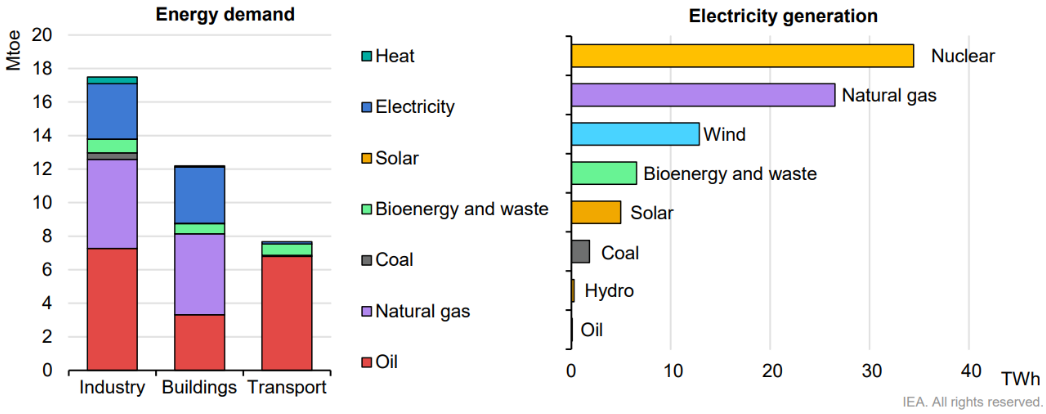

Figure 4.1: Energy demand per sector and per fuel, and electricity generation by fuel in Belgium, 2020, from ("World Energy Balances 2022- IEA", 2022)

As displayed in Figure 4.1, the highest share of electricity generation belongs to the nuclear sector, around 35 TWh. Therefore, it is remarkable to mention this sector of the Belgian (and Flemish) energy characteristic explicitly. Historically, more than half of Belgium's electricity has been produced via nuclear energy. With a total generating capacity of 5.94 GW, Belgium's seven nuclear reactors are housed in two nuclear power plants: Tihange in Wallonia (three reactors) and Doel in Flanders (four reactors). A combination of technical, regulatory, policy, and external factors caused significant annual changes in nuclear power generation from 2012 to 2020, resulting in an average capacity factor of 68.3%. All seven of Belgium's reactors returned online in 2020, and by 2021, nuclear availability had increased to 92%.

Belgium's nuclear energy policy, which aims to phase out the majority of nuclear power generation in a secure manner by 2025, ensure the safe disposal of spent reactor fuel and radioactive waste, and preserve expertise in nuclear energy research and development, is within the purview of the federal government. Under the direction of the Interior Minister, the Federal Agency for Nuclear Control is the regulatory agency responsible for nuclear safety, licensing, and delicensing.

The federal law of January 31, 2003, in Belgium mandates the phase-out of nuclear electricity generation nationwide. The Tihange 1, Doel 1, and 2 reactors will continue to operate until 2025, according to 2013 and 2015 amendments to the law. The federal government resolved in March 2022 to take the required actions to extend 2 GW of nuclear capacity (Tihange 3 and Doel 4) by ten years, including amending the 2003 law, in light of the Russian invasion of Ukraine and aims to minimise dependency on fossil fuels, (I. E. Agency, 2022). By 2025, most of Belgium's nuclear power capacity will be phased down under this new agreement, Figure 4.2.

Empowering energy communities in Belgium could indeed play a significant role in supporting alternative electricity generation solutions in the context of Belgian nuclear phase-out strategies. The phase-out of nuclear power in Belgium is a complex and long-term process, and it necessitates the development of reliable and sustainable energy sources to replace the nuclear capacity. Energy communities can contribute to this transition in several ways like Renewable Energy Generation, Decentralized Generation, Energy Efficiency (By encouraging energy conservation and the adoption of energy-efficient technologies), Grid Integration (including energy storage solutions and demand-side management), Local Support and Public Acceptance (Community-based energy projects often enjoy local support and can help build public acceptance for alternative energy generation solutions), and Economic and Social Benefits (Energy communities can create economic opportunities and jobs in the local area).

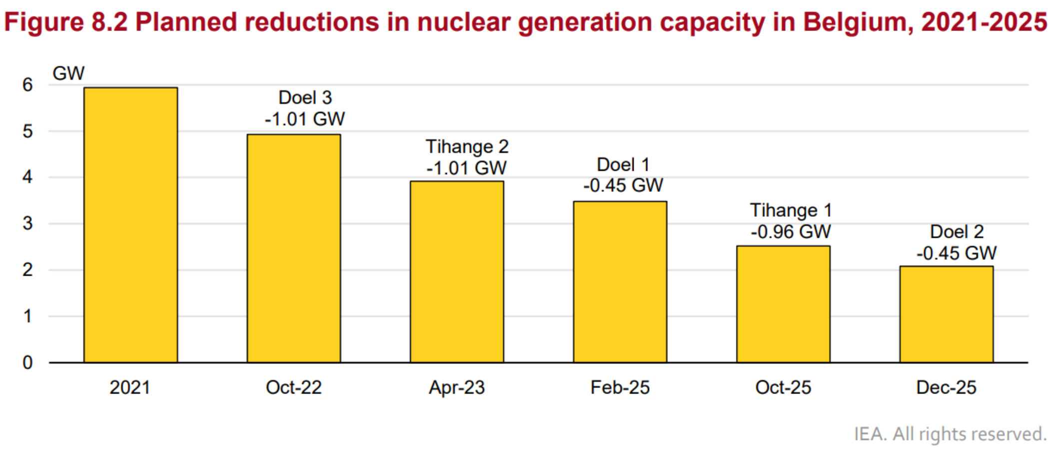

Figure 4.2: Planned reductions in nuclear generation capacity in Belgium, 2021-2025, from ("World Energy Balances 2022-IEA", 2022)

However, it's important to note that transitioning from nuclear power to alternative energy sources is a complex and multifaceted process. It requires careful planning, investment, and coordination among various stakeholders, including government agencies, utility companies, and local communities. Additionally, the specific impact of energy communities in Flanders will depend on the scale and scope of their projects, as well as the regulatory and policy framework in place.

In conclusion, the empowerment of energy communities can play a valuable role in supporting the Belgian nuclear phase-out strategies by promoting alternative electricity generation solutions, fostering sustainability, and engaging local communities in the energy transition. In the upcoming sections, an extensive stakeholder analysis is provided to better illustrate the position, influence, power and coordination mechanisms of essential stakeholders in the Flemish (and/or Belgian) Energy sector and specifically related to community energy projects.

4.1.2. Key characteristics of Flemish Energy sector

The previous section covered some important aspects of the Belgian energy mix. The focus now shifts to the Flemish region and how it compares to the rest of the country. This section examines the main characteristics of the energy sector in Flanders, a region located in Belgium. There are several distinct features and factors that have a significant impact on the energy landscape in this region. To provide an overview, some of the key characteristics of the Flemish energy sector will be discussed. Here are some key characteristics of the Flanders energy sector and how they approach renewable and innovative energy technologies and policies, as presented in the literature.

- **1. Renewable Energy Focus:** Flanders has a strong emphasis on renewable energy sources. It has set ambitious targets for renewable energy generation and consumption. The region promotes the development of wind, solar, and biomass energy and energy efficiency measures. ("Flemish Government - Energy Policy", 2018)
- **2. Proactive Energy Policies:** Flanders has implemented proactive energy policies and support mechanisms to facilitate the transition to clean and sustainable energy sources. These policies include incentives for renewable energy production and energy efficiency improvements. ("REScoop Vlaanderen", 2021)
- **3. Citizen and Community Engagement:** The Flemish energy sector encourages citizen and community participation in energy production. Energy communities and cooperatives actively participate in renewable energy projects, promoting local ownership and involvement. ("Flemish Energy Agency", 2017)

- **4. Diverse Energy Resources:** Flanders boasts diverse energy resources, including wind, solar, biomass, and hydro-power. This diversity allows for a mix of renewable energy technologies and contributes to energy security. ("Flemish Climate Policy", 2018)
- **5. Collaborative Governance:** Collaborative governance structures involving various stakeholders, including government bodies, energy cooperatives, and communities, are a characteristic of the Flemish energy sector. These structures facilitate coordinated efforts in the energy transition. ("Flux 50", 2023)
- **6. Innovative Technologies:** Flanders invests in innovative energy technologies and solutions. These technologies aim to enhance energy efficiency, reduce emissions, and promote sustainable energy practices. ("European Commission - Energy Transition in Belgium", 2016)
- **7. Community-Based Energy Projects:** Energy communities in Flanders are actively engaged in community-based energy projects. These projects may include wind turbines, solar panel installations, and energy-efficient measures in local neighbourhoods.
- **8. Supportive Legal Framework:** The region benefits from a supportive legal framework for citizen energy initiatives. Regulations and policies encourage the establishment of energy communities and renewable energy cooperatives. ("Local Energy Communities in Flanders", 2022)
- **9. Integration of Energy Efficiency:** The Flemish energy sector strongly emphasises energy efficiency measures. These measures aim to reduce energy consumption, lower costs, and decrease the carbon footprint. ("Flemish Energy Community Map", 2023)
- **10. International Commitments:** Flanders is committed to international climate change and sustainable energy agreements. It aligns its energy policies with global efforts, such as the Paris Agreement.
- **11. Local Job Creation:** The growth of renewable energy projects and energy communities contributes to local job creation. These projects stimulate employment opportunities in the region.
- **12. Interconnection:** Flanders is well-connected to neighbouring regions and countries through energy interconnection infrastructure. This interconnection allows for the exchange of energy resources and enhances energy security.
- **13. Research and Development:** Flanders invests in research and development activities related to energy. Universities and research institutions in the region contribute to advancements in energy technologies and practices.
- **14. Energy Transition Monitoring:** The Flemish energy sector closely monitors the progress of the energy transition. Data and statistics on energy production, consumption, and emissions are regularly tracked and reported.

These key characteristics reflect Flanders' commitment to sustainable and clean energy practices, its support for community engagement, and its alignment with international efforts to combat climate change. They contribute to a dynamic and forward-looking energy sector actively working towards a more sustainable and low-carbon energy future. The region of Flanders, situated in Northern Belgium, has emerged as a dynamic and forward-looking hub within the global energy landscape. Its distinct commitment to sustainable and clean energy solutions has garnered worldwide recognition. In this section, the key features that define Flanders' energy sector are explored, as detailed in the provided information.

The federal government of Belgium is responsible for overseeing energy and climate policy, while the regional governments of Wallonia, Flanders, and the Brussels-Capital Region share responsibility. The national rail system, transportation fuels, offshore energy generation, nuclear energy, large-scale electricity generation and transmission, natural gas and oil transportation, price regulation, consumer protection, and energy-related RD&D (Energy Research, Development & Demonstration)fall under the purview of the federal government. Regional governments are in charge of energy-related RD&D, vehicle registration, public transportation, urban and rural planning, renewable energy (apart from offshore energy), energy efficiency and GHG emissions (apart from federal buildings and vehicles), distribution of electricity and natural gas, regulation of retail energy markets, and vehicle registration, (I. E. Agency, 2022).

This region embarked on its journey towards energy sustainability with groundbreaking achievements in wind energy. The area has played a pivotal role in developing wind turbine technology, with one of the world's first large-scale wind energy parks taking shape in Zeebrugge, West Flanders, as early as 1986. This early involvement is a testament to Flanders' historical dedication to renewable energy sources. Over the years, Flanders has made significant progress in integrating wind energy into its energy mix. By 2022, wind energy had met an impressive 12.5% of the electricity demand in Belgium and the Flanders region. This accomplishment underscores Flanders' unwavering commitment to transitioning towards sustainable energy sources. This region's commitment to advancing renewable energy is rooted in innovation. In 2022 alone, the area filed an impressive 656 patents, solidifying its position as a global leader. Flanders is not content with simply consuming clean energy; it actively creates it, pushing the boundaries of what is possible, ("Flanders investment and trade", 2021).

Belgium, with Flanders at the forefront, has established itself as a critical player in the offshore wind energy industry. For instance, offshore wind energy is a crucial driver of Flanders' economy. By 2030, it is projected to contribute between EUR 1 billion and EUR 1.5 billion annually to Belgium's GDP. This financial impact highlights the significant returns on investment in sustainable energy. The country ranks 5th globally for installed offshore wind capacity and 2nd for offshore wind production per capita. This achievement is a testament to Flanders' investment and expertise in renewable energy, ("Belgian offshore platform", 2023).

The renewable energy sector is a technological revolution and an economic powerhouse. Flanders has generated 14,000 direct and indirect jobs in the offshore wind energy industry alone, with a projected 24,000 by 2030, ("Global offshore wind: Belgium", 2023). This underscores the sector's ability to create jobs and boost the local economy. Flanders is a hub of innovation for environmental technology and sustainability, including cleantech, biomass production, and circular economy solutions. Its practical expertise fosters collaboration among industry players and research organisations. Furthermore, it has cultivated advanced smart energy niches, particularly in renewable energy, smart grids, storage, co-generation, and network integration. The region has several companies and organisations that excel in these areas. This location has earned a reputation as a thriving centre for research and development initiatives, contributing to the energy sector's continuous evolution. Spearhead clusters such as Flux50 and The Blue Cluster have been instrumental in fostering Flanders' innovative spirit, with Flux50 focusing on clean energy solutions and the empowerment of local energy communities, and the Blue Cluster emphasising the synergy between the economy and ecology, with a focus on offshore energy, ("Flux50 Projects overview", 2022), ("Blue Cluster", 2021).

Flanders boasts strategic research centres and university research groups dedicated to sustainable energy and smart technologies. Organisations such as imec (Inter-university Microelectronics Centre), VITO (Flemish Institute for Technological Research), Flanders Make, EnerGhentIC, and MOBI provide essential R&D support in these domains, which have been instrumental in shaping Flanders' future in smart energy, ("Sustainable energy | imec", 2023), ("Expertise | imec", 2023), ("Expertise | EnerGhentIC", 2023). Several sector-specific research centres, knowledge platforms, and research groups have also played a key role in catalysing innovation. Notable among them are EnergyVille, Cleantech Flanders, WaterstofNet, and GreenVille, which have facilitated the growth of cleantech and sustainable energy solutions, ("EnergyVille | Research", n.d.), (Cleadmin, 2022), ("Cleantech Flanders", 2021), ("Waterstofnet | Knowledge centre ", 2020).

Flanders' energy sector has several success stories to share. For instance, the PERCISTAND consortium, coordinated by EnergyVille, achieved an impressive 25% energy efficiency with thin-film solar cells, promising the production of next-generation solar panels, ("Percistand", 2020). Additionally, Flanders' seaports have demonstrated a commitment to clean energy and cleantech solutions, with initiatives such as the hydrogen plant in Ostend and the Carbon Capture and Utilization hub in North Sea Port Ghent ("North Sea Port | Hydrogen", 2023). Moreover, they offer a supportive environment for businesses engaged in smart energy, with the government providing subsidies and support for various aspects of business, including investments in R&D, strategic transformation, ecological efforts, and growth. Tax incentives for research-intensive activities, such as the innovation income deduction and the R&D investment deduction, further sweeten the deal, (Petit, 2023).

In conclusion, Flanders' energy sector presents a compelling narrative of sustainable growth, technological innovation, and economic impact. The region's historical contributions to wind energy, leadership in offshore wind, commitment to cleantech, and fostering of research and innovation exemplify its role as a vibrant, forward-looking player in the global energy arena.

The previous sections have highlighted the organization and structure of the energy sector in Belgium and the Flemish energy sector's focus on renewable and innovative sustainable energy technologies and policies. As previously mentioned, Belgium and Flanders, an important region within the country, are taking proactive steps towards a more efficient energy transition process. This includes phasing out nuclear energy and focusing more on renewable energy and electrification. To support this goal, one innovative approach is the up-scaling and empowerment of energy communities in the region. However, according to a study by (Laes et al., 2019), the transformation of the energy system in Flanders encounters various obstacles and barriers that can be classified into three layers: technological, niche-innovation, and system innovation barriers. Technological barriers include issues related to the performance, cost, and scalability of low-carbon technologies. Niche-innovation barriers refer to challenges associated with the up-scaling of technological niche innovations, such as regulatory barriers and a lack of funding. System innovation barriers are more fundamental and relate to the need for transformative system change, including issues related to governance, culture, and power relations (Laes et al., 2019).

The development and scaling of energy communities, a form of niche innovation, can face obstacles at all three levels of a socio-technical nature. However, since it is still a niche innovation, the major barriers it faces are related to regulatory and business case-related barriers.In order to gain a better understanding of how the development of energy communities can contribute to the regional energy transition goals in Flanders, the potential social and economic benefits of this niche innovation are being discussed based on qualitative analysis of the data collected from interviews and available literature. Prior to this, a detailed stakeholder analysis was conducted to clarify the coordination mechanisms and the position of each actor involved in this niche innovation.

4.1.3. Stakeholder Analysis and Coordination Mechanisms

In this section, a detailed analysis is provided on the key stakeholders who significantly impact the development and progress of energy communities in Flanders. The coordination mechanisms utilized by these stakeholders are also explored. Finally, a power-interest grid is employed to understand their position within the initiatives comprehensively.

Key Stakeholders in the Flemish Energy Sector

In this sub-section, the list and description of the main stakeholders playing an essential role within the Flemish energy sector are presented; afterwards, within Figure 4.3, their coordination mechanism is displayed and elaborated on.

The list of these key stakeholders in the Flemish energy sectors is as follows:

- **1. Flemish Ministry of Environment, Nature, and Energy:** The Flemish Ministry of Environment, Nature, and Energy plays a vital role in the government of Flanders, Belgium. Its mission is to create and implement comprehensive environmental, nature conservation, and energy policies. The ministry is responsible for formulating and executing strategies that promote sustainable development and address significant environmental challenges. It plays a crucial role in shaping Flanders' energy landscape by promoting the adoption of renewable energy and facilitating actions to address climate change. ("Renewable Energy in Flanders: Targets and Incentives", 2021)
- **2. VEKA (Flanders Energy and Climate Agency):** VEKA, also known as the Flanders Energy and Climate Agency, is a significant institution committed to enhancing energy efficiency and promoting sustainability in the Flanders region. It is a central hub for individuals, businesses, and

organisations seeking guidance and support in reducing energy consumption and transitioning to cleaner energy solutions. VEKA plays a crucial role in raising awareness, providing incentives, and implementing programs to reduce the carbon footprint and encourage using renewable energy sources. (“VEKA - Flanders Energy and Climate Agency”, 2018)

- **3. VREG (Flemish Regulator of the Electricity and Gas Market):** VREG, which stands for the Flemish Regulator of the Electricity and Gas Market, is responsible for regulating and overseeing the electricity and gas markets in Flanders. Its main objectives are ensuring fair competition among market players, regulating tariffs to safeguard consumer interests, and maintaining a transparent and well-functioning energy market. By promoting a level playing field for energy suppliers and safeguarding consumer rights, VREG plays a critical role in the energy sector in Flanders.(“VREG - Flemish Regulator of the Electricity and Gas Market”, 2016)
- **4. Distribution System Operator (DSO) - Fluvius:** Fluvius is the distribution system operator for the Flanders region, responsible for managing the complex distribution networks of natural gas and electricity. The company ensures the reliability and safety of the infrastructure by maintaining and upgrading the grid. Additionally, Fluvius connects households and businesses to the energy grid, making it an essential player in the energy sector. Its contribution is critical to providing a stable and accessible energy supply.(“Fluvius”, 2017)
- **5. Transmission System Operator (TSO)- Elia:** Elia is responsible for maintaining the high-voltage electricity grid in Belgium, including Flanders, as the transmission system operator. The company plays a crucial role in ensuring the country’s safe and efficient transportation of electricity. In addition, Elia collaborates with neighbouring countries to facilitate cross-border electricity exchange, which promotes regional energy security and incorporates renewable energy sources. There are no spelling, grammar or punctuation errors in the original text.(“Elia”, 2017)
- **6. VVSG (Association of Flemish Cities and Municipalities):** The VVSG, which stands for the Association of Flemish Cities and Municipalities, is a group that represents the interests of local government entities in Flanders. Although not exclusively focused on energy, it often becomes involved in local governance, sustainability, and community development initiatives. The VVSG can play an important role in promoting and implementing local energy projects, sustainability programs, and environmental initiatives at the municipal level. (“VVSG - Association of Flemish Cities and Municipalities”, 2017)
- **7. REScoop EU:** REScoop EU is a European umbrella organisation supporting and advocating for renewable energy cooperatives. Its mission is to promote the idea of community-owned renewable energy projects. By representing the interests of energy cooperatives, REScoop EU encourages local participation in sustainable energy generation. It fosters the growth of community-led initiatives that produce clean energy and contribute to reducing greenhouse gas emissions. (“REScoop EU”, 2021)
- **8. REScoop Vlaanderen:** REScoop Vlaanderen is a regional organisation operating within Flanders with the primary goal of promoting and supporting renewable energy cooperatives at the local level. It aims to empower communities to establish and manage renewable energy projects by providing guidance, expertise, and resources. Through REScoop Vlaanderen, the residents of Flanders can actively engage in the transition to clean energy and play a role in shaping the future of their energy supply. (“REScoop Vlaanderen”, 2022)
- **9. Flux 50:** Flux 50 is a dynamic network that brings together various stakeholders in the Flemish energy sector, including research institutions, businesses, governmental bodies, and other organisations. The network’s main objective is to promote collaboration, research, and development in the energy field, focusing on driving progress, enhancing energy efficiency, and advancing cutting-edge technologies. (“Flux 50”, 2023)
- **10. Energy Suppliers in Flanders:** In Flanders, several energy suppliers specialise in offering renewable energy options to consumers. These companies provide electricity and gas from sustainable wind, solar, and biomass sources. By selecting one of these suppliers, consumers can actively create a greener and more sustainable energy landscape in Flanders. Some notable examples of such suppliers include Ecopower, Wase Wind, and Eneco, which prioritise eco-friendly energy solutions and align with the region’s commitment to environmental sustainability and climate action. (“Eneco Belgium”, 2016), (“Wase Wind”, 2023), (“Ecopower”, 2021).

Stakeholders' Coordination Mechanisms

Figure 4.3 shows a stakeholder map. The stakeholder map displays the different relations and coordination mechanisms between the stakeholders related to the establishment and development of energy communities in the Flanders region.

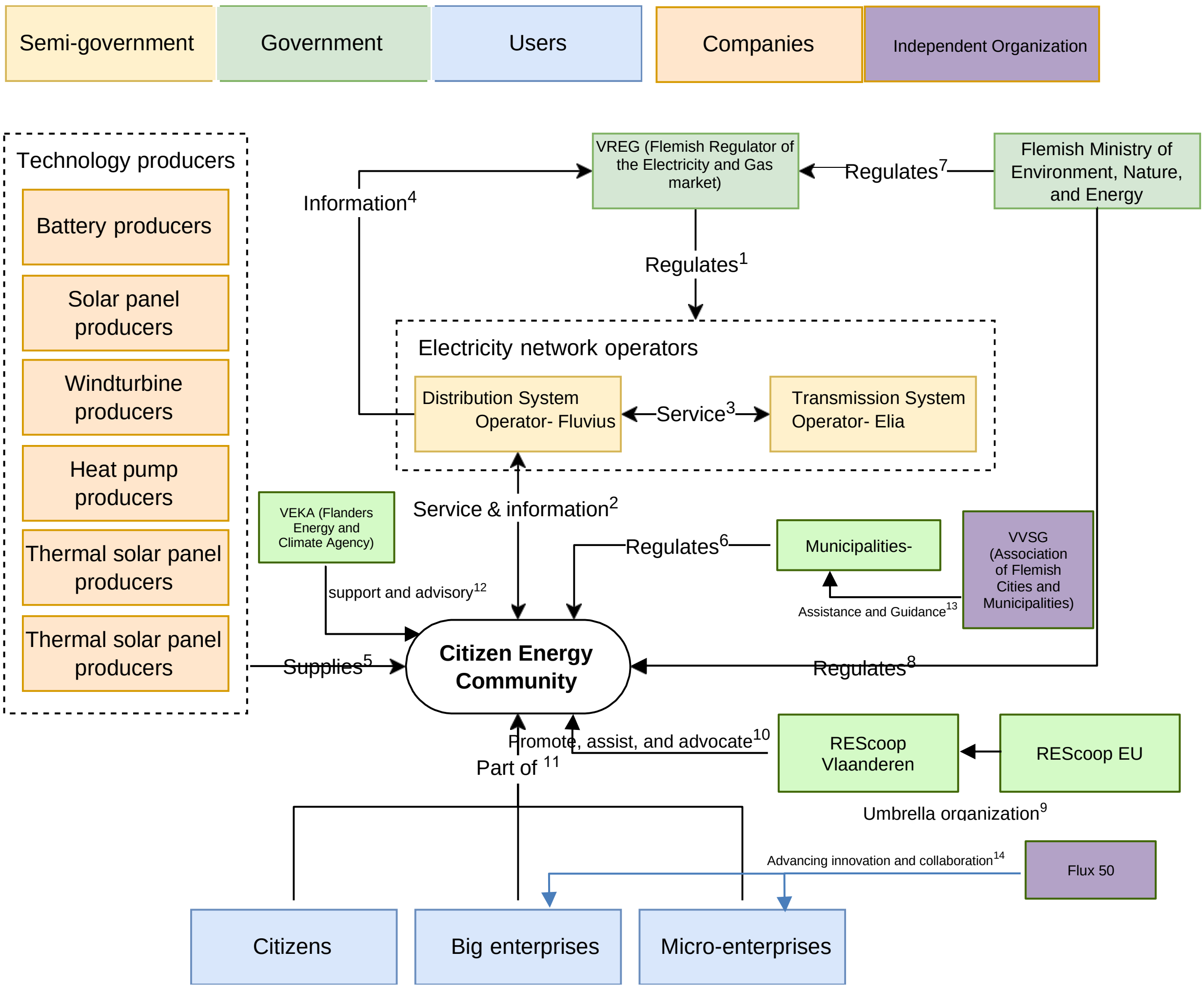

Figure 4.3: Stakeholder map and coordination mechanisms of citizen energy communities in Flanders

1 Regulates The VREG is an authority for regulating the Flemish electricity and gas market. Their remit is to regulate and monitor the Flemish electricity and gas markets. They ensure an efficient and reliable operation of the energy retail markets while ensuring compliance with environmental and social public service obligations. Distribution grids are regulated to ensure efficient, accessible, and reliable energy supply for consumers and producers. Access to the free market is encouraged for customers. (Vlaamse Regulator van de Elektriciteits- en Gasmarkt (VREG), 2023)

2 Service The DSO duties around cooperation with ECs and facilitation of energy sharing It is currently possible to conduct collective self-consumption at the building level, and energy sharing beyond the building level by RECs and CECs will become possible as of the beginning of 2023. However, the DSOs are still in a piloting phase, and many details of how 'cooperation' should be established are still under development. From 23 January 2023, sharing energy within a REC/CEC is possible. An energy community will be connected to the distribution network of a Distribution system operator (DSO) in their area. The DSOs are currently also supporting pilots for energy communities. During the pilots, the DSO and energy community will distribute their knowledge about the system. (Rescoop.EU, 2023)

3 Service In Belgium, as in many European countries, the DSO and TSO have distinct roles and responsibilities. The DSO is responsible for the distribution network, which delivers electricity from the high-voltage transmission grid to end-users (e.g., homes and businesses). Conversely, the TSO manages the high-voltage transmission grid that transports electricity over long distances. Both are obligated to ensure the reliability and stability of their respective networks to provide electricity to consumers. The DSO and TSO are interconnected, as electricity must flow seamlessly from the transmission to the distribution grid to reach end-users. The connection points between these networks are crucial for the overall functioning of the electricity supply chain. Both operators collaborate to ensure a reliable and efficient energy supply. This collaboration includes the exchange of information and coordination to manage the flow of electricity, ("Electricity law and regulation in Belgium", 2012).

4 Information According to the EU Network Codes implemented in Belgium, The VREG will regulate the DSOs based on the information received from the DSOs,(Harlem, 2018).

5 Supplies The different technology producers will supply the Energy Communities (ECs) with the technology required to make the EC feasible.

6 Regulates The energy communities need to adhere to the regulations set by the municipalities. The placement of technology in public space within the EC must conform to the spatial planning of the specific municipality (.) Municipalities in Flanders are governed by their own local authorities and adhere to Belgian laws and regulations. Regulatory matters related to municipalities are typically overseen by regional and national government authorities in Belgium, (Blixt et al., 2020).

7 Regulates The VREG is regulated and governed by a board of directors, but its daily management is overseen by a managing director appointed by the Flemish government("Electricity law and regulation in Belgium", 2012).

8 Regulates The Flemish Ministry of Environment, Nature, and energy does have a regulatory role in overseeing aspects of energy communities (ECs). Still, it primarily focuses on policy, legislation, and support rather than directly regulating the buying and selling of energy between users within ECs. The regulatory aspects of energy sales and transactions are often under the purview of energy market regulators such as the Flemish Regulator of the Electricity and Gas Market (VREG), ("Flemish Ministry of Environment, Nature, and Energy", 2017).

9 Umbrella organisation REScoop EU serves as an umbrella organisation and advocate for renewable energy cooperatives across Europe, providing support and representation on a broader scale, ("REScoop EU", 2021).

10 Regulates REScoop Vlaanderen (the Flemish branch of the REScoop network) does not have regulatory authority over energy communities in Flanders. Instead, REScoop Vlaanderen is an organisation that supports and represents renewable energy cooperatives in the region. Its role is to promote, assist, and advocate for community-led renewable energy initiatives. REScoop Vlaanderen focuses on supporting and fostering the growth of renewable energy cooperatives within the regulatory framework, ("REScoop Vlaanderen", 2021).

11 Part of There are big and small enterprises plus the citizens themselves that are part of the energy communities.

12 support and advisory VEKA (Flanders Energy and Climate Agency) primarily serves as a support and advisory agency rather than a regulatory body for energy communities in Flanders. While VEKA does not have regulatory authority over energy communities, it is crucial in promoting and facilitating energy efficiency and sustainability initiatives. VEKA's role is to offer guidance, incentives, and support to individuals, businesses, and organisations in Flanders looking to adopt cleaner energy practices and improve energy efficiency, ("VEKA - Flanders Energy and Climate Agency", 2018).

13 Assistance and Guidance VVSG (the Association of Flemish Cities and Municipalities) is not a regulatory body; rather, it is an association that represents and supports municipalities in Flanders, Belgium. Its primary purpose is to provide assistance, guidance, and support to municipalities in various aspects of local governance, including issues related to administration, policies, and services. VVSG serves as a resource and platform for municipalities to share best practices, access information, and collaborate on common challenges in local governance, ("VVSG - Association of Flemish Cities and Municipalities", 2017).

14 Advancing innovation and collaboration Flux50 in Flanders primarily focuses on advancing innovation and collaboration in the energy sector for big and micro enterprises. It provides services in areas like Research and Development, Networking and Collaboration, Access to Expertise and Innovation Ecosystem, ("Flux50 Projects overview", 2022).

Power- Interest Grid of Stakeholders

In Figure 4.4, the stakeholders' power-interest grid is shown. The Influence-Interest grid is a helpful tool to map out stakeholders involved in energy community projects in Flanders. This tool helps to determine each stakeholder's level of influence and interest. It is useful in deciding the best way to engage and communicate with them throughout the project.

As shown in the power-interest grid (see Figure 4.4), most governmental stakeholders hold high levels of power and influence. Two leading organisations, REScoop EU and REScoop Vlaanderen, represent energy communities in Flanders. These organisations are actively involved in the growth, development, and promotion of energy communities from various aspects. As key stakeholders, they play a critical role in shaping the future of energy communities. Apart from these organisations, public authorities such as the Flemish Energy and Climate Ministry, municipalities, and the VEKA organisation also show a keen interest in these projects. The reason is that empowering citizen energy communities in Flanders can help achieve sustainable development goals, promote carbon neutrality, encourage energy sharing, renewable energy generation, electric vehicle use, energy storage and savings, and foster social and community engagement. ("REScoop EU", 2021), ("REScoop Vlaanderen", 2021).

Municipalities in Flanders, along with the Association of Flemish Cities and Municipalities (VVSG), are interested in participating in the development of energy communities. However, some stakeholders, such as the VREG organisation and the Flemish Regulator of the Electricity and Gas Market, may have less interest due to the regulatory changes and policy settlements required to establish such communities. These changes could increase their workload and complexity, which might explain their lack of interest.

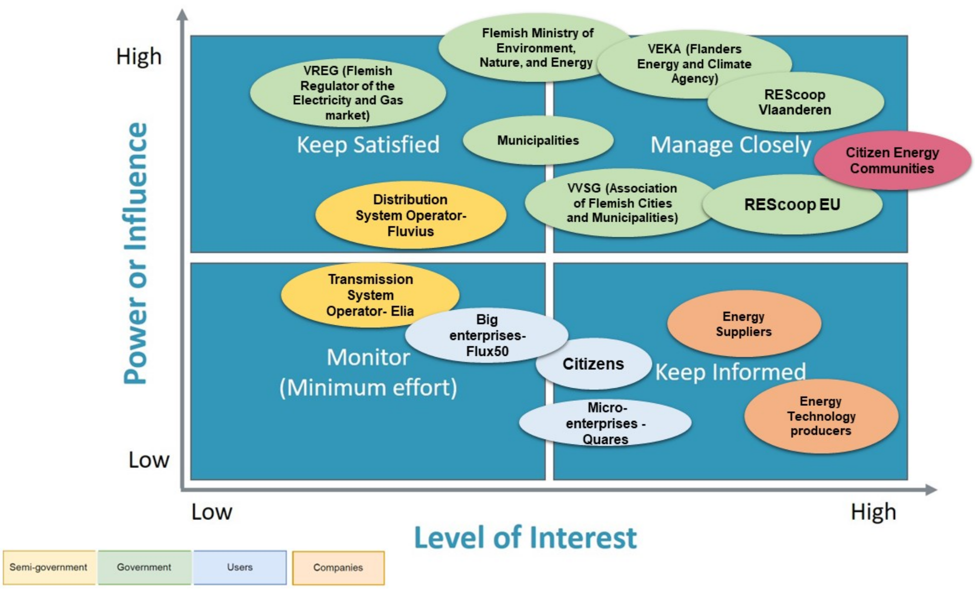

Figure 4.4: Power-Interest Grid of Stakeholders

Grid operators such as the Distribution System Operator (DSO) Fluvius in the Flanders region and Transmission System Operator Elia might be less interested in energy communities due to the complexity they bring to their tasks, particularly for the DSO. In many instances, data input for electricity meters for energy communities must be manually done by the DSO, and their procedures are not yet fully digitalised. Therefore, they may have a lower interest in these projects but still have a reasonable level of influence.

Companies that produce technology for the energy sector, such as batteries, solar panels, wind turbines, heat pumps, thermal solar panels and related accessories, and green energy suppliers, are likely to be more interested in developing energy communities. They can engage in more projects and increase profits by establishing and maintaining these projects. Although technical facilitators play an essential role in advancing energy communities, they may have less influence than other stakeholders since they are not the primary decision-makers or policymakers in these projects.

While citizens, micro-enterprises, and large enterprises like Flux50 do not have much influence in policy-making for scaling energy community projects, they are interested in participating in them. For instance, citizens may join an energy community if it can provide more affordable, reliable, and efficient energy. On the other hand, smart energy accelerators like Flux50 may also be interested in the success of these communities if they can benefit financially and use them as a business case within their organisation. By offering various services to energy communities, Flux50 can help both parties prosper.

4.2. Social and Community Engagement Impacts

During the interviews conducted for this study, one of the main questions asked to the stakeholders was about the Social and Community Engagement Impacts that the establishment and development of energy communities have had in the Flanders separately Figure 4.5, a summary of the social benefits generated by energy communities in Flanders is provided, which is further elaborated on elaborated in the following section. Additionally, the role of energy communities in promoting energy poverty alleviation and democratic participation among community members is analyzed separately at the end of this section.

Social Benefits Generated by Energy Communities	Description
Financial Savings	Energy communities can offer their members lower energy costs, resulting in significant savings on their energy bills. This financial benefit is particularly valuable for social renters and households looking to reduce their expenses.
Long-Term Price Stability	Members of energy communities with solar panels benefit from price stability for the energy generated. This stability shields them from market fluctuations for the 20-year lifetime of the panels, providing predictability and cost control.
Community Building	Energy communities bring people together and create social connections. In an individualistic society, these communities offer opportunities for individuals to connect, collaborate, and share common interests.
Socialization	By fostering interactions among community members and neighbours, energy communities contribute to socialization. Residents engage with one another, strengthening social bonds and a sense of belonging.
Local Value Retention	Community-owned energy projects can keep more economic value within the local economy. This approach helps maintain local wealth and benefits the community as a whole.
Social Inclusion	Energy communities aim to be inclusive, ensuring that all segments of society can participate and benefit from community energy projects. This promotes social equity and access to clean energy.
Social Cohesion	By acting together, learning from each other, and engaging in collective efforts, people within energy communities build social cohesion. This strengthens the bonds within the community and encourages collaboration.
Addressing Energy Poverty	Energy communities can play a role in addressing energy poverty, a significant social challenge. Their initiatives provide solutions to energy poverty issues by providing clean energy at reasonable costs to low-income households.
Promoting Renewable Energy	Energy communities raise awareness and understanding of renewable energy sources. Their initiatives contribute to the social acceptance of renewable energy and investment in sustainable practices.
Empowering Democratic Participation	Community members have a say in energy production and consumption decisions. This democratic approach empowers individuals to have a say in the operation of the energy system, fostering a sense of ownership and participation.
Streamlined Formation	Simplifying the process of forming energy communities through standardized platforms can reduce barriers to entry and facilitate the establishment of new energy communities. This can lead to more community engagement.
Awareness and Interest	Energy communities create awareness and interest among people about the possibilities of energy exchange and community energy projects. People become curious about how they can exchange energy with their neighbours and family members.
Reducing Energy Poverty	Projects involving larger buildings and apartments, where energy financing is not borne by residents but by third-party investors, can help reduce energy poverty. Residents benefit from locally produced energy, which can alleviate their energy costs.
Promoting Community Revitalization	Some energy communities contribute to community revitalization by using revenues to support local initiatives, such as reopening local businesses. This can lead to more opportunities for people in the community and contribute to the community's revival.
Local Empowerment	Energy communities empower individuals and communities to take ownership of their energy generation and consumption. The community-focused approach fosters local control and decision-making, creating a different narrative and dynamic.

Figure 4.5: Summary of the social benefits generated by energy communities in Flanders

Energy communities are transforming the energy landscape in Flanders and providing a range of social benefits that go beyond the traditional energy sector. These communities, which include a diverse group of stakeholders, come together to create a sustainable future.One of the main benefits of energy communities is the significant financial savings they offer members. For instance, Ecopower enables its members to enjoy lower energy costs, with social renters and households saving about €500 on their energy bills. Additionally, Ecopower values its members' engagement and ensures that every member has a say in the direction they take. This is achieved through General Assemblies and energy cafes that foster transparency and information sharing.

Energy communities offer more than just financial relief. They create a sense of belonging and connection that is often difficult to find in today's individualistic society. By bringing people together, they establish strong and lasting bonds within communities. Local ambassadors and collaborators further strengthen these connections and spread the message of community energy within neighbourhoods. Energy communities go beyond mere savings and connections. They serve as beacons of social inclusion, ensuring that everyone, regardless of their background or circumstances, can partake in and benefit from their projects. Promoting renewable energy isn't just a tagline; it's a reality. Members become ambassadors for the cause, raising awareness and understanding of renewable energy sources in their communities. (IRENA, 2020)

Energy communities in Flanders provide residents with locally produced energy that helps alleviate their energy costs. In addition, these communities foster democratic participation by giving members a voice and vote in important decisions. This sense of ownership and participation creates a vibrant sense of community and shared purpose. Energy communities also contribute to the region's overall well-being by retaining more economic value within the local economy. By keeping the value local, these communities can lead to community revitalization by reopening local businesses and attracting young people back to struggling areas.

However, establishing energy communities is not without its challenges, from regulatory constraints to communication gaps and technical complexities. To overcome these challenges, standardized platforms can simplify the formation process and foster more community engagement. In Flanders, energy communities focus on people, relationships, and the collective pursuit of a brighter, more sustainable future. Members engage in behaviour change and contribute to flexible energy usage, adding value to the energy system. An educational aspect enables local communities to shape the future of their energy landscape.

These energy communities demonstrate the power of collective action, showing that through shared values, collaborative effort, and a commitment to a sustainable future, Flanders can reap the many social benefits of community energy initiatives. Additionally, energy communities help alleviate energy poverty, promote democratic participation, and encourage niche development in the energy sector.

4.2.1. Energy poverty alleviation and democratic participation

In Flanders, energy communities are crucial in addressing energy poverty and promoting democratic participation among community members. Firstly, energy poverty is a significant issue affecting many people in Flanders, particularly those with lower incomes. Energy communities work to alleviate energy poverty by providing affordable, sustainable energy solutions to their members. By pooling resources and investing in renewable energy infrastructure, energy communities can reduce energy costs and ensure that all members have access to clean, reliable energy.

Secondly, energy communities promote democratic participation among community members. By involving members in the decision-making process and giving them a voice in how the community is run, energy communities help to build a sense of ownership and pride among members. This, in turn, fosters a stronger sense of community and encourages members to take an active role in shaping the future of their community.

Energy Poverty Alleviation: Energy communities offer innovative solutions to alleviate energy poverty. Providing access to affordable and green energy sources ensures that even those at risk of energy poverty can enjoy the benefits of sustainable energy. For instance, social renters within these communities often benefit from lower energy tariffs, which result in tangible savings on their energy bills. This not only makes green energy more accessible but also helps those who are most vulnerable economically.

One notable initiative is the ”Power Up” project, which showcases how energy communities collaborate with cities to make their services accessible to households facing financial constraints, (“POWER UP project | BUILD UP”, 2020). In this model, cities work together with energy communities to provide energy shares for free to families in need, which can be repaid over time. This innovative approach addresses affordability issues and provides a pathway for disadvantaged households to access renewable energy.

Moreover, energy communities prioritize social inclusion, ensuring that the advantages of renewable energy are accessible to all segments of society. By offering affordable energy solutions and actively involving disadvantaged households, these communities contribute to a more inclusive energy landscape.

For instance, in the city of Mechelen, a medium-sized town in the province of Antwerp, a collective renewable energy project is underway to help vulnerable families. Social housing companies play a vital role in this project, which aims to install solar panels in 400 homes (1GwH) owned by a social housing company. The installation process involves several steps, including collecting information on the state of the art, pre-selecting social housing companies and neighbourhoods, conducting a technical analysis of neighbourhoods, developing a legal and financial architecture for collective solar panels, informing and motivating inhabitants, conducting a public procurement process to install panels, and monitoring and evaluating the installation. These projects have significant benefits in terms of helping families with lower incomes, promoting energy justice, and reducing energy poverty, (Be$_{reel}$, 2020). Furthermore, Klimaan is a cooperative from the region of Mechelen that aims to develop sustainable projects concerning four ‘commons’: earth, air, water, and energy. In the cVPP (Community-based Virtual Power Plant) project, the working group focussing on energy aims to set up a cVPP project together with schools and community members in Mechelen, (Van Summeren et al., 2022).

Democratic Participation: Energy communities are inherently democratic structures with open, transparent, and inclusive decision-making. They actively engage community members and provide them with a platform to influence the direction and operations of the community. General Assemblies, for example, serve as a forum for members to voice their opinions and actively participate in energy production, consumption, and management decisions.

This empowerment enables community members to influence local energy policies and practices. By actively participating in the decision-making processes of energy communities, individuals gain a sense of ownership and responsibility in shaping their local energy systems. These communities’ transparency and open communication foster trust and understanding among members, which is instrumental in building a cohesive and collaborative community.

For instance, the EcoPower is a large regional cooperative in Belgium consisting of over 67,000 citizens who have come together to produce local, sustainable energy. In 2022, the energy cooperative saved almost 61,000 tons of carbon emissions and had the lowest energy bills in Belgium despite the ongoing energy prices crisis. The cooperative has a ”one member, one vote” policy to ensure that every member has an equal say in the decision-making process, regardless of their socio-economic background. (O’Connor, 2023).

In summary, energy communities in Flanders are driving positive change by addressing energy poverty challenges and encouraging democratic participation. They make renewable energy accessible to a broader spectrum of society, ensuring that even the most economically vulnerable individuals can access clean and affordable energy. By engaging community members in decision-making processes and involving them in the energy transition, these communities empower individuals to have a voice in their local energy systems, ultimately contributing to more sustainable and equitable energy solutions.

4.3. Economic Impacts

During the data collection phase, another focus was to examine energy communities' impacts on society from an economic perspective. This section presents a list of how empowering energy communities in the Flanders region has influenced economic aspects. As highlighted by multiple stakeholders in the energy sector, energy communities in the Flanders region have contributed to local economic development in several ways. These aspects are gathered from the conducted interviews with the mentioned stakeholders and also from the literature.

- **1. Job Creation:** Although energy communities like Ecopower may not create many jobs themselves, they do play a vital role in generating employment opportunities in related sectors. Collaborations with specialized companies and local installers for renewable energy projects, such as solar panel installations and wind turbines, contribute to job creation within those industries. Besides, initiatives such as the Re-powering London project focus on training and equipping young people with skills, thereby creating employment opportunities for solar PV installations in disadvantaged areas, (REScoop.EU, Energy Cities, Friends of the Earth Europe, 2020).
- **2. Investment Opportunities:** Investing in renewable energy projects within their community is a great opportunity for members of energy communities. These investments provide a financial return, usually through dividends or a share of the profits generated from energy sales. This means people can earn returns on clean energy initiatives and diversify their investment portfolios. Furthermore, a study conducted by Bauwens in 2019 (Bauwens, 2019) provides a detailed analysis of the determinants of the size of investments made by community renewable energy members in Flanders, Belgium. The study draws on case study research on two RE cooperatives based in Flanders, Ecopower and BeauVent, and a large-scale survey of 4061 members of these cooperatives. According to the study, the return on investment is the most important factor for members of large communities of interest, while environmental, social, and other non-economic drivers tend to dominate financial motives for members of smaller communities of place.
- **3. Lower Energy Costs:** Energy communities can reduce energy costs by collectively owning and operating renewable energy installations, such as solar panels or wind turbines, allowing participants to access affordable, locally generated energy. ("Energy communities to transform the EU's energy system", 2022)
- **4. Local Economic Stimulus:** Energy communities play a vital role in boosting the local economy by engaging local entrepreneurs, contractors, and businesses in various project-related activities. This encompasses solar panel installation, renovation programs, and equipment supply. Consequently, these local enterprises experience an increased demand due to the energy community initiatives. (Felice et al., 2022)
- **5. Energy Independence:** Energy communities enable their members to become more energy independent. This means they rely less on energy purchased from external suppliers, which, in the long run, can reduce energy costs and stabilize energy expenses for members. (IRENA, 2020)
- **6. Additional Income Sources:** The surplus energy generated by community projects can be sold back to the grid or energy suppliers. This provides an additional income source for the energy community, which can be reinvested in local projects or distributed among members.
- **7. Educational Opportunities:** Energy communities often provide educational programs, workshops, and opportunities for information sharing. These programs equip members with knowledge on energy efficiency and the advantages of renewable energy sources. Such education can lead to cost savings on energy bills and increased economic efficiency for the community members. ("Flux 50", 2021)
- **8. Increased Property Values:** Properties with solar panels or other renewable energy installations tend to have increased resale values. This can benefit property owners and contribute to

the overall economic well-being of the community. (Hammerle et al., 2023)

- **9.Social Return on Investment:** Investment in community energy projects often leads to a social return on investment (SROI), which considers financial returns and environmental and social benefits. This approach measures the broader impact of community energy initiatives on society.(Walton, 2012)

These contributions to local economic development vary in scale and impact but collectively demonstrate how energy communities play a crucial role in fostering sustainable economic growth and supporting job creation in Flanders.

In conclusion, energy communities in Flanders contribute significantly to local economic development, job creation, and financial empowerment. The diversified economic benefits, ranging from job opportunities to increased property values, position energy communities as crucial actors in addressing the economic aspects of the energy transition. These initiatives not only provide tangible economic advantages but also contribute to the overall sustainability and resilience of the Flanders region in the face of energy transition challenges.

4.4. Application of SNM Framework on the case study

In this section, the SNM framework which was basically elaborated on in chapter 2, has been applied to the selected pilots which were mentioned in section 2.4. First, the community energy niche is defined by elaboration on the niche characteristics and dynamics of the energy communities, then, it is followed by the Niche development of community energy.

4.4.1. Defining the community energy 'niche' in Flanders

During the analysis of the selected pilots, the SNM framework was applied and three key indicators of niche characteristics related to energy communities and their interaction with other stakeholders were identified. These indicators were used to evaluate the pilots. While conducting the interviews with stakeholders, one of the main focus areas of the questions was about the niche characteristics of energy communities and their vision for that. These niche characteristics are displayed in the subsections below. Additionally, at the end of each subsection, the results are discussed, highlighting insights gained for each niche characteristic and process.

Niche Characteristics and Dynamics:

A. The dynamics of expectations within energy communities and between communities and external stakeholders

Energy communities in Flanders encompass a diverse range of member expectations and vice versa. In the Figure 4.6, these expectations gathered through the interviews with the mentioned stakeholders are presented.

Indicator analysis of dynamics of expectations

As classified by (Kamp & Vanheule, 2015), and mentioned in chapter 2, Figure 2.6, the expectations of energy communities and other stakeholders mentioned in Figure 4.6, can be classified based on the indicators of expectations within the SNM framework:

Indicator analysis of Expectations of Energy Communities:

- 1. Cost Savings: Internal Expectation. This expectation primarily concerns the quality and affordability of renewable energy services provided within the energy community niche. It reflects the preferences and expectations of current actors (members) within the niche.
- 2. Environmental Concerns: A Combination of Internal and External Expectations. While there is an internal aspect related to the quality of green energy services, it also has an external dimension. It reflects the awareness and confidence of actors outside the niche (such as members with environmental concerns) in the community's ability to promote clean energy.
- 3. Community and Social Aspects: Endogenous Expectation. This expectation originates from the learning experiences and social dynamics within the niche. It is influenced by the network composition and interactions among current actors (members) in the energy community.

Indicator analysis of Expectations of Other Stakeholders:

- 1. Local Authorities: Exogenous Expectation. The expectations of local authorities are shaped by developments external to the energy community niche, such as broader sustainability and climate goals. Local authorities expect the niche to contribute to these external goals.
- 2. Energy Producers: A combination of Internal and External Expectations. There is an internal aspect related to the potential competition within the niche, as energy producers might see energy

Niche Characteristic	Description
The dynamics of expectations- Expectations of Energy communities/ Energy cooperatives from other related stakeholders	1. Cost Savings: Many members join energy communities with the primary goal of lowering their electricity costs. They expect affordable and competitive prices for renewable energy.
	2. Environmental Concerns: Some members are driven by environmental concerns and wish to support the transition to clean energy sources. Their expectations revolve around consuming green energy and reducing carbon footprints.
	3. Community and Social Aspects: Another group values the social aspects and sense of community that come with being part of an energy cooperative. Expectations include community engagement, participation in decision-making, and a shared sense of responsibility.
The dynamics of expectations- Expectations of other stakeholders from the Energy communities/ Energy cooperatives	1. Local Authorities: Local authorities may expect energy communities to help achieve their sustainability and climate goals. They look for cooperation that adds value to their communities and may see energy communities as allies in local energy projects.
	2. Energy Producers: Energy producers, often profit-oriented, may have different expectations. They may view energy communities as potential competition or entities to cooperate with for mutual benefit. Expectations can include profitable ventures or potential collaboration on renewable energy projects.
	3. Government Support: Both energy communities and external stakeholders, especially at the European level, expect supportive policies and financial incentives. Expectations include subsidies and programs that promote the growth of energy communities and the transition to clean energy sources.

Figure 4.6: The dynamics of expectations within energy communities

communities as competitors. The external aspect relates to potential cooperation and mutual benefit, reflecting the awareness of external opportunities for collaboration.

- 3. Government Support: Exogenous Expectation. While not explicitly mentioned in the provided expectations, government support can be classified as an exogenous expectation. It originates from developments external to the niche, such as regulatory landscape and government policies. Both energy community actors and external stakeholders expect supportive policies and financial incentives from the government, which are shaped by the broader regulatory framework in the external environment.

These classifications are based on the provided information and the specific indicators of expectations as defined in the SNM framework and the research conducted by (Kamp & Vanheule, 2015). They reflect the interplay of actors within and outside the energy community niche and how their expectations are influenced by different factors.

In delving into the dynamics of expectations within the energy community niche in Flanders, a rich tapestry of insights emerges, underscoring the unique blend of expectations held by community members and external stakeholders in this particular regional setting. The findings not only unveil the diverse motivations driving individuals to join energy communities but also shed light on the intricate interplay between various actors in the Flanders energy landscape.

A key revelation surfaces regarding the motivations of community members, where a substantial number are primarily drawn to energy communities with a keen eye on cost savings. This distinct emphasis on the economic dimension underscores the pragmatic incentive for Flanders residents, anticipating not only affordable but also competitively priced renewable energy—a crucial factor in their engagement with energy cooperatives. Concurrently, another noteworthy segment within the community is animated by profound environmental concerns. These individuals aspire to contribute actively to Flanders' transition to clean energy sources, expressing expectations centred on the consumption of green energy and a commitment to reducing carbon footprints. This highlights a broader regional commitment to sustainability and environmental responsibility.

Equally compelling is the recognition of the social fabric within energy communities, particularly pronounced in Flanders. Beyond economic and environmental considerations, a subset of community members places significant value on the communal and social aspects inherent in participation in an energy cooperative. Their expectations extend beyond the transactional, encompassing active community engagement, involvement in decision-making processes, and the cultivation of a shared sense of responsibility—a testament to the importance of community bonds within the Flanders context.

Expanding our lens to include external stakeholders adds another layer of complexity to Flanders' energy landscape. Local authorities, for instance, foresee energy communities as pivotal contributors to the region's sustainability and climate goals, positioning these communities as valuable allies in Flanders' broader environmental initiatives. On a contrasting note, profit-oriented energy producers in Flanders may perceive energy communities as both potential competitors and collaborators, underscoring the dual nature of their expectations. Government support, a crucial external factor in Flanders, emerges as a shared expectation among both energy communities and external stakeholders. This underscores the significance of supportive policies and financial incentives at the regional level, crucial for fostering the growth of energy communities and navigating the broader transition to clean energy sources.

The subsequent indicator analysis further contextualizes these expectations, shedding light on their origin and nature within the unique Flanders landscape. Internal expectations within Flanders' energy communities, such as the emphasis on cost savings and environmental consciousness, are juxtaposed with external expectations, notably those of local authorities and energy producers. The distinction between endogenous expectations, shaped by Flanders' internal learning experiences and social dynamics, and exogenous expectations, influenced by external developments and regional goals, provides a framework for understanding the intricate interplay shaping the trajectory of energy communities in Flanders.

To sum up, the expectations dynamics in the energy community niche in Flanders are complex and vary according to the region. The energy community members have diverse motivations, and external stakeholders have different expectations, which creates a dynamic interplay that both reflects and shapes the trajectory of energy communities. It is crucial for regional policymakers, community leaders, and external partners to have a nuanced understanding of these dynamics as they collaborate to support and encourage the growth of energy communities in Flanders while aligning with the region's unique sustainability goals.

B. Network formation between energy communities and other actors in the energy sector

Several networks have emerged to support energy communities in Flanders; the description and typology of these networks are presented in Figure 4.7; afterwards, they have been contextualized based on the living examples of these kinds of networks in the Flanders area.

Network formation between energy communities and other actors	Description
Cooperative Networks:	- Energy communities collaborate within networks such as REScoop Flanders, REScoop EU, and other cooperative platforms.
	- These networks serve as hubs for knowledge exchange, experience sharing, and collective influence on climate policies.
	- By pooling resources and experiences, energy communities can effectively navigate regulatory complexities and advocate for favourable policies.
Energy for Social Houses:	- Energy Houses are local entities responsible for providing information and support related to energy efficiency and sustainability.
	- Collaboration with Energy Houses strengthens the support system for citizens interested in participating in energy communities.
	- Energy Houses provide valuable expertise and resources to help energy communities expand their reach and impact.
Local Authorities:	- Engaging with local authorities is crucial for energy communities, as these entities serve as gateways to citizens, farmers, and industries.
	- Collaborative efforts with local authorities extend communication channels and facilitate outreach to a broader audience.
	- Local authorities can significantly spread information, mobilise citizens, and facilitate partnerships with external stakeholders.
Industry Partners:	- Collaboration with industry partners, including regional development organisations, contributes to the expansion of energy communities into industrial sectors.
	- Experimentation with projects within industrial contexts helps develop sector-specific knowledge and practices.
	- Industry partnerships provide access to expertise, resources, and potential for large-scale renewable energy projects.

Figure 4.7: Network formation between energy communities and other actors

A learning hub, also known as a learning network, has been established within Flux50 to facilitate cooperative networks. In this learning network, various stakeholders and managers of energy communities/cooperatives can share their insights and lessons learned with each other. Through this sharing of knowledge, other energy communities can benefit and refer to these insights at their convenience.("Flux50 Projects overview", 2022).

Moreover, energy communities collaborate within networks such as REScoop EU and REScoop Flanders, and these are also empowered networks because of the energy community niche development. ("REScoop EU", 2021), ("REScoop Vlaanderen", 2021).

In reference to social housing, there are projects aimed at reducing energy poverty and improving energy access within social housing networks. For instance, the Klimaan initiative in Mechelen city was mentioned earlier in the selected pilots' section in section 2.4.

Furthermore, energy communities sometimes collaborate with their local authorities to form networks. For example, there is a project called ”Transfo Zwevegem” that is a collaboration between The Municipality of Zwevegem, Intercommunal Organisation Leiedal, and the Province of West-Flanders.("Transfo Zwevegem | Provincie West-Vlaanderen", 2023). Transfo Zwevegem, a former electricity power plant, stopped its production in 2001. Since then, the site has been abandoned. The Municipality of Zwevegem became the owner of the site and collaborated with two partners - the intercommunal organisation Leiedal and the Province of West-Flanders - to revamp the entire site. They restored the buildings and engaged new partners to give the site a new and meaningful function. The process followed the Transfo A-B-C-D-E principle, which stands for Adventure, Business, Culture, Sustainability, and Energy education. The first three were developed first, with ”Energy” being incorporated into the site's DNA. The partnership is now working on developing a ”future-proof sustainability and renewable energy” dimension to the reformation. The D&E part of the site is being developed in partnership with two European projects:

- EMPOWER2.0 (Interreg NSR): was the starting point of the development of a smart grid with limited storage capacity on the Transfo site. Empower2.0 put the right stakeholders around the table to develop the energy concept with citizen and stakeholder involvement and in the light of the EU legislation on energy communities. The partners started a series of mutually organised activities to build up a community feeling at the site. Storage capacity and production capacity on the site level are prepared. The project will focus on demo installations of storage and the storytelling of the urgency of the energy transition, persuading a broad public to participate in the quickly changing energy market actively.
- RE/SOURCED (EU Urban Innovative Actions-program). Within this program, the partners want to develop a new kind of (micro)grid: renewable energy production and storage are to be connected through a DC –grid, which in turn is connected to the low-voltage AC grid. In the first stage, people on site get the opportunity to form a local energy community. Furthermore, a visitor trail with several installations will be developed. These interactive installations explain the principles of energy production/ distribution/storage and the role energy played in human development in history (heritage), present and future. Within this site-levelled concept, the intention is to experiment with investing in renewable energy and its effect on various factors, such as the energy bill

Apart from the production and storage of renewables, the project also initiated the development of a smart grid, smart energy usage/users and the start-up of a smart energy management system. This is done via engaging and enthusing the partners, homeowners, offices, … on-site in rational use of energy, but also by activating them to participate in a 'Transfo–Cooperative'. Next, an educational tool will be developed to valorise the workings of the grid, and the knowledge that has been built up will be used to develop the site further. ("Transfo Zwevegem | Provincie West-Vlaanderen", 2023).

At the end of the D & E - project, there will be a (technical) fully operational (DC/AC) microgrid, with renewable energy of wind and sun and storage with different types of batteries. The site has a variety of participants (diving tank, brewery, climbing hall, event location, …). The grid (and its legal context) will function as a living lab. This kind of connection among the energy community and the local business as mentioned, is also another way of network formation because of the empowerment of this niche.

Regarding the industry partners mentioned in Figure 4.7, Quares can be taken as an example of an organization that provides industry support for local energy management and community development.(Quares, 2021). As part of their involvement in a local energy community, they strive to balance the supply and demand of energy at the local level. Active knowledge and management of energy demand and building energy production are deemed essential in this context. The success of a complete transition to renewable energy is contingent on these efforts.

The most significant challenge resides not in the technological or financial aspects but in the genuine commitment of building owners and users. Building owners and users must comprehend that responding effectively to this energy challenge is in their best interest. This understanding is underscored by the realization that the energy performance of their assets significantly impacts their value. Hence, there is a need to incentivize building owners and users positively with compelling arguments and inspirational examples. As a building and business park manager, they can play a pivotal role. Their expertise, network, and building portfolio are instrumental for conducting feasibility studies, piloting cases, and carrying out relevant field trials. Quares and Jade Synergies aim to actively contribute to establishing such energy communities by offering energy services as a service.(Quares, 2021). Therefore, these kinds of industry partners and network formation can also be considered as elements of the energy community niche.

These active networks play a pivotal role in stimulating the empowerment of energy communities by fostering knowledge sharing, resource allocation, and improved communication channels. They provide the necessary support structure for energy communities to thrive, adapt to changing circumstances, and effectively contribute to the energy transition.

Indicator analysis of network formation

An indicator analysis has been conducted on networks formed as a result of energy communities being established and empowered in Flanders, based on the indicator classification provided by (Kamp & Vanheule, 2015):

Learning Hub (Learning Network within Flux50):

- - *Network Composition:* The Learning Hub within Flux50 is a platform for various stakeholders and energy community managers to share insights and knowledge. It promotes a diverse network composition aimed at facilitating cooperative networks.
- - *Quality of the Sub Networks:* The active participation of energy community managers and stakeholders in the Learning Hub contributes to the quality and robustness of the network within Flux50. It enhances niche development by sharing best practices.
- - *Network Interactions:* The Learning Hub encourages interactions and knowledge sharing among energy community managers and stakeholders, fostering collaboration and cooperative networks.
- - *Network Alignment:* The Learning Hub helps align the vision and strategies of actors within the niche with the overall niche development goals, as it facilitates knowledge exchange and learning experiences.

Collaboration with REScoop EU and REScoop Flanders:

- - *Network Composition:*Energy communities in Flanders collaborate within networks such as REScoop EU and REScoop Flanders. These collaborations result in network compositions that extend beyond the local niche, connecting energy communities to a broader network of cooperative initiatives.
- - *Quality of the Sub Networks:*Collaborating with established networks like REScoop EU and REScoop Flanders contributes to the quality of the sub-networks. These networks offer expertise and resources that enhance niche development.
- - *Network Interactions:* Collaboration with REScoop EU and REScoop Flanders encourages interactions with other cooperative initiatives, leading to knowledge sharing and coordinated efforts in promoting renewable energy.
- - *Network Alignment:* These collaborations align the vision, expectations, and strategies of energy communities with those of cooperative networks, fostering a shared commitment to renewable energy and cooperative development.

Collaboration with Local Authorities (Transfo Zwevegem Project):

- - *Network Composition:* Energy communities sometimes collaborate with local authorities, as seen in the Transfo Zwevegem project. This collaboration involves a network composition that combines local government, intercommunal organizations, and provincial entities.
- - *Quality of the Sub Networks:* The involvement of multiple stakeholders in projects like Transfo Zwevegem enhances the quality of sub-networks. It leverages the expertise and resources of various partners to drive niche development.
- - *Network Interactions:* Collaborations with local authorities facilitate interactions among different stakeholders, enabling the collective development of renewable energy projects.
- - *Network Alignment:* Collaborations with local authorities align the energy community's vision and strategies with the broader sustainability and energy goals of the region. This alignment reinforces the commitment to niche development and clean energy.

Collaboration with Industry Partners (Quares and Jade Synergies):

- - *Network Composition:*Collaborations with industry partners like Quares and Jade Synergies represent a network composition that involves private sector entities. These industry partners play a crucial role in supporting energy community development.
- - *Quality of the Sub Networks:*The involvement of industry partners enhances the quality of sub-networks by providing expertise, resources, and support for energy community initiatives.
- - *Network Interactions:* Collaborations with industry partners promote interactions between energy communities and businesses, resulting in knowledge sharing and mutual benefits.
- - *Network Alignment:* Industry partnerships align the energy community's vision and strategies with industry-specific knowledge and practices, contributing to the growth of renewable energy projects and sustainable energy management.

These network formations and collaborations demonstrate the multifaceted nature of energy community development in Flanders, where various networks are formed and contribute to niche development through different indicators of network formation. These networks play a crucial role in fostering knowledge exchange, resource sharing, and alignment of strategies for successful energy community empowerment.

In exploring the network formation between energy communities and other actors in Flanders' energy sector, a complex and interconnected landscape emerges, characterized by diverse collaborations and partnerships. The insights gained from the results provide a comprehensive understanding of how these networks contribute to the empowerment and development of energy communities in the region.

One prominent observation is the existence of cooperative networks, exemplified by collaborations within REScoop Flanders, REScoop EU, and other cooperative platforms. These networks serve as vibrant hubs for knowledge exchange, experience sharing, and collective advocacy for favorable climate policies. The pooling of resources and experiences within these networks enables energy communities in Flanders to navigate regulatory complexities effectively and amplify their impact on regional energy policies. This cooperative model is not just about individual communities; it extends to a broader, collaborative effort that enhances the collective influence of energy communities in shaping sustainable energy practices.

Additionally, the collaboration with Energy Houses, local entities focusing on energy efficiency and sustainability, represents a strategic partnership that strengthens the support system for citizens interested in joining energy communities. Energy Houses provide valuable expertise and resources, fostering an environment where energy communities can expand their reach and impact. This collaboration underscores the importance of local-level support structures in bolstering the growth and influence of energy communities in Flanders.

The engagement with local authorities emerges as a critical aspect of network formation. Recognizing local authorities as gateways to citizens, farmers, and industries, energy communities in Flanders actively collaborate with them. These partnerships extend communication channels, facilitate outreach to a broader audience, and empower local authorities to mobilize citizens and foster partnerships with external stakeholders. The collaboration with local authorities becomes a cornerstone for the dissemination of information, the mobilization of resources, and the establishment of partnerships, contributing to the overall success of energy communities.

Industry partnerships, particularly with regional development organizations like Quares, demonstrate the expansion of energy communities into industrial sectors. Collaboration with industry partners not only brings about sector-specific knowledge and practices but also provides access to expertise and resources necessary for large-scale renewable energy projects. The engagement with organizations like Quares goes beyond mere support; it exemplifies a commitment to balancing the supply and demand of energy at the local level, a crucial aspect of the energy transition in Flanders.

The establishment of a learning hub within Flux50 further accentuates the collaborative nature of network formation. This learning network serves as a platform for stakeholders and energy community managers to share insights and lessons learned. Active participation in such a learning network contributes to the quality and robustness of the network within Flux50, fostering interactions and aligning the vision and strategies of actors within the niche with overall niche development goals.

Furthermore, real-world examples, such as the Transfo Zwevegem project, showcase how energy communities in Flanders collaborate with local authorities and multiple stakeholders to revitalize sites and integrate sustainability and renewable energy dimensions. These collaborative initiatives, as seen in projects like Transfo Zwevegem, serve as living labs, experimenting with renewable energy concepts and engaging citizens in the energy transition actively.

The indicator analysis reinforces these observations, providing a structured lens through which to understand the network formations. The learning hub within Flux50, collaborations with REScoop EU and REScoop Flanders, partnerships with local authorities, and engagements with industry partners all exhibit varying network compositions, qualities of sub-networks, levels of network interactions, and alignment with overarching niche development goals.

In conclusion, the network formation between energy communities and other actors in Flanders is a dynamic and multifaceted process that significantly contributes to the empowerment and growth of energy communities. These networks serve as vital conduits for knowledge sharing, resource allocation, and improved communication channels. They provide the necessary support structure for energy communities to thrive, adapt to changing circumstances, and effectively contribute to the energy transition in Flanders. The collaborative spirit embedded in these networks exemplifies a shared commitment to sustainable energy practices and the collective success of the energy community niche in the region.

C.The key learning processes involved in the development and scaling of energy communities in Flanders

Key learning processes involved in the development and scaling of energy communities in Flanders encompass a range of strategies and insights that are all displayed in Figure 4.8 and Figure 4.9:

Key Learning Processes	Description
Community Building and Values:	*Patience and Persistence*: Energy communities must be patient and persistent in the early stages of development as projects may take time to gain traction and develop. Long-term commitment is crucial.
	Clear Vision and Cooperative Values: Having a clear vision and adhering to cooperative values serve as guiding principles for energy communities. These values help keep the organization focused on its core mission.
	Member-Centric Approach: Energy communities should prioritize the needs and expectations of community members in decision-making to ensure continued relevance and responsiveness.
	Building Strong Networks: Maintaining strong networks, both within the community and with external stakeholders, is essential for support, expertise, and collaboration.
	Engagement with External Stakeholders: Collaborating with external stakeholders, including consultancy firms and EU projects, provides valuable insights, expertise, and support, enhancing the impact of energy communities.
Regulatory and Legislative Understanding:	*Legislative Interpretation*: Energy communities need to understand and interpret energy-related legislation to navigate legal complexities, compliance, and regulation.
	Navigating Legislative Variations: Navigating and comprehending the different legislative requirements for renewable energy projects in various regions are essential for successful implementation.
Collaboration and Knowledge Sharing:	*Collaborative Learning*: Energy communities benefit from informal learning networks, where they share experiences, challenges, and solutions with each other to fine-tune their operations and overcome obstacles more effectively.
	Learning from Existing Energy Communities: Learning from existing energy communities provides valuable insights and best practices for the development and growth of new ones.
	Knowledge Sharing and Collaboration: Knowledge exchange and collaboration among energy communities help drive innovation and influence larger climate and social goals.
	Lessons Learned and Best Practices: Sharing lessons learned allows energy communities to improve their operations and learn from both successful and unsuccessful experiences.
Business Development and Sustainability:	*Business Case Development*: Developing a strong business case is essential for attracting investments and participants by demonstrating the financial advantages and social benefits of energy communities.
	Sustainable Business Models: Energy communities should explore sustainable business models that don't rely solely on subsidies. Government intervention can help create favorable market conditions.
	Case Development for CO2 Neutrality: Cases for achieving CO2 neutrality through multifaceted approaches are developed, emphasizing long-term renewable energy goals.
Social Inclusion and Vulnerable Groups:	*Secure Energy Access for Vulnerable Groups*: Energy communities focus on ensuring that renewable energy access is available to all, especially vulnerable segments of society.

Figure 4.8: Key learning processes involved in the development and scaling of energy communities

	Addressing Energy Poverty: Collaboration with energy poverty organizations is used to address social impact and energy justice, especially during times when schools are closed.
	Inclusive Targeting of Different Audience Segments: Energy communities target various audience segments like schools and aggregations of schools to promote energy communities.
Network Expansion and Scaling:	*Reducing Entry Barriers*: Understanding the challenges and barriers associated with different forms of energy sharing and simplifying entry processes to encourage greater participation.
	Phased Implementation: A phased approach to energy sharing and peer-to-peer selling allows for gradual learning and development, building momentum for energy community adoption.
	Utilizing European Programs: Exploration of European programs to support and encourage the growth of energy communities within specific sectors.
Stakeholder Management and Engagement:	*Stakeholder Engagement*: Learning how to effectively engage various stakeholders, including citizens, industries, and governmental organizations, to involve them in energy initiatives.
	Managing Lobbying Perspectives: Balancing varying interests and lobbying efforts within energy communities to ensure a balanced and inclusive energy transition.
	Government Oversight: Recognizing the crucial role of governments in overseeing and regulating the energy community sector to prevent monopolization and ensure widespread benefits.
	Long-Term Perspective: Acknowledging the importance of addressing market failures and adopting a long-term perspective for a successful energy transition beyond short-term profits.
Transparency and Credibility:	*Transparency and Credibility*: Focusing on transparency, communication, and credibility to meet stakeholder expectations and grow networks.
	Information Exchange and Sharing: Initiatives like newsletters and information sharing keep stakeholders informed about the latest developments in the energy community sector, promoting growth and empowerment.

Figure 4.9: Key learning processes involved in the development and scaling of energy communities

These key learning processes facilitate the development, adaptation, and scaling of energy communities in Flanders. By sharing knowledge, collaborating with partners, and tailoring solutions to specific contexts, energy communities can effectively contribute to the transition to clean and sustainable energy sources.

Indicator Analysis of Key Learning Processes

As stated by (Kamp & Vanheule, 2015), and displayed in Figure 2.6, the indicators of the above-mentioned key learning processes involved in the development and scaling of energy communities in Flanders, have been analyzed as below:

Community Building and Values: - *Technical Development and Infrastructure:* Energy communities learn about the technical aspects of energy projects, including the design specifications, technology infrastructure, and complementary technologies required for effective community energy generation and distribution. - *Social and Environmental Impact:* Learning about the impact of renewable energy projects on safety, the environment, and energy consumption is an integral part of community building and values. It involves understanding the social and environmental consequences of energy choices. - *Development of the User Context:* Energy communities must engage in the learning process of understanding end-user characteristics, their requirements, barriers to technology adoption, and the meanings they attach to renewable energy technologies. This is essential for tailoring services to meet user needs.

Regulatory and Legislative Understanding: - *Government Policy and Regulatory Framework:* Energy communities engage in the learning process of understanding government policies and the regulatory framework, which is relevant for the dissemination of renewable energy. They need to comprehend the institutional structures and incentives provided by government authorities.

Collaboration and Knowledge Sharing: - *Collaborative Learning:* Energy communities actively participate in collaborative learning networks, sharing experiences and knowledge. This promotes the technical development and infrastructure learning by fine-tuning operations and overcoming obstacles effectively. - *Learning from Existing Energy Communities:* Learning from existing energy communities contributes to the technical development and infrastructure by providing insights and best practices. - *Knowledge Sharing and Collaboration:* Collaborative learning networks facilitate knowledge exchange, which influences the technical development and infrastructure, as well as other aspects of energy community development. - Lessons Learned and Best Practices: Sharing lessons learned contributes to learning about the technical aspects of energy projects and helps refine practices.

Business Development and Sustainability: - *Appropriate Business Models:* Energy communities engage in the learning process of exploring appropriate business models that support the technical and infrastructure development by creating favorable market conditions. - *Sustainable Business Models:* Understanding and implementing sustainable business models ensures the long-term sustainability of the energy community and its technical infrastructure. - *Case Development for CO2 Neutrality:* Learning about the development of cases for CO2 neutrality involves understanding the technical requirements for achieving renewable energy goals and minimizing environmental impact.

Social Inclusion and Vulnerable Groups: - *Social and Environmental Impact:* Energy communities learn about the social and environmental impact of their projects, especially in terms of energy justice and inclusion. This understanding influences how they design their technical infrastructure and services to address the needs of vulnerable groups.

Network Expansion and Scaling: - *Technical Development and Infrastructure:* Reducing entry barriers and using phased implementation strategies involves learning about the technical and infrastructure requirements necessary for scaling energy communities. - *Appropriate Business Models:* The exploration of European programs for scaling energy communities influences business models and the development of technical infrastructure.

Stakeholder Management and Engagement: - *Government Policy and Regulatory Framework:* Energy communities engage in the learning process of understanding government policies and regulatory frameworks, which is relevant for effective stakeholder management and engagement.

Transparency and Credibility: - *Transparency and Credibility:* Focusing on transparency, communication, and credibility involves learning about effective ways to convey technical and environmental information to stakeholders, contributing to technical development and infrastructure learning. - *Information Exchange and Sharing:* Initiatives like newsletters and information sharing help disseminate knowledge about technical developments and infrastructure enhancements to stakeholders, promoting growth and empowerment.

These learning processes are interconnected and contribute to the development and scaling of energy communities in Flanders, with a focus on the technical, social, environmental, and regulatory aspects of energy projects.

Certainly, let's customize the concluding text to specifically highlight the insights and takeaways in the context of Flanders:

The exploration of key learning processes involved in the development and scaling of energy communities in Flanders unveils a nuanced tapestry of strategies and insights crucial for their success in this regional context. These processes, spanning community building and values, regulatory and legislative understanding, collaboration and knowledge sharing, business development and sustainability, social inclusion and vulnerable groups, network expansion and scaling, stakeholder management and engagement, and transparency and credibility, lay the foundation for the growth and adaptability of energy communities in Flanders.

One compelling insight is the emphasis on community building and values, a theme deeply rooted in the unique characteristics of Flanders. The importance of patience and persistence underscores the region's commitment to sustainable energy initiatives, acknowledging the necessity for a steadfast, long-term approach. The clarity of vision and adherence to cooperative values align seamlessly with the region's cooperative ethos, guiding energy communities to stay focused on their core mission. The member-centric approach resonates with the close-knit communities in Flanders, emphasizing the priority of community needs in decision-making for sustained relevance and responsiveness. Building strong networks, both within the community and externally, reflects the collaborative spirit ingrained in Flanders, providing crucial support, expertise, and collaborative opportunities. Engagement with external stakeholders, including consultancy firms and EU projects, reflects Flanders' openness to external collaboration, enriching energy communities with diverse insights and support.

In the realm of regulatory and legislative understanding, Flanders' energy communities showcase a keen awareness of the regional landscape. Navigating the intricacies of energy-related legislation and comprehending the variations in legislative requirements across different regions underscore the region's commitment to a well-informed and compliant approach.

Collaboration and knowledge sharing emerge as vital components deeply intertwined with Flanders' culture. Collaborative learning networks, knowledge exchange, and learning from existing energy communities become channels for fine-tuning operations and fostering a culture of continuous improvement. The emphasis on sharing lessons learned, both successful and unsuccessful, aligns with Flanders' pragmatic and adaptive approach to challenges.

In the sphere of business development and sustainability, the region showcases a pragmatic stance. The development of a strong business case aligns with Flanders' focus on practicality and demonstrating tangible benefits. The exploration of sustainable business models, distinct from sole reliance on subsidies, resonates with the region's emphasis on self-sufficiency and market viability.

Social inclusion and addressing vulnerable groups echo Flanders' commitment to equity. Ensuring secure energy access for vulnerable segments and collaborating with energy poverty organizations underline the region's dedication to social impact and energy justice. The inclusive targeting of diverse audience segments, such as schools, reflects Flanders' commitment to broad accessibility.

Network expansion and scaling strategies reflect a deep understanding of Flanders' specific challenges and opportunities. The nuanced approach to reducing entry barriers and phased implementation aligns with the region's preference for gradual, well-calibrated initiatives. The utilization of European programs resonates with Flanders' openness to international collaboration for growth.

Stakeholder management and engagement strategies demonstrate a balanced approach tailored to Flanders' unique dynamics. Effective engagement with various stakeholders, recognition of government oversight, and the adoption of a long-term perspective align with Flanders' commitment to inclusive governance and sustainable transitions.

Transparency and credibility, as identified in the learning processes, become paramount in Flanders' context. Focusing on transparency, communication, and credibility aligns seamlessly with the region's values of openness and trust. Initiatives like newsletters and information sharing become powerful tools for disseminating knowledge and promoting growth in Flanders.

The indicator analysis further reinforces these insights, providing a structured lens to understand how learning processes in community building, regulatory understanding, collaboration, business development, social inclusion, network expansion, stakeholder management, and transparency and credibility are interconnected and contribute to the development and scaling of energy communities in Flanders.

In conclusion, these key learning processes form a dynamic and interconnected framework tailored to Flanders' unique characteristics, facilitating the development, adaptation, and scaling of energy communities. By prioritizing community values, understanding the regional regulatory landscape, fostering collaboration, and tailoring solutions to Flanders' specific context, energy communities can effectively contribute to the transition to clean and sustainable energy sources in this distinctive and vibrant region.

4.5. Niche development of community energy

After analyzing the key niche characteristics of energy communities in Flanders and their potential contribution to the social and economic prosperity of the region and its citizens, the barriers and obstacles hindering the better development of this niche concept towards a sustainable energy transition of Flanders have been identified. This section elaborates on the current challenges that different stakeholders are facing. Later on, the Key Insights derived from the Application of the SNM Framework considering the mentioned challenges in the case study will be summarized.

In order to advance the growth and prosperity of energy communities across diverse dimensions, it is imperative to discern the pivotal challenges encountered by various energy communities, particularly those encompassed within the selected pilot cases in Flanders. Furthermore, it is essential to recognise the challenges confronting other pertinent stakeholders in the region of Flanders. These stakeholders include, but are not limited to, Distribution System Operators (DSOs), governmental bodies, and additional networks that assume a critical role in the sustenance and progressive evolution of energy communities within Flanders.

Upon the completion of comprehensive data collection and analysis, a compilation of noteworthy challenges obstructing the path to the specialised development of these energy communities can be delineated as follows:

4.5.1. Challenges and Barriers

Common Challenges for Energy Communities/cooperatives in Flanders:

- 1. Complex Regulatory Environment: Energy communities operate in an intricate and constantly evolving regulatory landscape. Regulations governing energy sharing, ownership, and participation often involve technical calculations and time constraints that can be challenging for energy communities to navigate effectively.
- 2. Competition for Land: Acquiring suitable land for renewable energy projects, particularly wind projects, poses a significant challenge. Energy communities often compete with commercial players who can afford to pay high land acquisition costs. One suggested solution to address this challenge is including participative criteria in tenders, enabling energy communities to participate in projects.
- 3. Public Opinion and Awareness: While energy communities primarily aim to benefit society and promote sustainable energy practices, they often face challenges in convincing the public about the benefits of their cooperative model. Overcoming public scepticism and ensuring that communities can effectively communicate the advantages of their initiatives to the broader public is crucial for their success.
- 4. Business Case Viability: A significant challenge is establishing a positive business case for energy communities. While their primary goal is societal benefit, participants in energy communities are also interested in the financial aspect. The modest difference between what participants pay for energy and what they receive for energy injection can make it challenergy to justify the costs associated with setting up and managing an energy community.
- 5. Legislative Variations: Different regions in Belgium, including Flanders, have varying definitions and requirements for energy communities. This legislative variation creates complexity and uncertainty for energy communities when setting up and operating their initiatives. Clear and consistent regulations across regions would simplify energy community development.
- 6. Participant Knowledge Gap: Many participants in energy communities lack a deep understanding of the complex legislation surrounding energy sharing and peer-to-peer selling. This knowledge gap results in basic questions and difficulties in implementing and managing energy communities. Bridging this knowledge gap adds extra costs to community facilitation.
- 7. Administrative Burden: The administrative requirements for registering energy communities and fulfilling regulatory criteria can be overwhelming. The paperwork and procedures can deter

potential energy community initiatives, requiring them to allocate significant resources to compliance.

- 8. Definition and Objectives: The definition and objectives of energy communities can be ambiguous, particularly concerning the inclusion of industries. Clarifying the mission and purpose of these communities is essential to ensure that their initiatives align with both local and European energy goals.
- 9. Evolution of Legislation: The energy sector is subject to evolving legislation at both regional and European levels. These legislative changes necessitate ongoing adaptation by energy communities to ensure that they remain compliant and can operate effectively in changing regulatory environments.
- 10. Transaction Costs: As emphasised by the VVSG (The Association of Flemish Cities and Municipalities), transaction costs related to various aspects of energy community operations, such as energy sharing, acquisition, onboarding, membership management, outreach, and go-to-market efforts, pose a significant challenge. These challenges arise from the evolving energy market dynamics and global energy crises, and they require a clear vision and understanding of organisational roles in the energy transition context.

Challenges Specific to DSO (Fluvius):

- 11. Grid Fee Reduction and Grid Benefits: The distribution system operator (DSO), Fluvius, faces the challenge of reducing grid fees for energy communities to align with genuine grid benefits. Ensuring that any reductions in grid fees correspond to real benefits for the grid is essential to prevent unfairly shifting costs onto non-participants.

Challenges Specific to VEKA (Flemish Energy and Climate Agency):

- 12. Legislation Understanding: VEKA, as an organisation, must ensure a comprehensive understanding and interpretation of the complex legislation related to energy communities. This understanding is crucial to providing accurate guidance and support to stakeholders who may have questions or need assistance navigating the regulatory landscape.
- 13. Administrative Complexity: Handling the administrative complexities of registering energy communities and guiding them through the process is a significant challenge. The administrative requirements can be time-consuming and daunting for potential energy community initiatives, making support and simplification efforts crucial.
- 14. Defining Objectives: Determining the objectives of energy communities, especially concerning the potential participation of industries, presents a challenge. Clarifying the mission and purpose of these communities is vital to ensure that they align with local and European energy goals and effectively address energy challenges.
- 15. Legislative Changes: VEKA needs to anticipate and adapt to legislative changes in the energy sector, which can impact the framework and operation of energy communities. Staying vigilant and responsive to evolving regulations is essential to enable energy communities to thrive in Flanders.

These challenges collectively illustrate the intricate and multifaceted nature of the energy community landscape in Flanders. Addressing these challenges requires collaboration among stakeholders, including energy communities, regulatory authorities, distribution system operators, and organisations like VEKA, to create an environment where sustainable energy initiatives can flourish. Overcoming these obstacles is vital to realising the potential benefits of energy communities for both the environment and society.

4.5.2. Key Insights from the Application of SNM Framework

Based on an external scientific analysis of the application of the Social Niche Management (SNM) framework to the selected pilots in the Flanders region, several key insights and challenges have emerged. Here are the relevant findings from the data:

1. Defining the Community Energy 'Niche' in Flanders: The analysis identified that energy communities in Flanders exhibit a dynamic interplay of expectations among their members and interactions with external stakeholders. These expectations can be classified based on the SNM framework's indicators: - *Cost Savings:* Internal expectations related to the quality and affordability of renewable energy services within the community. - *Environmental Concerns:* A combination of internal and external expectations, where both members and external stakeholders have an interest in promoting clean energy. - *Community and Social Aspects:* Endogenous expectations influenced by the network composition and interactions among current community members.

2. Network Formation between Energy Communities and Other Actors: Various networks and collaborations have emerged to support energy communities in Flanders. These networks serve as a crucial component of niche development. Some examples include the Learning Hub within Flux50, collaborations with REScoop EU and REScoop Flanders, and partnerships with local authorities and industry partners. These networks contribute to the development of energy communities in different ways and align with SNM indicators of network formation.

3. Key Learning Processes Involved in Energy Community Development: The analysis highlighted key learning processes that play a significant role in the development and scaling of energy communities in Flanders. These processes cover a wide range of aspects, from technical development and infrastructure to regulatory and legislative understanding, collaboration and knowledge sharing, business development and sustainability, social inclusion and vulnerable groups, network expansion and scaling, stakeholder management, transparency, and credibility. These learning processes are essential for the successful growth and empowerment of energy communities.

4. Challenges and Barriers: The research identified a series of common challenges faced by energy communities in Flanders. These include navigating a complex regulatory environment, competition for land acquisition, addressing public opinion and awareness, ensuring the viability of the business case, and dealing with legislative variations. Moreover, the specific challenges faced by key stakeholders, including Distribution System Operators (DSOs) and the Flemish Energy and Climate Agency (VEKA), were also highlighted. These challenges underscore the need for comprehensive solutions and clear legislative frameworks to support the growth of energy communities.

5. Importance of Collaboration: The analysis emphasizes the need for collaboration among various stakeholders, including energy communities, regulatory authorities, DSOs, and organizations like VEKA. Collaborative efforts are essential to overcome the identified challenges and create an enabling environment for sustainable energy initiatives to thrive in Flanders.

The application of the SNM framework to the case study of energy communities in Flanders has provided valuable insights into their dynamics, the networks they form, the learning processes they engage in, and the challenges they face. These insights can be used as a foundation for further research and policy development to support the growth of energy communities in the region.

In the following sections, the insights from the SNM analysis and the challenges faced by stakeholders and selected pilots of energy communities will be used to discuss the concept of scaling the energy community niche through various types and approaches. Additionally, the SNM analysis will provide better insights for suggestions on alterations and improvements in the policy and regulatory environment of energy communities in the Flanders region.

4.6. Scaling the community energy niche

After applying the SNM framework to the energy community niche in Flanders, valuable insights were gathered about its potential social and economic benefits and how it impacts the regime. In this section, the concept of scaling this niche innovation from various approaches will be explored. Live and ongoing examples from the Flanders region will also be used to illustrate the points.

In the last section of chapter 2, the discussion explores the concept of scaling niches, with a particular focus on scaling the community energy niche in Flanders. The study applies this concept to the mentioned case study and uses qualitative data analysis of interviews to understand how stakeholders involved in the empowerment of energy communities in the Flanders region perceive the need and typology of scaling. The literature on the application of the scaling concept and its position within the SNM framework on the energy community niche is summarized first. Then, the typology analysis of scaling is applied to the case study. Additionally, insights are provided into the merging and not-merging of energy communities on a larger (provincial) level, and a discussion ensues around this topic. Following that, the discussion delves into the Shielding and Nurturing Energy Communities Niche, analyzing their Future Perspectives in that region. Furthermore, this section is followed by Suggestions for improvements to the policy and regulatory landscape based on the insights provided by the interviewed stakeholders.

In their research on Sociotechnical Niche Management (SNM), (Naber et al., 2017) identify four ways of scaling: growing, replication, accumulation, and transformation. These four scaling types can be developed into a typology.

Growing refers to experiments that become bigger or more active as more actors participate or as market demand increases. **Replication** happens when the main concept of an experiment is used in other locations. When the experiment is replicated in other geographical locations or contexts, local knowledge of the initial experiment can be used. For example, in 2020, the Belgian City of Bruges adopted “Buurkracht”, an approach developed and tested in the Netherlands, to encourage sustainable heating investment by households using a neighbourhood ambassadors approach.

Accumulation means that an experiment gets linked to other experiments. In this process, intermediary organizations facilitate interaction between experiments that exist simultaneously. This is important because when the lessons learned in experiments at different locations are compared and aggregated, the experiments can contribute to a more stable technological trajectory at the global niche level (Geels & Raven, 2006).

Finally, **transformation** refers to the levels in the Multilevel Perspective (MLP) (Raven, 2007). It means that the experiment shapes wider institutional change in the regime selection environment (Smith & Raven, 2012). A graphical depiction of the four scaling types within niche development is presented in Figure 4.10.

In their study, (Naber et al., 2017) analyzed the scaling of a smart grid innovation program that involved four experimental projects, some of which had energy cooperatives involved. The study applied four types of scaling and found that building broad and deep social networks is crucial for growth and replication. Additionally, articulating and sharing expectations is important for replication, and broad and reflexive learning processes are critical to transformation and replication.

Another study conducted by (Bauwens, 2019) analyzed the scaling of community energy cooperatives in the Flanders region of Belgium. The study found that scaling strategies and the orientations toward mutual or general interests of cooperatives are reflected in a set of strategic choices such as the type of renewable energy sources and positions in the energy supply chain. These choices are also influenced by the behaviour of other cooperatives in the sector.

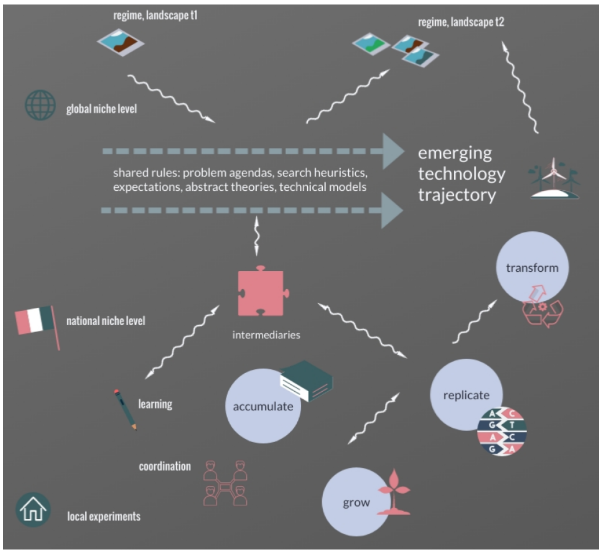

Figure 4.10: Patterns of up-scaling and the emerging technological trajectory from (Hoppe et al., 2023), adapted from (Geels & Raven, 2006) and (Naber et al., 2017).

In this section, the framework introduced by (Naber et al., 2017) is applied to the case study in the Flanders region, utilizing the four typologies of up-scaling community energy niches and considering the selected pilots. After analyzing the regime level and key elements of the Flemish energy sector, conducting a stakeholder analysis, and examining the social and economic benefits of energy communities in the Flanders region, the study proceeds to the next phase. Furthermore, the characteristics and processes of energy communities in Flanders are investigated using the SNM framework. Following an examination of the current challenges and barriers faced by the main stakeholders, the results are now utilized in the subsequent phase of the study, which involves scaling energy communities. In the upcoming paragraphs, the up-scaling typology patterns are analyzed based on the study by (Naber et al., 2017). As mentioned in chapter 2, in the "Scaling niche innovation" section of the SNM framework, there are four main typologies for the up-scaling patterns for niche innovations, namely, *"Growing," "Replication," "Accumulation,"* and *"Transformation"* Figure 2.8. The main data presented in the upcoming paragraphs are based on qualitative data collected from interviews. The perspective of (Naber et al., 2017) will be applied to these data. In addition, to better support the interviewees' statements, some literature will be provided to elaborate on specific details.

For the ***Growing*** type of scaling (The experiment continues and more actors participate, or the scale at which technologies are used increases), the example of the successful energy cooperative of Ecopwer can be mentioned here. The people of Rotselaar founded Ecopower in 1991. The Ecopower narrative began in 1985 when a watermill was purchased as a component of a cooperative housing initiative. In 2003, the General Assembly of Belgium decided to become an energy supplier in the Flanders region when the country's power market was liberalised. These days, the cooperative serves Flanders as a supplier and producer of power. Ecopower provides approximately 57,000 residents with the chance to take control of their energy supply and production thanks to its 40 employees. Recent projects include the construction of wind turbines, the production of energy from solar and hydropower, cogeneration, and a business that makes wood pellets. Together, these installations generate over 100 million kWh annually, (Cities, 2022). It is clear then that during the course of the last 3 decades, Ecopower could have a Growing pattern of scaling as a community energy niche. However, they have discussed in the interviews the importance of balancing the production of solar and wind energy with the consumption by the community. When energy production falls short and has to be shared among a growing number of people, it becomes necessary to purchase electricity from the market. This situation can be problematic, especially when market prices are high, as they were at the beginning of the previous year (2022). In fact, the organization had to cease accepting new clients due to the increasing cost of procuring electricity from the market.

The rising market prices had a negative impact on their ability to expand and undertake new projects. This limitation hindered their efforts to scale up their operations. However, Ecopower has highlighted that when market conditions improve, they can swiftly embrace new opportunities. For example, last April, they initiated a new wind project in the Antwerp region, which enabled them to accommodate an additional 3000 clients in just one month. The high demand for these spots emphasizes the community's enthusiasm for renewable energy initiatives. However, they had to halt new client admissions once again, underlining the need for a balanced and sustainable energy production-consumption framework. This is a clear example of up-scaling with a growing typology. However, this path is not linear nor straightforward and requires careful consideration.

Moreover, another type of up-scaling pattern that is happening in relation to the Ecoppower energy cooperative is a European project called Power Up (the catalyst for social innovation in the energy market). This project is intended to assist with energy poverty alleviation with the help of energy communities' empowerment. This project has different pilots in the European Union. The POWER UP project will encourage the growth of local businesses with a socio-ecological agenda in the energy market. The rationale for this is that energy poverty may be addressed, and local energy services can be rendered. These social entrepreneurs will work with low-income households to jointly develop new business plans centred on energy efficiency and renewable energy production. Pilot projects will be developed in six European towns, ranging from North Macedonia to Spain.

Six European cities—Eeklo, Belgium; Heerlen, Netherlands; Valencia, Spain; Skopje, North Macedonia; Campania, Italy; and the Czech Republic—will be the sites of Energy Cities' pilot programme execution. (Cities, 2023). In order to define and implement the best social business model, project partners will innovate by enlisting the help of energy-poor households and local stakeholders (cities, social groups, energy utilities, citizen energy communities, etc.). This could affect 55,588 energy-poor users and result in investments in sustainable energy before the project's conclusion of at least EUR 2.5 million, (Cities, 2023). This example of activity is clearly a ***Replication*** type of up-scaling pattern of the Energy community niche. The reason for that lies within the definition of the Replication type of up-scaling patterns, which is that the main concept of the experiment is replicated in other locations or contexts where it is happening in this case. This concept of using energy community niches in order to assist with energy poverty alleviation and run the same concept in different geographical cases (pilots) is clearly a Replicative way of up-scaling the energy community niche. This action for the pilot in Flanders is taken by the Ecopower Energy Cooperative. Ecopower discusses a unique approach to promoting community participation in renewable energy initiatives, specifically focusing on a wind turbine in the city of Eeklo. In this innovative model, the city itself invests 1% in the wind turbine, which translates to €30,000. This investment is then leveraged to create social shares for people facing energy poverty.

The city of Eeklo channels its investment to provide up to 100 households struggling to pay their energy bills with shares in EcoPower, a green energy provider. These shares are financed by the city of Eeklo, enabling these households to become EcoPower clients right from day one. However, instead of having to pay the full €250.00 for a share upfront, these clients are offered a more accessible repayment plan.

Each month, they contribute €3.00 towards repaying the €250.00 cost of a share over a period of 6 years. This approach makes it more feasible for people experiencing financial difficulties, as the full €250.00 may be a significant burden. Even when the cost is spread over several months, it can be financially challenging for those in poverty.

The benefit of this model is clear: the electricity costs for these households can be reduced significantly, often halving their expenses compared to traditional energy providers. By making cooperative participation more accessible to those with financial constraints, this model helps to address energy poverty while promoting green energy adoption.

Ecopower also emphasizes the potential for expanding this model to different cities in Flanders. If successful, it can become a powerful tool to increase accessibility to renewable energy and simultaneously address financial challenges for vulnerable populations, making it a win-win solution for the community and the environment.

Furthermore, other types of up-scaling patterns are also taking place among the selected pilots and case studies within the Flanders region of this study. For instance, as mentioned by the coordinators at the ECoOB energy community (EnergieCoopratie Oost-Brabant) ECoOB, the City of Leuven, and Kelvin Solutions are building an innovative heating network on the Marie Thumas site. On the site of the old Marie Thumas canning factory on the Leuvense Vaart, the city of Leuven, Revive, Kelvin Solutions, and ECoOB are starting a pilot project for a heating network in which they will use aquathermal, geothermal and solar energy together in a smart way. The combination of energy from water, soil, air and sun must ensure that the entire environment can be heated and cooled in a climate-neutral manner. This is a first in Flanders. This groundbreaking technological concept offers potential for the rest of the city and is an important link in Leuven's climate-neutral ambition by 2030. This kind of action is a ***Accumulation*** (Experiments are linked to other initiatives) type of scaling pattern in relation to the energy community niche in that area. The significance of this accumulation pattern lies in the fact that it links and aggregates the experiences, knowledge, and technologies developed in these experiments. By comparing and sharing lessons learned from different locations and projects, a collective body of expertise is formed. This accumulation of knowledge and experience contributes to a more stable and well-developed technological trajectory at a global niche level in the field of energy communities.

In essence, the accumulation pattern signifies the interconnectedness of experiments and projects within the niche, aiming to create a network of shared knowledge and resources that can drive the development and adoption of sustainable energy solutions, as exemplified by the innovative heating network in Leuven.

Scaling concept through the SCCALE 203050 Project

This research aimed to support the SCCALE 203050 Project, which was explained in detail in section 2.4. The project, which is funded by the EU, is focused on implementing the Scaling concept in its study pilots. SCCALE intends to bring Europe closer to its citizens by promoting the creation of energy communities and utilizing the favorable EU legal framework on citizen energy. The project's goal is to establish a minimum of 26 energy communities, initiate the formation of 34 community projects, and develop a comprehensive methodology for creating energy communities that can be replicated in Europe and beyond. The methodology will be tested and validated in five pilot communities located in Belgium, the Netherlands, France, Greece, and Croatia, ("SCCALE 203050", 2023). Within the SCCALE project, their main focus is on the *Replication* type of scaling. Since, they are using a Scaling-Across type of strategy which is basically, the same concept of replication type of scaling (as proposed by (Naber et al., 2017)), diffusion by other actors, and adoption rather than organisational control.

One of the primary goals of the SCCALE project, numbered 203050, is to help Energy Communities, particularly Renewable Energy Communities, to improve their ability to track and accelerate their progress. This implies making evaluation and monitoring practices easier, which is crucial to clarify the different stages of change in the energy communities' niche. In the SCCALE project, they used the approach of (Seebauer et al., 2022) towards the development of the maturity scale. This approach is based on the stages of change framework to explain the development of community energy initiatives and is extended to collective action. Within the SCCALE project these proposed stages were changed into inspiration, preparation, implementation, and operation (Hoppe et al., 2023). Within the final stage, operation, this replication concept (as described previously) happens as in assuring the replication of the SCCALE project pilots in other locations of the European Union. In order to monitor the operation stage, they use their Development Progress Tool can be used to track and monitor both the Energy communities' own projects as well as potential replication site projects (to which good practice of the REC is scaled-out) (Hoppe et al., 2023).

4.6.1. Niche Empowerment

As previously mentioned, a crucial aspect discussed in more recent literature and linked to the conceptualization of scaling-up is ***niche empowerment*** (Smith & Raven, 2012). Through these processes, specialised innovation is able to challenge the status quo. *A) Fit and conform and B) stretch and transform* are the two primary tactics used by important niche players for niche empowerment, according to (Smith & Raven, 2012). The primary objective of the first is to show that specialised innovation may be seamlessly incorporated into the current system without significantly altering the markets, institutions, infrastructures, or foundational knowledge (R. Raven et al., 2016). The second, on the other hand, seeks to alter the game's rules by reshaping organisations and establishing new sustainability standards.

In our case study and throughout the data collection phase, an intriguing topic emerged during the series of semi-structured interviews. This topic revolved around the question of whether the consolidation of smaller energy communities with the already established larger ones, which boast a greater number of members, investments, and overall scale at a provincial level in the Flanders region, constitutes a beneficial proposition or not, basically, matter of ”Balancing Autonomy and Scale”.This discussion points to a significant consideration in the realm of niche empowerment, particularly in the context of energy communities. The idea of some of the actors was merging small energy communities into the provincial level, basically scaling them from the size perspective rather than scaling the number of these communities.

This question raises the broader issue of how niche innovations can fit and conform within the existing energy regime. Specifically, it delves into whether the integration of smaller energy communities into larger, established ones aligns with the aim of demonstrating that niche innovation can be seamlessly incorporated into the existing energy landscape without causing significant disruption to existing markets, institutions, infrastructures, and foundational knowledge. In essence, it underscores the importance of striking a balance between innovation and compatibility with the prevailing energy ecosystem.

Merging energy communities, typically at larger regional levels, can lead to more efficient operations, streamlined decision-making, and increased impact on local energy production. It can reduce competition among communities and enhance financial sustainability.

On the other hand, some other actors stated that Maintaining smaller, localised energy communities preserves local identity, fosters strong community engagement, and allows for flexibility in responding to local needs. It also promotes diversity in approaches. Therefore, they believed that maintaining this local identity is the main point and social benefit of building these energy communities. They also believed more in scaling energy communities from their number point of view around the Flanders region. Moreover, some actors also had a more balanced idea of finding a balance between maintaining local engagement and community spirit while achieving the necessary scale and professionalisation to make energy communities financially sustainable and capable of executing meaningful projects.

In the discussion that follows, a cost-benefit analysis will be provided by elaborating on the advantages and challenges of this empowerment method.

Explaining the Two Sides of Merging and Not Merging Energy Communities in on a provincial level in the Flanders region:

1.Merging Energy Communities (on a provincial level):

Advantages:

- Efficiency and Sustainability: Merging energy communities, especially at the provincial or regional level, can lead to more efficient and sustainable operations. Larger communities often have the resources and expertise to handle complex projects, making them financially viable in the long run.

- Streamlined Decision-Making: Larger communities may benefit from streamlined decision-making processes and economies of scale, allowing them to execute projects more swiftly and effectively.
- Increased Impact: By merging, communities can pool resources to tackle larger, more impactful projects, such as large-scale renewable energy installations. This can contribute significantly to local energy production and reduce reliance on external sources.
- Reduced Competition: Merging reduces the competition among multiple small communities, potentially improving their chances of securing funding, projects, and partnerships.

Challenges:

- Loss of Local Identity: One of the most significant concerns is the potential loss of local identity and community spirit. Merged communities might struggle to maintain the more prominent bonds and sense of ownership that smaller, local energy communities enjoy.
- Complexity: Managing a larger, merged community can be more complex, with diverse interests and priorities to consider. This complexity can slow down decision-making and project execution.
- Exclusivity: Larger energy communities might unintentionally exclude smaller, less resourceful communities, potentially leaving them without support or access to benefits.

2. Not Merging Energy Communities:

Advantages:

- Preservation of Local Identity: Smaller, localised energy communities maintain a strong sense of local identity and ownership. Members often feel more connected to the projects and their immediate surroundings.
- Community Engagement: Smaller communities often excel at engaging citizens, fostering a sense of community, and encouraging democratic participation. Members have a direct say in decision-making processes.
- Flexibility: Local communities can respond more quickly to unique local needs and opportunities. They can implement projects that align closely with the preferences and priorities of their members.
- Diversity: Maintaining a variety of energy communities allows for diversity in approaches, business models, and levels of professionalism, catering to different needs and preferences.

Challenges:

- Limited Resources: Smaller energy communities may struggle to secure sufficient resources, both financially and in terms of expertise, to tackle substantial energy projects. This can hinder their growth and impact.
- Competition: Multiple small communities operating in the same region might compete for the same projects, funding sources, or opportunities, potentially reducing the overall success rate.
- Sustainability: The financial sustainability of smaller communities can be precarious, as they may rely heavily on volunteers and struggle to generate significant revenue to support their operations.
- Administrative Hurdles: Establishing and maintaining individual energy communities can be administratively burdensome, with each community needing to navigate legal and financial complexities.

These two sides reflect the complex considerations surrounding merging or maintaining separate energy communities. Ultimately, the choice often depends on local circumstances, goals, and the willingness of communities to strike a balance between efficiency and local engagement. The decision involves complex considerations, and it may vary based on regional preferences and the desire to maintain the identity and community spirit of smaller energy communities. Ultimately, niche empowerment within energy communities in Flanders encompasses a delicate balancing act between achieving scale and preserving local engagement.

4.6.2. Shielding and Nurturing Energy Communities Niche- Future Perspectives

In chapter 1, the following research question was posed: "What future strategies can be advised for shielding and nurturing of energy communities niche in Flanders, and what insights are needed to develop those strategies?" To answer this, stakeholders in the energy sector of Flanders were interviewed and asked for their opinions on the future of energy communities in the region. Here are some key points that emerged from their responses. According to the stakeholders, policy and regulatory adaptations will play a critical role in shaping the future of energy communities in Flanders. They were curious about how changes in regulations and policies would impact the development of energy communities, recognizing that these shifts can either help or hinder their progress.

Another important trend that emerged is the emphasis on international collaboration and expansion. Based on the information from the interviews, energy communities in Flanders seek to establish strategic alliances beyond national borders, indicating a growing interest in knowledge sharing, experience transfer, and resource pooling. Additionally, stakeholders and interviewees emphasized the importance of sustainable heat solutions, particularly district heating networks, which are expected to play a significant role in achieving more sustainable and eco-friendly heating (mainly due to the instability of gas prices). For instance, as mentioned by the general coordinator of Beauvent Energy Cooperative in Ostend, there are currently two main projects related to sustainable district heating that they are in charge of. One is the Heat network Ostend, and the other is Sint-Jozef Pittem. The former is a heating network that transfers heat from a heat source via underground, insulated pipes to buildings with a heat demand. The latter had issued a tender for the supply of sustainable heating and cooling for the site. Beauvent was awarded an ESCO in January 2022. The project consists of a sustainable boiler room in which the heat generators are installed. In addition, there is a BEO field (borehole energy storage) from which heat is extracted by the heat pump for heating. This BEO field is also used for cooling in the summer.

Moreover, another aspect that was mentioned by the interviewees was Electrification. The energy market is growing, and there is an increasing need for electrification. Energy communities are exploring ways to optimize market flexibility through various strategies, such as optimizing energy consumption during peak periods, integrating energy storage solutions like batteries, and harnessing renewable energy sources to provide affordable and reliable energy for their members. For instance, in order to better maintain and nurture the usage of electric vehicles on a local and neighbourhood basis, In 2020, ECoOB installed more than 1,000 solar panels on the roof of WZC De Wingerd (Wingerdstraat 14, Leuven), which is now publicly accessible charging stations. Also, a fast charger with a capacity of 150kW.

Additionally, the stakeholders are committed to reaching a diverse range of demographics, including women, young people, and those facing energy poverty. They are also exploring the creation of a fund to support social projects linked to the energy transition. Inclusivity and social impact are core ambitions. For instance, the energy community of Klimaan in the city of Mechelen is a living example of this, which aims to help the people facing energy poverty have more reliable and affordable access to energy via building energy communities in the context of social housing.

The stakeholders in the Flanders region are aware of the urgency of the energy transition and the need to shift towards renewable energy sources. Reducing greenhouse gas emissions is a pressing concern. Effective management of the complexity introduced in the future of energy communities is important to ensure that they remain accessible and practical. During the interviews, the stakeholders mentioned that the role of the government, particularly in influencing grid fee reduction and the implementation of the Metering and Data Handling (MD) reform, is central to shaping this future. The coordinator of the

ZonneWind energy community in Voorkempen mentioned that they are collaborating with other energy communities such as Klimaan and Zuidtrant, to gain a better understanding of the market and explore the possibility of utilizing it for their future energy communities. Due to their limited resources, they are unable to manage large energy communities independently. At present, the main challenge they face is that all the tasks are performed manually. For instance, Klimaan is managing everything manually and storing all their data in Excel files, which is a time-consuming process.

Stakeholders in the energy sector in the Flemish region are observing that energy communities are expanding into emerging sectors, particularly heating communities. This expansion has the potential to introduce specialized regulations. They are also recognizing the significance of diverse energy sources such as solar, wind, bio-electricity, and rest heating to enhance versatility and resilience. The stakeholders stress the importance of maintaining the ownership and identity of individual energy communities to encourage community engagement and participation, which is a crucial factor for their success.

Moreover, during the qualitative data collection in the meetings and interviews, the stakeholders mentioned that balancing discounts on the grid and investments in infrastructure is a complex challenge that requires careful consideration in Flanders. Stakeholders emphasized the importance of establishing transparent key performance indicators (KPIs) and objective assessments to measure the societal impact of government support for these initiatives, ensuring that they provide benefits without undermining infrastructure investments. Greater flexibility and innovative solutions are expected to address regulatory and financial obstacles. This flexibility, which extends beyond energy trading to include activities such as behavioural management, differentiated charging, and backup services, is expected to offer societal benefits without compromising infrastructure investments. One of the issues that is hindering the nurturing of energy communities in Flanders is the fact that some of the energy providers charge an administrative fee of €150 per year per participant, which is extremely high, and some do not charge.

In conclusion, the general statements stemming from the interviews reveal that the future of energy communities in Flanders is a dynamic and multifaceted landscape characterized by adaptability, collaboration, sustainability, inclusivity, and a resolute drive toward renewable energy sources. The diverse perspectives stakeholders share reflect the region's unwavering commitment to sustainability, community engagement, and cooperative energy solutions. As the journey continues, it will undoubtedly entail adapting to evolving regulations, seizing opportunities for collaboration, and addressing both local and global challenges on the path to a more sustainable energy future.

To explore the shielding and nurturing concepts of the energy community niche, the future perspectives for energy communities in Flanders will be combined with the Strategic Niche Management (SNM) framework. This will be done specifically focusing on the "shielding" and "nurturing" aspects. When it comes to predicting the future of energy communities, this framework can be utilized in the following way by combining the above-mentioned aspects and categorising them in 4 main groups:

- **Creating an Enabling Regulatory Environment (Shielding):** In the context of the SNM framework, energy communities can be seen as innovative niches. One way to shield these niches is by creating an enabling regulatory environment. Government policies and regulations should provide safeguards and incentives that protect these energy communities from unfavourable market dynamics or existing energy regimes that may not be favourable to their growth. By shielding them from the challenges and pressures of the established energy sector, these communities can thrive and develop.
- **Supporting Innovation and Collaboration (Nurturing):** Nurturing energy communities within the SNM framework involves fostering innovation, collaboration, and trust among their members. This can be achieved by providing financial support, technical assistance, and opportunities for collaboration with other actors in the energy sector. By nurturing these niches, they can develop innovative solutions, adapt to changing market conditions, and remain close-knit and cooperative. The nurturing process ensures that these communities are sustainable and achieve their environmental and social objectives.

- **Balancing Interests and Investment (Nurturing and Shielding):** The SNM framework can guide policymakers in striking a balance between shielding energy communities from adverse market forces and nurturing them to ensure fairness. It involves nurturing the financial sustainability and growth of energy communities while simultaneously shielding them from competitive disadvantages. This balance is essential to maintain the viability and effectiveness of these niches while protecting them from negative external pressures.
- **Promoting Flexibility and Inclusivity (Nurturing):** SNM can be applied to promote flexibility and inclusivity within energy communities. Nurturing these niches involves encouraging them to adopt innovative technologies, business models, and solutions to address current and emerging challenges in the energy sector. Additionally, it includes ensuring that these communities are inclusive, engaging diverse demographics, addressing energy poverty, and serving social and environmental objectives.

By combining the concepts of future perspectives for energy communities in Flanders with the SNM framework, policymakers and stakeholders can better guide the development, protection, and nurturing of these niches. This approach emphasizes creating a supportive regulatory environment, supporting innovation and collaboration, and finding a balance between interests and investments to ensure the sustainability and impact of energy communities. It also encourages flexibility and inclusivity to address evolving challenges in the energy sector. And lastly, the different stakeholders within the Flemish energy sector and, more specifically, the energy communities themselves can overcome their challenges.

One remarkable initiative by the Flemish government to mention is the following: During the course of the interviews for this study, the Advisor on Climate, Energy and European policy of Kabinet Viceminister-President of the Flemish government introduced a new tool called the *”Technical Assistance Hub”*. This tool is aimed at shielding and nurturing the energy community niche in the Flanders region. Flanders has taken a pioneering move by initiating ”Technical Assistance Hubs for Energy Communities”. This is a groundbreaking endeavour that offers essential support to local governments and communities in their pursuit of establishing energy communities. The Advisor on Climate, Energy and European Affairs within the Flemish government came up with the idea of these hubs, which encompass various key features designed to empower and facilitate the energy transition at the grassroots level.

At the core of these hubs is a dedication to providing technical support, which is essential to guide communities through the intricate process of planning and executing energy projects. This includes renewable energy installations, integration of energy storage, and grid connectivity.

The initiative’s cornerstone is financial support, which offers subsidies to act as a financial springboard for communities. This effectively lowers the barriers to entry, making energy communities financially viable.

Recognizing the legal intricacies that often encircle energy projects, these hubs also provide legal assistance, helping communities navigate the complex regulatory landscape. However, inclusivity is the guiding principle here. These hubs are not just about supporting those with the means to invest but also about reaching out to individuals facing energy poverty to ensure that the energy transition leaves no one behind.

Moreover, these hubs are champions of community engagement and social cohesion. They serve as a vital bridge, connecting local governments with their communities, fostering citizen involvement in the energy transition, and strengthening the social fabric. The scope of these hubs extends beyond energy sharing alone. They encourage and enable energy communities to diversify their efforts, engaging in a spectrum of activities, from energy-saving initiatives to flexibility solutions and shared mobility programs.

Transparency is a key aspect of these hubs. They are committed to making the costs associated with energy sharing and related activities more visible, empowering consumers to make informed choices in the energy market. In its initial phase, the government will generously subsidize these hubs for the first three years. This support is crucial for assisting communities in their early stages of development.

Looking ahead, the vision is clear. These hubs aim to standardize processes and procedures, making support more accessible and replicable. This standardization paves the way for communities to professionalize and scale up their projects, ultimately driving a more widespread and impactful energy transition. With these hubs in place, Flanders is striding dynamically towards an inclusive, sustainable, and community-driven energy future.

4.6.3. Suggestions for improvements to the policy and regulatory landscape

In this chapter, the various challenges and barriers faced by stakeholders in the development and protection of energy communities were discussed. Building upon the semi-structured interviews, this section focuses specifically on policy and regulatory changes that can be made to address these challenges. The suggestions provided in this subsection are based on the opinions of interviewees and are normative-prescriptive statements aimed at improving the policy and regulatory landscape. In the context of Flanders, Belgium, and based on the insights gathered from stakeholders' discussions and semi-structured interviews, this section presents region-customized recommendations for improving the policy and regulatory landscape concerning energy community projects. These normative-prescriptive statements are rooted in the opinions and experiences of interviewees tailored to address the unique needs and challenges of the Flanders region.

Policy and regulatory improvement recommendations	Description
Regulated Administrative Fees	There is a repetitive request for regulated administrative fees charged by energy suppliers, particularly to prevent excessive charges. Flexibility should be maintained, with exemptions for individuals or small consumers with low energy volumes.
Default Metering Setting	Simplification of metering settings to make it easier for individuals to join an energy community, eliminating the need for separate requests for metering changes.
Balanced Communication	Calls for a more balanced communication strategy from the government that acknowledges both the benefits and costs of energy transition efforts.
Recognition Criteria	Clear criteria for recognizing genuine citizen-based energy communities and distinguishing them from larger corporations.
Flexible Implementation	Creation of a flexible regulatory environment that can adapt to different types of energy community models.
Streamlined Permits and Regulations	Simplifying and streamlining the permitting process and regulations for energy community initiative.
Support for Financial Models	Introduction of financial models that incentivize and make it economically viable for citizens and industries to participate in energy communities.
European Collaboration	Emphasis on collaboration at the European level to drive policy changes and ensure that energy community initiatives can thrive across borders.
Impact Assessment	Conducting thorough impact assessments when formulating policies and regulations to inform more balanced decision-making.

Figure 4.11: Policy and regulatory improvement recommendations

The Figure 4.11 argues a summary of some points of improvement and alteration for the current policy and regulatory environment around the energy community projects, proposed by the experts during the interviews. This modification to policy recommendations is all collected from the stakeholders related to these projects and the Flemish energy sector during the interviews. As the energy community niche in Flanders takes on an increasingly prominent role in the regional energy transition, the identification of key policy and regulatory improvements is paramount. These recommendations offer a road map to bolster and scale these grassroots initiatives while ensuring their efficacy and sustainability. These region-customized recommendations aim to address key policy and regulatory enhancements, ensuring their alignment with the specific characteristics of Flanders. Here are the detailed region-specific recommendations as stated by the interviewees:

1. Regulated Administrative Fees: Flanders has witnessed concerns regarding excessive administrative fees, especially for smaller energy communities. To address this issue, it is proposed that Flanders introduce regulated administrative fees charged by energy suppliers. These fees should be tailored to strike a balance between flexibility and fairness, focusing on individuals and small consumers with lower energy volumes. By doing so, these regulated fees will no longer act as barriers but rather as equitable facilitators, specifically within the Flanders context.

2. Default Metering Setting: In Flanders, streamlining administrative processes is of utmost importance. Therefore, it is suggested to establish default metering settings that eliminate the need for separate requests when joining an energy community. This streamlined approach minimizes administrative hurdles and invites more participants in Flanders to engage in these sustainable endeavours.

3. Balanced Communication: Effective communication is key to garnering public support for the energy transition in Flanders. Recommendations emphasize the need for a balanced government communication strategy tailored to the specific characteristics of Flanders. This strategy should transparently address both the advantages and costs of energy transition efforts, ensuring a well-informed public that actively participates in the Flanders energy transition.

4. Recognition Criteria: Clarity in distinguishing authentic citizen-based energy communities from larger corporations is vital for Flanders. It is recommended that Flanders establish clear recognition criteria. This ensures that smaller, community-driven initiatives in Flanders receive the support and recognition they rightfully deserve, ultimately driving the regional transition forward. The registration process for energy communities in Flanders needs further regulation to distinguish between citizen energy communities, energy cooperatives, and energy-sharing modules, each with its unique definition. Therefore, an enhanced and monitored registration procedure in Flanders is suggested to establish clear recognition criteria for these energy communities.

5. Flexible Implementation: A flexible regulatory environment in Flanders is paramount, recognizing the diverse energy community models within the region. Flanders should tailor regulations to accommodate these varied models, enhancing adaptability and inclusivity within the regulatory framework. It is recognized that in Flanders, implementation of required regulatory changes can often encounter complexities, leading to delays. Thus, a more streamlined process is recommended, acknowledging the Flanders-specific context.

6. Streamlined Permits and Regulations: Flanders should focus on streamlining the permitting process and regulations for energy community initiatives to reduce administrative burdens. This simplification expedites the development of these initiatives in Flanders, making them more accessible and encouraging participation.

7. Support for Financial Models: The introduction of financial models that incentivize citizen and industrial participation in energy communities is a pivotal recommendation, particularly within the Flanders context. These models make participation economically viable and emphasize the importance of citizen involvement in the transition to sustainable energy practices. Especially regarding transaction fees and costs, mainly imposed by the Distribution System Operator (DSO) in Flanders, a suggestion is to balance these costs with financial governmental support, especially for newly established energy communities in Flanders.

8. European Collaboration: Collaboration at the European level is vital to drive policy changes that transcend borders. In the case of Flanders, strengthening ties with neighbouring regions ensures a harmonized approach to energy community development, maximizing their impact while considering cross-border collaboration.

9. Impact Assessment: Flanders should emphasize comprehensive impact assessments when formulating policies and regulations. These assessments are data-driven and tailored to the unique characteristics of Flanders, ensuring that decision-making is balanced and well-informed. These assessments evaluate the social, economic, and environmental impacts specific to Flanders, helping to minimize the risk of unintended negative consequences. This regular impact assessment of different scales of energy communities that have various focuses of technologies helps the development of energy communities in 2 ways:

Informed Decision-Making: Impact assessments provide policymakers and regulators with a holistic view of the potential consequences of new policies and regulations. By considering the social, economic, and environmental impacts, decision-makers can make well-informed choices that align with the needs and aspirations of energy communities. This informed decision-making minimizes the risk of unintended negative consequences and ensures that new policies are tailored to the unique landscape of energy communities.

Balanced Outcomes: Impact assessments help strike a balance between the goals of sustainability and the practical needs of energy communities. They allow for a nuanced understanding of how policies may affect various stakeholders. By considering the potential benefits and challenges, policymakers can design regulations that offer the best possible outcomes. This balance ensures that energy communities can thrive without facing unnecessary hurdles, ultimately fostering their growth and sustainability.

Collectively, these recommendations provide a strategic framework for a supportive policy and regulatory landscape that fosters the growth and impact of energy communities in Flanders.

In conclusion, the energy community stakeholders in Flanders recognize the existing policy and regulatory framework's complexities and challenges. Their suggestions and concerns encompass a wide range of areas, including fees, metering, communication, recognition criteria, flexibility, and financial support. The overarching theme is to create a more supportive environment for energy community initiatives, fostering their growth and ensuring they contribute effectively to the region's energy transition goals. The journey ahead involves a collective effort to adapt and improve the framework in response to these insights and recommendations.

4.7. Conclusion

In summary, this Results chapter sheds light on the current landscape and future prospects of energy communities in Flanders, Belgium. Energy communities are diverse, with members having varying expectations and interactions with external stakeholders. They rely on networks and key learning processes to navigate challenges and grow.

Challenges include complex regulations, competition for land, and the need to gain public support. Distribution system operators and governmental bodies face unique hurdles in understanding legislation and managing administrative complexity.

Stakeholders in Flanders debate the merits of merging smaller energy communities for greater efficiency versus maintaining their local identity. Achieving a balance between these two approaches appears to be the most prudent.

Looking ahead, the future of energy communities in Flanders will depend on regulatory changes, international collaboration, decarbonizing heating, market flexibility, inclusivity, and a sense of urgency to transition to cleaner energy sources. The key lies in managing complexity while preserving local identity.

Drawing from the Strategic Niche Management framework, policymakers can shield energy communities by creating an enabling regulatory environment, nurturing innovation and collaboration, and balancing interests and investments. Promoting flexibility and inclusivity is essential for success in this transition.

Moreover, the concept of Scaling the energy community niche was elaborated on, and different approaches towards scaling were applied to the selected pilots and case studies in the Flanders region. In the discussion on scaling the community energy niche in Flanders, the chapter outlines four scaling types: growing, replication, accumulation, and transformation, categorizing how energy communities evolve.

Real-world examples demonstrate these types, emphasizing their impacts on energy communities. Growing is exemplified by the growth of Ecopower, a cooperative facing challenges as it expands. Replication is showcased through the POWER UP project, replicating the concept of using energy communities to alleviate energy poverty in different regions. Accumulation is observed in collaborative projects that link knowledge and experiences. The discussion also delves into the niche empowerment concept, which involves merging smaller energy communities into larger ones while preserving local identity and community engagement.

The chapter concludes by highlighting future perspectives, including regulatory changes and the expansion of energy communities. It introduces the Technical Assistance Hub initiative, aimed at supporting energy communities by providing technical, financial, legal, and community support. These findings offer valuable guidance for Flanders and beyond, ensuring the continued success of energy communities as they drive the transition to sustainable energy sources while fostering community engagement and cooperation.

Finally, the stakeholders' suggestions and recommendations to enhance the policy and regulatory landscape in the energy community sector have identified several key points. These suggestions aim to overcome challenges and promote the growth of energy communities in the region. A summary of the recommendations that were mentioned include:

- Introducing fair administrative fees to remove barriers for smaller energy communities.
- Implementing default metering settings to streamline administrative processes for community participation.
- Developing transparent communication strategies to garner public support for the energy transition.
- Establishing clear criteria to differentiate citizen-based energy communities from larger corporations.
- Adapting regulations to accommodate the diverse models of energy communities within Flanders.
- Simplifying permitting processes to reduce administrative burdens.
- Creating financial models to incentivize citizen and industrial participation, balancing costs with governmental support.
- Strengthening cross-border collaboration to drive policy changes.
- Prioritizing comprehensive impact assessments to ensure well-informed and balanced decision-making.

These recommendations collectively form a strategic framework to support and expand the role of energy communities in Flanders' energy transition, fostering their growth and impact.

5 | Conclusion and Discussion

5.1. Conclusion

In our research, we delved into the energy community niche in Flanders and explored concepts of transition and scaling. Let's revisit our research questions to determine if they have been answered:

Sub-question 1: What is the concept of energy community, and what does scaling mean in that regard?

During this study, we discussed the concept and definition of energy communities and the concept of scaling related to the community energy niche. We provided a clear definition and conceptualisation of this niche. In summary, regarding the conceptualisation of the energy community, we addressed the following points:

Energy is no longer just a utility; it has evolved into a fundamental necessity in contemporary societies. The concept of "energy justice" has gained popularity, emphasising the equitable distribution of energy resources in a just and economically fair manner. However, current policies often favour exclusive energy systems, leading to energy injustices. Energy communities have emerged as a potential solution to mitigate these injustices by challenging the hierarchical and centralised energy structure. Energy communities play a critical role in achieving the European Union's (EU) energy transition goals, allowing local citizens to produce a significant portion of renewable energy. EU regulations, like the Clean Energy Package, have provisions to empower local communities in driving the energy transition, using the concept of energy communities.

Energy communities can take various legal forms, including associations, cooperatives, partnerships, non-profit organisations, or limited liability companies. This legal flexibility enables citizens and other stakeholders to collaborate and invest in energy assets, fostering a more decarbonised and flexible energy system.

Definition of Energy Communities:

Energy communities are collective initiatives where local households and businesses join forces to promote sustainability and adaptability. Renewable energy communities (RECs) are particularly prominent, engaging consumers actively in the energy sector, raising awareness of renewable energy technologies, and reducing greenhouse gas emissions. According to the European Commission, energy communities are defined as legal entities with voluntary, open participation, controlled by shareholders or members, and aim to provide environmental, economic, or social community benefits rather than financial profits.

Energy communities can participate in various energy-related activities, including electricity generation, distribution and supply, consumption, aggregation, storage, energy efficiency services, renewable electricity generation, electric vehicle charging, and other energy services for their members.

Advantages of Energy Communities:

Energy communities offer several benefits to society, including:

1. Reduced Energy Costs: Members can enjoy lower energy expenses through collective energy generation and management.

2. Local Economic Boost: These initiatives contribute to the local economy by creating jobs and ensuring that investments stay within the community.

3. Decreased Carbon Emissions: Energy communities play a vital role in reducing carbon emissions at the local level, promoting sustainability.

4. Fostering Renewable Energy Acceptance: By actively involving citizens, energy communities help build trust and acceptance of renewable energy sources.

5. Increased Energy Efficiency: Energy communities often prioritise energy efficiency, leading to reduced wastage and more responsible energy use.

6. Supporting Local Economies: These initiatives create local job opportunities and stimulate the local economy.

Despite these benefits, energy communities face challenges like maintaining community engagement and navigating financial constraints. Additionally, legislation needs further development to accommodate the implementation of energy communities.

Energy Communities as Social Innovation:

Energy communities represent a form of social innovation aiming to bring about positive social and environmental impacts. They enable consumers to participate in the energy transition actively, promote local involvement, and contribute to democratic decision-making. These community initiatives combine energy transition and social innovation, providing a platform for grassroots and niche innovation within the energy sector.

Overall, energy communities are a promising model for driving the energy transition, empowering local communities, and fostering social and environmental benefits. Researchers continue to explore how these initiatives can impact the existing energy landscape and address challenges while capitalising on opportunities.

Definition of Scaling of Energy Community Niche:

As presented previously, using the study conducted by (Naber et al., 2017), four types of scaling are introduced: Growing, Replication, Accumulation, and Transformation. We applied this perspective to the living example of our selected pilots in the Flanders region, and the outcome was as the following typologies of up-scaling patterns of energy community niche in that region:

1. Growing: This type of scaling involves experiments growing as more actors participate or market demand increases. An example is Ecopower, which started as a small cooperative in 1991 and expanded its renewable energy projects over the years. However, growth can pose challenges, such as the need to balance energy production with consumption.

2. Replication: Replication happens when the main concept of an experiment is used in other locations. An instance is the ”Buurkracht” approach adopted by the Belgian City of Bruges, originally tested in the Netherlands. In Flanders, the ”Power Up” project replicates the concept of energy communities to address energy poverty.

3. Accumulation: This type of scaling involves linking multiple experiments, enabling knowledge sharing and cooperation. For example, a heating network project in Leuven smartly combines various energy sources, representing an accumulation of efforts to create a climate-neutral heating system.

4. Transformation: Transformation refers to experiments leading to wider institutional change. It involves reshaping the existing energy regime. In the context of energy communities, transformation is about challenging the established energy system and adopting sustainability standards.

The section dedicated to the definition scaling of energy community niche in chapter 4 also discusses the concept of ***niche empowerment***, which involves challenging the existing energy regime. Two tactics for niche empowerment are ***"Fit and Conform"*** (seamlessly integrating innovations into the current system) and ***"Stretch and Transform"*** (changing the game's rules). The section delves into the debate about merging smaller energy communities into larger ones on a provincial level and the balance between autonomy and scale.

The advantages and challenges of merging energy communities include increased efficiency, streamlined decision-making, and higher impact but may risk losing local identity and facing complexity. On the other hand, not merging energy communities preserves local identity, encourages community engagement, and offers flexibility, but may encounter limited resources and competition.

Ultimately, the decision to merge or not merge energy communities depends on local circumstances and the desire to balance efficiency with local engagement. It is a complex issue with various considerations and may vary based on regional preferences and goals.

Sub-question 2: What are the roles, influences, and coordination mechanisms of relevant stakeholders in the implementation and scaling of energy communities in Flanders?

An extensive stakeholder analysis was conducted in this research to analyse the roles and influences of the relevant stakeholders. In chapter chapter 4, a section within the Regime analysis was dedicated to this matter. During that section, we elaborated on a set of key stakeholders and their positions within this niche. Additionally, using qualitative data collected through interviews and existing literature, we provided a stakeholder map to show the coordination mechanisms among these critical stakeholders. The map also demonstrated how they communicate, coordinate, collaborate, and generally relate to each other in the context of energy community niche development.

To further elaborate on the position and influences of these stakeholders, a Power-Interest analysis was conducted in that section. The Influence-Interest grid was a helpful tool to map out the stakeholders involved in energy community projects in Flanders. This tool helped to determine each stakeholder's level of influence and interest, making it easier to decide the best way to engage and communicate with them throughout the project.

In the Results chapter's stakeholder analysis section, the outcomes of the analysis can be summarised as follows:

The section discusses vital stakeholders, their coordination mechanisms, and their positions within the initiatives regarding the implementation and scaling of energy communities in Flanders.

Key Stakeholders in the Flemish Energy Sector:

1. Flemish Ministry of Environment, Nature, and Energy: The ministry is responsible for shaping Flanders' energy landscape by promoting the adoption of renewable energy and addressing climate change.

2. VEKA (Flanders Energy and Climate Agency): VEKA is committed to enhancing energy efficiency and sustainability, providing guidance incentives, and implementing programs to reduce carbon footprints.

3. VREG (Flemish Regulator of the Electricity and Gas Market): VREG regulates and oversees the electricity and gas markets in Flanders, ensuring fair competition, transparent tariffs, and consumer rights.

4. Distribution System Operator (DSO) - Fluvius: Fluvius manages distribution networks for natural gas and electricity, ensuring reliability and accessibility of the infrastructure.

5. Transmission System Operator (TSO) - Elia: Elia maintains the high-voltage electricity grid, ensures efficient electricity transportation, and promotes cross-border electricity exchange.

6. VVSG (Association of Flemish Cities and Municipalities): Represents local government entities and gets involved in local governance, sustainability, and community development initiatives.

7. REScoop EU: An umbrella organisation supporting renewable energy cooperatives across Europe, encouraging local participation in sustainable energy generation.

8. REScoop Vlaanderen: Promotes and supports renewable energy cooperatives at the local level in Flanders.

9. Flux 50: A network that fosters collaboration, research, and development in the energy sector.

10. Energy Suppliers in Flanders: offer renewable energy options to consumers and contribute to a greener and more sustainable energy landscape.

Stakeholders' Coordination Mechanisms:

These mechanisms illustrate the interactions between stakeholders in the development of energy communities. Some key relationships include:

- VREG regulates the electricity and gas market and collaborates with DSOs for efficient energy distribution.

- DSOs cooperate with energy communities and facilitate energy sharing.

- VEKA provides support and advisory services, promoting energy efficiency and sustainability.

- Municipalities and local authorities, including VVSG, play a role in governance, spatial planning, and support for energy communities.

- Flux 50 focuses on innovation and collaboration, offering services for research and development in the energy sector.

The summary of these coordination mechanisms is illustrated at Figure 4.3.

Power-Interest Grid of Stakeholders:

The power-interest grid assesses the influence and interest of various stakeholders in energy communities in Flanders.

- Governmental stakeholders, including the Flemish Ministry of Environment and VEKA, hold high levels of power and interest.

- REScoop EU and REScoop Vlaanderen actively represent and promote energy communities, making them key stakeholders.

- Public authorities and municipalities are interested in energy communities for achieving sustainable development goals.

- Regulatory bodies like VREG may have less interest due to increased workload and complexity related to regulatory changes.

- Grid operators like Fluvius and Elia may have lower interest due to the complexity energy communities bring to their tasks.

- Technology producers and green energy suppliers are more interested in developing energy communities to increase profits.

- Citizens, micro-enterprises, and enterprises like Flux50 may not have significant influence but are interested in participating in energy communities for benefits like affordability, reliability, and financial growth.

This overview provides a comprehensive understanding of the roles, influences, and coordination mechanisms of stakeholders involved in energy communities in Flanders.

The summary of the power-interest grid is illustrated at Figure 4.4.

Sub-question 3: What are the current challenges for the Flanders region's energy communities, and how have they responded to them?

Upon conducting interviews with the various stakeholders, an analysis was performed to extract and present their main challenges and barriers. The findings were reported in chapter 4, within the challenges and barrier subsection. The section highlights both general and actor-specific challenges that the stakeholders identified.

The data collected from the interviews revealed several general barriers that multiple stakeholders reiterated. These barriers appear to be shared across the industry and include factors such as inadequate resources, lack of awareness, and insufficient training and education. The stakeholders indicated that these issues impacted their ability to achieve their desired outcomes.

In addition to the general barriers, some of the stakeholders reported challenges that were specific to their roles or organisations. For example, some stakeholders cited issues related to funding or governance structures, while others noted challenges related to specific technologies or business processes.

In summary, the challenges that the stakeholders related to energy community development initiatives are facing are presented below:

Common Challenges for Energy Communities in Flanders:

1. Complex Regulatory Environment: Energy communities must navigate complex and evolving regulations related to energy sharing, ownership, and participation, which can involve technical calculations and time constraints.

2. Competition for land: Acquiring suitable land for renewable energy projects, especially wind projects, is challenging due to competition from commercial players. One solution is to include participative criteria in tenders.

3. Public Opinion and Awareness: Convincing the public about the benefits of the cooperative model used by energy communities can be challenging, requiring effective communication of advantages.

4. Business Case Viability: Establishing a positive financial business case for energy communities can be difficult, as participants seek both societal benefits and financial returns.

5. Legislative Variations: Varying definitions and requirements for energy communities in different regions of Belgium create complexity and uncertainty. Clear and consistent regulations across regions are needed.

6. Participant Knowledge Gap: Many participants lack a deep understanding of energy sharing and peer-to-peer selling legislation, resulting in challenges and additional costs for community facilitation.

7. Administrative Burden: Registering energy communities and meeting regulatory criteria can be administratively burdensome, deterring potential initiatives.

8. Definition and Objectives: Ambiguities in the definition and objectives of energy communities, particularly concerning industry participation, need clarification to align with energy goals.

9. Evolution of Legislation: Ongoing adaptation to evolving legislation at regional and European levels is required for energy communities to remain compliant and effective.

10. Transaction Costs: Transaction costs related to various aspects of energy community operations pose challenges and require a clear vision and understanding of organisational roles in the energy transition context.

Challenges Specific to DSO (Fluvius):

11. Grid Fee Reduction and Grid Benefits: Fluvius must reduce grid fees for energy communities in a way that aligns with genuine grid benefits to avoid shifting costs unfairly onto non-participants.

Challenges Specific to VEKA (Flemish Energy and Climate Agency):

12. Legislation Understanding: VEKA must ensure a comprehensive understanding of complex legislation related to energy communities to provide accurate guidance and support.

13. Administrative complexity: Handling the administrative complexities of registering energy communities and guiding them through the process is a significant challenge.

14. Defining Objectives: Determining the objectives of energy communities, especially concerning the potential participation of industries, presents a challenge to align with local and European energy goals.

15. Legislative Changes: VEKA needs to anticipate and adapt to legislative changes in the energy sector, which can impact the framework and operation of energy communities.

Addressing these challenges requires collaboration among stakeholders, including energy communities, regulatory authorities, DSOs, and organisations like VEKA. Overcoming these obstacles is essential to realising the potential benefits of energy communities for both the environment and society.

Sub-question 4: What are the current niche characteristics of Flanders' energy communities regarding learning processes, network formation and dynamics of expectations?

In addition, the Strategic Niche Management (SNM) framework was applied to the qualitative data collected from stakeholder interviews and other available sources to elaborate on the unique characteristics and processes of the niche. Three key attributes of the community energy niche in the Flanders region were identified: A) the dynamics of expectations within and between energy communities and external stakeholders, B) the formation of networks between energy communities and other actors in the energy sector, and C) the key learning processes involved in the development and scaling of energy communities. For each of these niche processes, indicator-specific analyses were provided. The Shielding and Nurturing aspects of the Energy Communities Niche were also analysed and elaborated on by combining it with the Future Perspectives of this niche in the Flanders region, particularly from the perspective of the interviewed stakeholders.

Below, the summarised analysis of Niche Processes and Characteristics is provided:

The dynamics of expectations within Flanders' energy communities and between these communities and external stakeholders involve a variety of expectations as classified within the SNM framework:

Expectations of Energy Communities:

1. Cost Savings (Internal Expectation): This expectation revolves around the quality and affordability of renewable energy services provided within the energy community. It reflects the preferences and expectations of current members within the niche. ***2. Environmental Concerns (Combination of Internal and External Expectations):*** These expectations concern the quality of green energy services and involve both internal (members) and external (those with environmental concerns) dimensions. It reflects awareness and confidence in the community's ability to promote clean energy. ***3. Community and Social Aspects (Endogenous Expectation):*** Originating from learning experiences and social dynamics within the niche, this expectation is influenced by the network composition and interactions among current members of the energy community.

Expectations of Other Stakeholders:

1. Local Authorities (Exogenous Expectation): External developments, such as broader sustainability and climate goals, shape the expectations of local authorities. They anticipate that the energy community will contribute to these external objectives. ***2. Energy Producers (Combination of Internal and External Expectations):*** These expectations have both an internal aspect, related to potential competition within the niche, and an external aspect, related to potential cooperation and mutual benefit. Energy producers may see energy communities as competitors but also recognise opportunities for collaboration. ***3. Government Support (Exogenous Expectation):*** Government support, although not explicitly mentioned, can be categorised as an exogenous expectation. It originates from external factors like the regulatory landscape and government policies. Both energy community actors and external stakeholders expect supportive policies and financial incentives from the government, shaped by the broader regulatory framework.

These classifications reflect the interactions between actors within and outside the energy community niche and how their expectations are influenced by different factors, as defined in the SNM framework and previous research conducted by (Kamp & Vanheule, 2015).

Network Formation in Energy Community Niche in Flanders

In Flanders, energy communities have formed various networks to support their development and growth. These networks are crucial in facilitating cooperation and knowledge exchange within the energy community niche. Here is a summary of the key points regarding network formation in Flanders' energy communities:

1. Diverse Networks: Several networks have emerged to support energy communities in Flanders, catering to a wide range of needs and objectives.

2. Learning Hub: Within Flux50, a learning hub or learning network has been established to facilitate cooperative networks. It is a platform where various stakeholders and energy community managers can share insights and lessons learned, promoting knowledge exchange and collaboration.

3. Collaboration with REScoop EU and REScoop Flanders: Energy communities in Flanders collaborate with networks such as REScoop EU and REScoop Flanders. These collaborations extend beyond the local niche, connecting energy communities to a broader network of cooperative initiatives. These networks offer expertise and resources that enhance niche development.

4. Projects for Social Housing: Some projects focus on reducing energy poverty and improving energy access within social housing networks. The Klimaan initiative in Mechelen City is an example of such a project.

5. Collaboration with Local Authorities: Energy communities sometimes collaborate with local authorities to form networks. For instance, the ”Transfo Zwevegem” project is a collaboration between the Municipality of Zwevegem, Intercommunal Organisation Leiedal, and the Province of West-Flanders. This collaboration aims to revamp a former electricity power plant site and incorporate sustainability and renewable energy into its redevelopment.

6. European Projects: European projects like EMPOWER2.0 and RE/SOURCED are contributing to the development of smart grids and renewable energy production. These projects involve stakeholders in activities that build a sense of community and aim to persuade the public to participate in the changing energy market actively.

7. Industry Partners: Organisations like ”Quares” actively support energy management and energy community development. They play a role in balancing the supply and demand of energy at the local level and emphasise the importance of active knowledge and management in achieving a transition to renewable energy.

8. Empowerment Through Network Formation: These active networks play a pivotal role in empowering energy communities by fostering knowledge sharing, resource allocation, and improved communication channels. They provide crucial support structures for energy communities to adapt to changing circumstances and effectively contribute to the energy transition.

These networks and collaborations demonstrate the complexity and multifaceted nature of energy community development in Flanders. They provide essential support for the growth and empowerment of energy communities and contribute to the transition to clean and sustainable energy sources.

The key learning processes of Energy Community Niche in Flanders

A summary of the key learning processes analysed through the application of the SNM framework in the selected pilots of energy communities in Flanders is presented below:

The key learning processes in the development and scaling of energy communities in Flanders involve a range of strategies and insights. These processes are essential for effectively transitioning to clean and sustainable energy sources. Here is a summary of the key learning processes and their indicator analysis:

1. Community Building and Values: Energy communities learn about the technical aspects of energy projects, including design specifications and technology infrastructure. They also understand the social and environmental impact of renewable energy projects and engage in the development of the user context to tailor services to user needs.

2. Regulatory and Legislative Understanding: Energy communities need to comprehend government policies, the regulatory framework, and institutional structures relevant to renewable energy dissemination.

3. Collaboration and Knowledge Sharing: Collaborative learning networks play a crucial role. Energy communities actively participate in collaborative learning, learn from existing energy communities, and share knowledge, which influences technical development and infrastructure, among other aspects.

4. Business Development and Sustainability: Energy communities explore appropriate business models, sustainable business models, and case development for CO2 neutrality to support technical and infrastructure development and ensure long-term sustainability.

5. Social Inclusion and Vulnerable Groups: Understanding the social and environmental impact is crucial, especially regarding energy justice and inclusion. Energy communities design technical infrastructure and services to address the needs of vulnerable groups.

6. Network Expansion and Scaling: Learning about the technical and infrastructure requirements for scaling energy communities. Exploration of European programs influences business models and infrastructure development.

7. Stakeholder Management and Engagement: Understanding government policies and regulatory frameworks are crucial for effective stakeholder management and engagement.

8. Transparency and Credibility: Focusing on transparency, communication, and credibility. Initiatives like newsletters and information sharing help disseminate knowledge about technical developments and infrastructure enhancements to stakeholders, promoting growth and empowerment.

These learning processes facilitate the development, adaptation, and scaling of energy communities in Flanders. They encompass technical, social, environmental, and regulatory aspects and involve collaboration, knowledge sharing, and the development of sustainable business models. These interconnected processes are pivotal in successfully transitioning to clean and sustainable energy sources.

Sub-question 5: What future strategies can be advised for shielding and nurturing energy communities niche in Flanders, and what insights are needed to develop those strategies?

Key Points regarding the future perspective and shielding/ nurturing of energy communities in Flanders:

- Stakeholders in the Flanders energy sector are concerned with the future of energy communities and recognise the critical role of policy and regulatory adaptations in shaping their development. They are interested in how changes in regulations and policies will impact these communities.

- *Example:* Stakeholders in Flanders are curious about how changes in regulations and policies will impact the development of energy communities. These changes could either help or hinder the progress of energy communities in the region.

- There is an emphasis on international collaboration and expansion, with energy communities seeking strategic alliances beyond national borders for knowledge sharing, experience transfer, and resource pooling.

- *Example:* Beauvent Energy Cooperative in Ostend is in charge of two main projects related to sustainable district heating: the Heat network Ostend and Sint-Jozef Pittem. These projects involve transferring heat from a heat source via underground, insulated pipes to buildings with a heat demand.

- Sustainable heat solutions, particularly district heating networks, are highlighted for their potential to provide eco-friendly heating and stability amid fluctuating gas prices.

- *Example:* Sustainable district heating projects such as the Heat network Ostend and Sint-Jozef Pittem are mentioned as key initiatives.

- Electrification is identified as a growing need, and energy communities are exploring strategies such as optimising energy consumption, integrating energy storage solutions like batteries, and utilising renewable energy sources.

- *Example:* ECoOB installed more than 1,000 solar panels on the roof of WZC De Wingerd in Leuven, creating publicly accessible charging stations and a fast charger with a capacity of 150kW.

- Stakeholders are committed to inclusivity, targeting a diverse range of demographics, including women, young people, and those facing energy poverty. There is also an exploration of creating a fund to support social projects related to the energy transition.

- *Example:* The energy community of Klimaan in the city of Mechelen aims to help people facing energy poverty have more reliable and affordable access to energy via building energy communities in the context of social housing.

- The urgency of the energy transition and the shift towards renewable energy sources to reduce greenhouse gas emissions are recognised. Effective management is crucial to ensure practicality and accessibility, with government involvement being central.

- *Example:* The ZonneWind energy community in Voorkempen collaborates with other energy communities, such as Klimaan and Zuidtrant, to gain a better understanding of the market and explore the possibility of utilising it for their future energy communities.

- Maintaining the ownership and identity of individual energy communities is highlighted as vital for fostering community engagement and success.

- *Example:* Ownership and identity of energy communities are crucial to encouraging community engagement and participation.

- Balancing discounts on the grid and infrastructure investments is a complex challenge requiring transparent key performance indicators (KPIs) and objective assessments to measure societal impact.

- *Example:* For instance, some energy providers charge an administrative fee of €150 per year per participant, which poses challenges for the nurturing of energy communities.

- Greater flexibility and innovative solutions are expected to address regulatory and financial obstacles.

One remarkable initiative by the Flemish government as an action towards better shielding and nurturing of the energy communities in Flanders is the following:

Technical Assistance Hubs:

The Flemish government introduced ”Technical Assistance Hubs for Energy Communities” to support the grassroots establishment of energy communities. The Advisor on Climate, Energy, and European Affairs within the Flemish government introduced the ”Technical Assistance Hub” to support the energy community niche in the Flanders region. These hubs provide technical support, financial subsidies, and legal assistance and prioritise inclusivity, ensuring that individuals facing energy poverty are not left behind. The Technical Assistance Hubs offer subsidies to make energy communities financially viable and provide legal assistance to navigate the regulatory landscape. They promote community engagement, diversification of efforts, and transparency in costs associated with energy sharing. The hubs aim to connect local governments with their communities, fostering citizen involvement in the energy transition and supporting a spectrum of activities beyond energy sharing. In its initial phase, the government will generously subsidise these hubs for the first three years. The government provides initial financial support to these hubs to assist communities in their early stages of development. Looking ahead, the vision is to standardise processes and procedures, making support more accessible and replicable for a more widespread and impactful energy transition. The long-term vision of the hubs is to standardise processes and procedures, enabling communities to professionalise and scale up their projects for a more impactful energy transition.

Suggestions for improvements to the policy and regulatory landscape

Finally, here are the suggestions for improvements to the policy and regulatory landscape in the energy community niche of the Flanders region that have been provided based on the arguments stated by the interviewed stakeholders:

1. Regulated Administrative Fees: Propose regulated fees to prevent excessive charges for small energy communities.

2. Default Metering Setting: Simplify administrative processes with default settings for joining energy communities.

3. Balanced Communication: Develop a balanced government communication strategy to inform the public about energy transition costs and benefits.

4. Recognition Criteria: Define criteria to distinguish citizen-based energy communities from corporations.

5. Flexible implementation: Tailor regulations to accommodate diverse energy community models within Flanders.

6. Streamlined Permits and Regulations: Simplify permitting and regulations to reduce administrative burdens.

7. Support for Financial Models: Introduce financial models to incentivise citizen and industrial participation, balancing costs with government support.

8. European Collaboration: Strengthen cross-border collaboration for harmonised energy community development.

9. Impact Assessment: Emphasise comprehensive impact assessments for data-driven, well-informed decision-making and balanced outcomes.

These recommendations aim to create a supportive regulatory environment for energy communities in Flanders, fostering their growth and impact on the regional energy transition.

Through semi-structured interviews, we have effectively examined and analysed each research sub-question using relevant methodologies and theoretical frameworks. Such an approach has enabled us to address each research sub-question comprehensively.

5.2. Academic Discussion

There have been multiple studies done related to the energy community niche and scaling this social innovation. Since our focus was on the selected pilots in the Flanders region of Belgium, therefore, here we discuss the studies that were explicitly working on the energy community niche topics in the Flanders and/or Belgium and then compare and discuss how our research has contributed to this topic. For instance, (Heuninckx et al., 2022) focuses on stakeholder involvement in energy communities (ECs) and examines the motivations driving stakeholder participation within these communities. It conducts a literature review on stakeholder involvement in the energy system and subsequently presents the findings of a study conducted in four Flemish pilot cases. The primary objective of this research is to enhance the understanding of the prerequisites an EC design should consider. In this thesis, the stakeholder analysis was taken a step further by providing a comprehensive coordination mechanism among different actors in the energy community niche. This mechanism was then applied in the case study of the Flanders region.

Moreover, (Van Summeren et al., 2021) investigated how energy communities could derive advantages from innovative ICT solutions and utilise them to facilitate the energy transition. It specifically concentrated on a case study involving community-based Virtual Power Plants (cVPPs) in Flanders (Belgium) and the Netherlands. The paper sought to contribute to the field of Sustainability Transitions by examining how energy communities employed digital technology to augment their influence in the sustainable energy transition. In another research by (Bauwens, 2019), the determinants of investments in community renewable energy initiatives are studied. It presents a detailed analysis of the economic, social, environmental, and institutional factors that influence the size of investments made by community renewable energy members in the Flanders region. In this thesis, however, the economic impacts that the energy community niche has on the regime in the Flanders region were studied, which can be used as motivations for future investments in this niche innovation in Belgium.

Furthermore, (Bauwens, 2016) in another study focused on investigating the connections between community-based governance and sustainable energy usage. It presented quantitative evidence from Flanders, detailing the influence of renewable energy cooperatives on the energy-related behaviours of their members. The study explored the roles of social norms, trust, and collective efficacy in moulding energy conservation and using renewable energy. Additionally, it delved into the potential of community-based social marketing to promote sustainable behaviours. Meanwhile, in this thesis, the social and community engagement and empowerment due to the impact of the energy community niche were studied through the qualitative data collection from stakeholders in the Flemish energy sector and selected energy communities in that region.

Additionally, a study by (Felice et al., 2022) about renewable energy communities (RECs) and their business case in Flanders. It provides insights into the economic viability of RECs and their potential to reduce greenhouse gas emissions. The paper also discusses the challenges and opportunities for promoting the growth of RECs in Flanders. This thesis can make a significant contribution to the energy community niche development by elaborating on live challenges and barriers faced by different stakeholders. The insights gained from the SNM analysis, combined with the key learnings from the niche processes, such as network formation, learning processes, and dynamics of expectations, can help design and change the business cases for energy community niches in the area. These insights can also clarify which expectations are critical, which networks are useful, and what lessons were learned. This information can be used to better support other energy community projects and nurture niche innovation in Flanders. A combination of these analysed results plus the conclusions provided by (Felice et al., 2022), regarding the challenges and opportunities for promoting the growth of RECs in Flanders, can lead to more reach and in-depth policy recommendations to better empower the energy community niche, not only in Flanders but also in other similar EU countries.

If we examine the role of this study in relation to other ongoing studies in the community energy niche, social innovation studies, and scaling typologies in Flanders, the following points can be mentioned:

This thesis investigation centred on energy communities and their up-scaling patterns in the Flanders region, contributing to several relevant academic debates in the field of energy communities. In particular, the research aligns with and advances discussions related to the Strategic Niche Management (SNM) framework, the empowerment of community energy niches, and the ongoing debates on energy communities in Flanders. Let's discuss how this research contributes to these debates:

1. Strategic Niche Management (SNM): The application of the SNM framework to analyse energy communities in Flanders significantly contributes to the ongoing academic debate surrounding niche management. Our study extracts niche characteristics and processes, such as dynamics of expectations, network formation, and key learning processes. This enriches the understanding of how energy communities in the Flanders region conform to or challenge niche management processes (Schot & Geels, 2008). By applying the SNM framework to a specific regional context, our research confirms the adaptability of SNM in assessing the development and evolution of energy communities in Flanders.

2. Empowerment of Community Energy Niches: Our research delves into empowerment strategies employed by energy communities in Flanders, aligning with ongoing debates on the roles of empowerment and adaptation in community energy niches and the debates related to merging energy communities in Flanders on a provincial level. By applying the typologies provided by (Smith & Raven, 2012), we provide insights into how energy communities adapt or strive for transformative change by enlightening the current challenges they face in Flanders. Our study confirms the existence of these diverse approaches and offers context-specific evidence of how empowerment strategies are utilised within the Flanders energy community niche (Smith & Raven, 2012).

3. Up-Scaling Patterns in Flanders: The thesis contributes to the ongoing academic debate on up-scaling patterns within energy communities. By using (Naber et al., 2017) typologies of Growing, Replication, Accumulation, and Transformation, our research identifies different up-scaling patterns within the Flanders energy community niche. This contributes to the discourse by confirming the relevance of various up-scaling strategies in the region, shedding light on the specific patterns adopted by energy communities in Flanders (Naber et al., 2017). Additionally, during the application of the (Naber et al., 2017) approach to the typology of up-scaling pattern into the case study of selected pilots in the Flanders region, one of the only types that was missing was the Transformation type, which as mentioned in chapter 2, occurs when the experiment shapes wider institutional change in the regime selection environment. During the study of the selected pilots in the qualitative data collection and also other experiments within the literature and desk research phase, there could not be found an up-scaling experiment or project related to the energy community niche that has resulted in an institutional change in the regime environment. That is the source of some of the challenges that were discussed in the chapter 4, which resulted in recommendations for changes within the policy and regulatory environment. There is still at least a significant lack of transformation up-scaling for the energy community niche in Flanders. For instance, the fact that some energy providers charge an administrative fee of up to €150 per year per participant, which poses challenges for the nurturing of energy communities. Overcoming this barrier requires transformational changes in the institutions regarding the set up of these administrative fees for energy suppliers.

Another interesting point to mention about both of the scaling approaches provided b (Naber et al., 2017) and (Smith & Raven, 2012), is the fact that there is clear overlap between the two. When analysing the two approaches, the stretch and transform strategy for niche empowerment (by (Smith & Raven, 2012)) is performing similar concepts within the transformation type of up-scaling (by (Naber et al., 2017)). However, the first niche empowerment strategy by (Smith & Raven, 2012)- fit and conform- could be better performing when it came to the debating area of merging the smaller energy communities with already existing bigger ones. One suggestion (also for further research) could be the application of an effective combination of these two approaches as a new framework for more in-depth study of the energy community scaling, not only in the Flanders region but also in many other similar countries.

4. Stakeholder Involvement: Our findings on the roles and influences of stakeholders in the Flanders energy sector and their collaboration in energy community niche development align with ongoing debates on stakeholder involvement in energy communities. While (Heuninckx et al., 2022) focused on motivations driving stakeholder participation, our research complements this by providing a nuanced understanding of how stakeholders operate and coordinate with one another within the energy community context in Flanders and how their power and influence position lies among the other relevant stakeholders.

5. Investments in Renewable Energy Initiatives: While (Bauwens, 2019) analysed determinants of investments in renewable energy initiatives, our research complements this by investigating the impact of energy community initiatives on some other economic factors such as; level of job creation, local economic stimulus and increased property values.

6. Community-Based Governance and Sustainable Energy Usage: In comparison to (Bauwens, 2016), which examined the connections between community-based governance and sustainable energy usage, our research contributes by expanding the focus on up-scaling patterns and empowerment strategies that drive sustainable energy behaviour within Flanders energy communities. This enriches the discussion about the multifaceted aspects of community-based governance and sustainable energy use.

In summary, our research contributes to the academic debates surrounding SNM, the scaling and empowerment strategies of community energy niches, and the broader discussions on energy communities in Flanders. It provides context-specific insights and confirms or expands upon existing claims and findings while offering some suggestions and recommendations for stakeholders, policymakers, and researchers in the field of energy communities for effective changes in the policy and regulatory environment within the Flemish energy sector.

5.3. Limitations

Throughout the study, we encountered several limitations and challenges. One of the most significant limitations was the difficulty in conducting interviews with experts in the Flemish energy sector. The study was reliant on their availability and willingness to participate, but unfortunately, only 25% of those approached agreed to take part. This highlights the challenges of conducting qualitative studies that are dependent on the cooperation of others. Furthermore, collecting data was a challenging task due to the busy schedules of many energy communities and cooperatives.

Moreover, one other aspect of the limitations of this study was the language barrier, as some policy and law documents were only available in Dutch, making it challenging to find suitable translations. Despite these limitations, the study yielded valuable insights into the Flemish energy sector. Additionally, the study faced a time limit due to the framework of the thesis and the general limitations of the timeline. To conduct interviews and connect with stakeholders, the study had to be completed as quickly as possible, which sometimes acted as a barrier.

Another point worth mentioning is the challenge of dealing with contradictory ideas regarding the scaling plans of energy communities in Flanders from various stakeholders. Although not a limitation, it was an interesting and challenging aspect of the study. The study aimed to be as inclusive as possible by selecting pilots in Flanders to study. It covered different energy communities from large to small scale and other areas within the Flanders region. However, to explore the real-time challenges that these energy communities face, we need to cover more pilots and collect data from more cases. Additionally, the stakeholder analysis section indicated that there were other critical stakeholders that we could not interview due to timing and set-up limitations. This is a limitation of the study as we could not access all of these stakeholders during the data collection phase. Therefore, we had to rely on existing literature and desk research to gather information about their point of view.

Another limitation was that we could only interview one person from each organisation (except for two organisations where we talked to two personnel). Conducting interviews with more than one person from each organisation could provide a broader vision and more qualified data collected from each stakeholder or organisation. This could help with preventing response bias occurrence. Furthermore, another aspect of limitations that should be considered is the limited generalizability of the findings. The study focused on energy communities in the Flanders region, and the results may not be directly transferable to the other areas with different energy policies, cultural contexts, or community dynamics. Acknowledging this regional specificity is essential. Additionally, it is important to note that the qualitative nature of the study may introduce subjectivity in the analysis and interpretation of data. This means that different researchers may draw different conclusions or variations from the same data, potentially affecting the study's reliability.

While every effort was made to ensure the robustness and credibility of the research, it is essential to acknowledge certain limitations that impacted the study. One notable constraint pertained to organising a seminar with all the participating stakeholders, a step that would have ideally enriched the research process. Unfortunately, due to infrastructure and timing limitations, this ambition could not be realised. However, the research employed alternative strategies to address this limitation. Cross-checking the qualitative data analysis findings with existing literature and practices in the energy community niche, particularly within the Flanders region, was diligently conducted. This served to provide external validation and enhance the trustworthiness of the research. Additionally, feedback from the participating stakeholders was actively sought, allowing them to validate the research findings and contribute their invaluable perspectives, thus mitigating the impact of the seminar's absence. These limitations, while noteworthy, were met with creative solutions to maintain the research's integrity and reliability.

Finally, another factor that could have impacted this type of study is cross-cultural communication. If the study involved interactions with individuals from diverse cultural backgrounds, it is essential to acknowledge the potential challenges in communication and understanding, which may have affected the quality of the collected data.

5.4. Suggestions for Future Research

Numerous ideas for future research could be used to explore and delve deeper into the transition and empowerment of energy communities' niche. Although this study only utilised the tools and features of the Strategic Niche Management (SNM) framework to analyse its data, there are also other helpful transition management tools and frameworks that could be utilised for future research on the topic of energy community niche. One of these frameworks is the Technological Innovation Systems (TIS) framework, which is more elaborated on by (Markard et al., 2015). Additionally, a combination of various transition management frameworks and perspectives could be applied as a new study on energy communities.

Furthermore, by considering the limitations mentioned earlier, several other future research ideas can be proposed. For example, this study could be extended to cover the whole country of Belgium so that the Wallonia region can also be considered, and even these two regions can be compared from the energy community empowerment and situation perspective. Moreover, this scope can be expanded to include many other EU pilots, as the SCCALE project is doing the same. This way, lessons learned from different regions can be collected, compared, and used for other countries with similar circumstances.

In future research, more focus could be given to the perspective of citizens or residents. Since this study did not have direct communication with the citizens and was not its main scope, findings from organisational and industrial stakeholders and citizens' opinions about energy community barriers, challenges, and opportunities can help policymakers to have a broader vision while setting up future policies related to energy community niche. Even the opinions of citizens with different levels of income and education could be considered to see how they can affect people's views about the energy community niche and related policies.

Finally, in a future study, it could be helpful to not only focus on energy communities that use renewable energy but also on those that invest in housing renovation and other measures for better energy management and efficiency. For example, an exciting area of research could be a specific study dedicated to Electrical Vehicles infrastructure and its role in the energy community niche.

5.5. Recommendations for Policymakers

In the dynamic landscape of Flanders and Belgium's energy communities, numerous challenges and barriers persist, demanding a thoughtful and collective approach to overcome them. Energy communities, often driven by their aim to promote sustainable energy practices, encounter an intricate web of complexities rooted in their regulatory environment. Navigating a constantly evolving set of regulations governing energy sharing, ownership, and participation requires immense effort and expertise. To address this common challenge, policymakers need to prioritise the streamlining and harmonisation of energy community regulations across different Belgian regions, creating consistent rules. This standardised regulatory framework will reduce complexity and uncertainty, providing the foundation for energy communities to thrive in the country.

Securing suitable land for renewable energy projects, especially wind-based initiatives, is another pressing challenge. Here, energy communities compete with well-funded commercial entities, increasing land acquisition costs. To level the playing field, policymakers should introduce participative criteria in tenders for renewable energy projects. By doing so, energy communities can effectively participate in projects while ensuring that the costs of acquiring land remain reasonable.

Public awareness remains a crucial hurdle for energy communities. While these communities are dedicated to societal and environmental benefits, they often struggle to communicate these advantages to the public effectively. To address this, policymakers should support targeted public awareness campaigns that resonate with the Belgian context. These campaigns can bridge the gap between energy communities and the broader public, fostering greater understanding and trust.

Establishing a compelling business case for energy communities is another significant challenge, given the need to balance societal benefit and financial viability. To boost the business case for members, policymakers should explore a range of financial incentives tailored to the Belgian context. These may include subsidies, tax benefits, or feed-in tariffs, making participation in energy communities financially attractive while ensuring sustainability.

Closing the knowledge gap among participants is a crucial endeavour for energy communities. Many individuals lack a deep understanding of the intricate legislation surrounding energy sharing and peer-to-peer energy transactions. To bridge this knowledge gap, policymakers should invest in educational and training programs tailored to the local legal framework. Empowering community members with this understanding will lead to more efficient operations.

Administrative requirements and procedures are a significant challenge for energy communities. These demands can be overwhelming, requiring substantial time and resources to ensure compliance. To reduce the administrative burden, policymakers should work toward streamlining registration processes and regulatory compliance to make it more straightforward and less daunting for energy communities.

Similarly, providing clear definitions and objectives for energy communities within the Belgian context is essential. This clarity will ensure that these communities align with local and European energy goals and adhere to well-defined missions and purposes that resonate with the local population.

The evolving legislative landscape at both regional and European levels necessitates continuous adaptation by energy communities. Staying responsive to changing regulations is essential to enable these communities to thrive in Flanders and throughout Belgium.

For energy communities and federations operating within Flanders and Belgium, there are several strategies recommended. Collaboration and knowledge sharing among these communities is crucial, as they can exchange best practices and expertise specific to the local context, overcoming common challenges and barriers more effectively. Engaging in advocacy and public relations efforts tailored to the Belgian context is essential for improving public opinion and awareness. Energy communities should showcase their achievements and the benefits they bring to Belgian society, building trust within the local context.

To strengthen the business case viability, energy communities should explore innovative economic models customised for Belgium. Diversifying income streams, exploring energy storage options, and developing partnerships with local businesses can generate additional revenue, improving financial sustainability.

Engaging with regulatory authorities, distribution system operators, and governmental organisations within the Belgian context is crucial. Energy communities should maintain open lines of communication with these stakeholders to ensure a coordinated approach to addressing challenges that align with local requirements.

Energy communities should focus on sustainable growth, ensuring that new members have a clear understanding of the community's objectives and principles customised to the Belgian context. Embracing innovative solutions and technology specific to the Belgian context can improve the efficiency and effectiveness of energy community operations. By exploring digital platforms, smart grids, and advanced monitoring systems aligned with the Belgian context, energy communities can enhance energy sharing and management.

Addressing these challenges and implementing these recommendations and strategies will help create an environment where energy communities can flourish in Flanders and Belgium. This, in turn, will contribute to the energy transition, offering lasting benefits for society and the environment.

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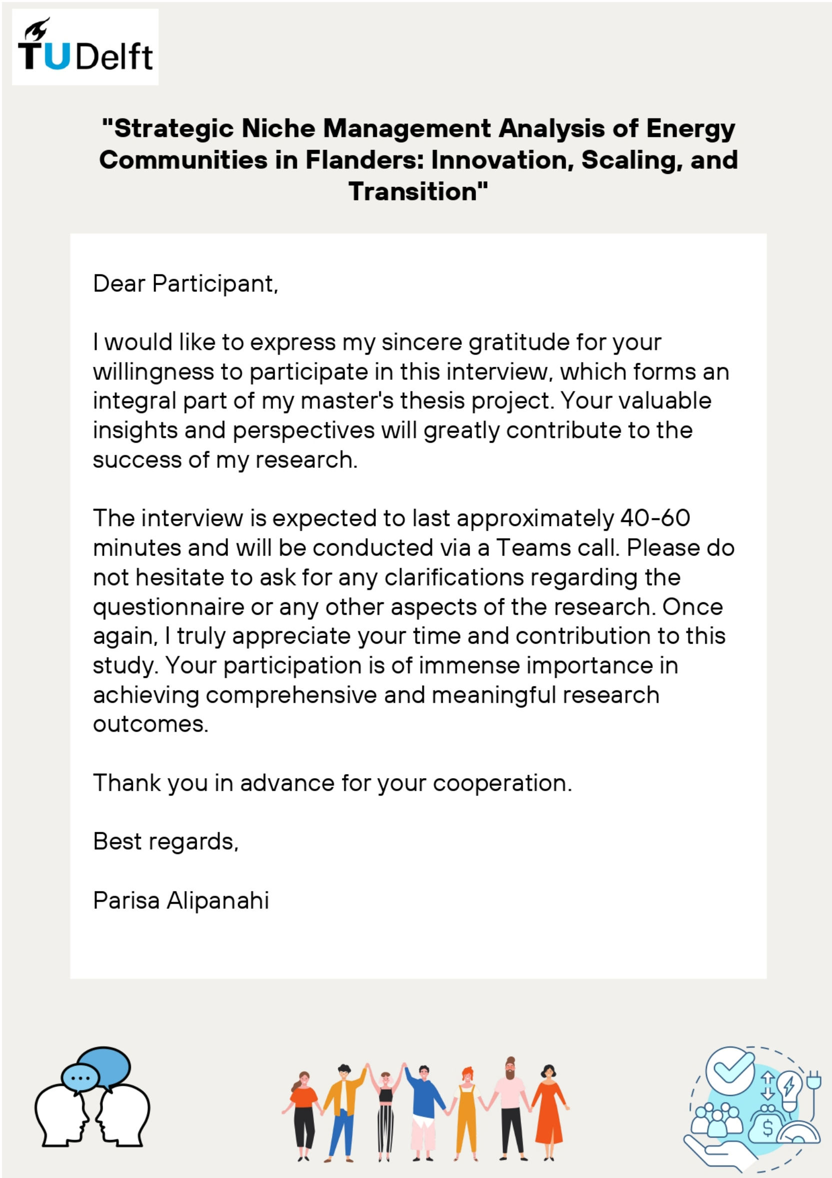
A | Questionnaire for Semi-structured Interview

In Figure A.1 to Figure A.4, the list of questionnaire used in the semi-structured interviews is presented. Throughout the semi-structured interviews, a questionnaire was utilized to delve into the primary topics with diverse stakeholders. Nonetheless, owing to the semi-structured nature of interviews, certain questions could have been adapted or overlooked depending on the interviewee's reactions and the information required to be obtained during the session.



TU Delft

"Strategic Niche Management Analysis of Energy Communities in Flanders: Innovation, Scaling, and Transition"

Dear Participant,

I would like to express my sincere gratitude for your willingness to participate in this interview, which forms an integral part of my master's thesis project. Your valuable insights and perspectives will greatly contribute to the success of my research.

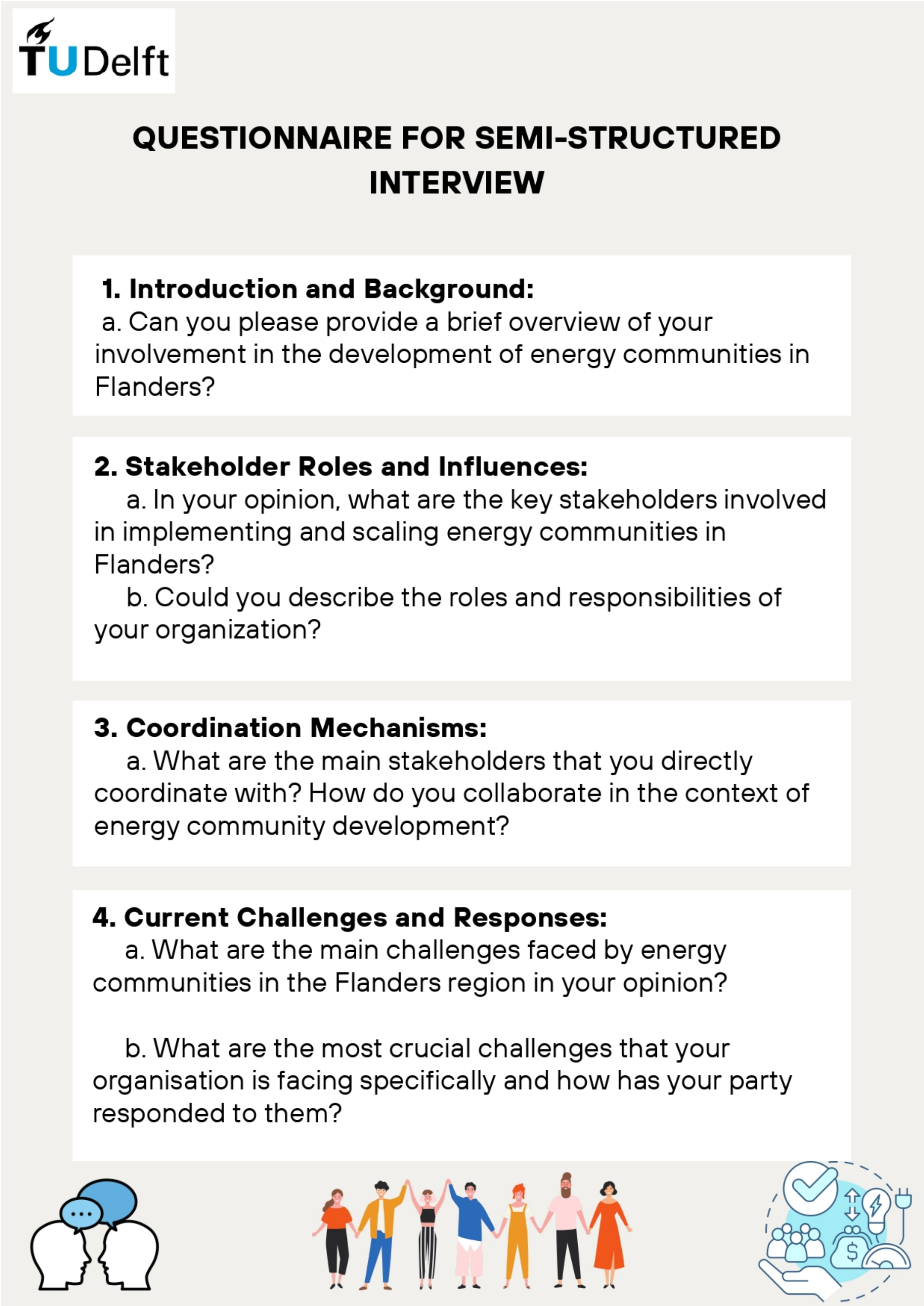
The interview is expected to last approximately 40-60 minutes and will be conducted via a Teams call. Please do not hesitate to ask for any clarifications regarding the questionnaire or any other aspects of the research. Once again, I truly appreciate your time and contribution to this study. Your participation is of immense importance in achieving comprehensive and meaningful research outcomes.

Thank you in advance for your cooperation.

Best regards,

Parisa Alipanahi

Figure A.1: Questionnaire for semi-structured interview



QUESTIONNAIRE FOR SEMI-STRUCTURED INTERVIEW

1. Introduction and Background:
a. Can you please provide a brief overview of your involvement in the development of energy communities in Flanders?

2. Stakeholder Roles and Influences:
a. In your opinion, what are the key stakeholders involved in implementing and scaling energy communities in Flanders?
b. Could you describe the roles and responsibilities of your organization?

3. Coordination Mechanisms:
a. What are the main stakeholders that you directly coordinate with? How do you collaborate in the context of energy community development?

4. Current Challenges and Responses:
a. What are the main challenges faced by energy communities in the Flanders region in your opinion?

b. What are the most crucial challenges that your organisation is facing specifically and how has your party responded to them?

Figure A.2: Questionnaire for semi-structured interview

TU Delft

QUESTIONNAIRE FOR SEMI-STRUCTURED INTERVIEW

5. Niche Characteristics and Dynamics:

a. What are the dynamics of expectations within energy communities and between communities and external stakeholders?

b. What networks have been formed between energy communities and other actors in the energy sector to further empower the energy community sector? To what extent do you think these active networks are supportive of stimulating the empowerment of energy communities?

c. From your experience, what are the key learning processes involved in the development and scaling of energy communities in Flanders?

6. Future Perspectives:

a. What do you envision for the future of energy communities in Flanders? Are there any emerging trends or opportunities that you think will shape the development of energy communities in the region?

7. Policy and Regulatory Environment:

a. How do you perceive the existing policy and regulatory framework in relation to energy communities' spatial planning in Flanders?

b. What changes or improvements would you suggest in the policy and regulatory landscape to better support energy community initiatives?



Figure A.3: Questionnaire for semi-structured interview

QUESTIONNAIRE FOR SEMI-STRUCTURED INTERVIEW

8. Social and Economic Impacts:

a. In your opinion, what are the social benefits generated by energy communities in Flanders?

b. How do you think energy communities contribute to local economic development (e.g. level of job creation and amount of investments)?

9. Community Engagement and Empowerment:

a. What role do you see energy communities playing in promoting energy poverty alleviation and democratic participation among community members?

10. Further Recommendations:

a. Are there any knowledgeable individuals or experts you can recommend who possess valuable insights related to energy communities in Flanders, or any relevant reports or publications that could provide valuable information for my research project?

THANK YOU FOR YOUR TIME

Figure A.4: Questionnaire for semi-structured interview

B | Informed Consent Form

SCCALE203050 WP2 Monitoring Tool Informed Consent Form

You are being invited to participate in a research study titled 'Sustainable Collective Citizen Action for a Local Europe 20-30-50' — 'SCCALE 203050'. This study is being done by Dr. Thomas Hoppe, ir. Michiel Fremouw, Dr. Nthabi Mohlakoana and mrs. Parisa Ali Panahi from Delft University of Technology under the Horizon 2020 project 'SCCALE203050', and is funded by CINEA under the H2020 Framework programme of the European Union under grant agreement No. 101033673. Contact person at Delft University of Technology is: Mrs. Parisa Ali Panahi (p.alipanahi@student.tudelft.nl).

Purpose: The purpose of this research study is to study maturation, niche development and scaling of the community energy sector in the Flanders region, Belgium, using a Strategic Niche Management approach. Data collection involves conducting expert and practitioner interviews and collecting text documents. The data will be used for data analysis and publications including a Master thesis, and potentially one or more academic publications. We will be asking you to participate in an interview that will take roughly 60 minutes.

Use and storage of data: The data provided here will be used for EU Horizon 2020 SCCALE 203050 project purposes and academic and purposes, which may include: data analysis and publishing. The information provided by the participant will be anonymized, where possible. This implies that all personal information, or information that enables the identification of the participant, will be censored and protected. After the completion of this project the anonymized data will be stored in a protected virtual database with limited access. All information collected will be kept on institutional servers (where available), or if institutional servers are not available, in password-protected electronic files on the hard drive of their secured computers. Data collected will be retained in secure filing cabinets for three years after the completion of the research project. All data with your personal information (e.g., full name and contact details) will be destroyed three years after the research study is completed unless you have agreed for us to contact you at a later date. The processed data would only be relevant and limited to the purposes of the research project (in accordance with the "data minimisation" principle).

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We guarantee privacy. We will minimize any risks by storing the data collected in a safe and confidential way at Delft University of Technology, and by anonymizing interview data.

Privacy and confidentiality: The researcher(s) will ask you for your agreement on providing information in the monitoring tool and making a recording when interviewing you. You can accept or decline to have your interview recorded.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions.

Contact person: The contact person for this research is Mrs. Parisa Ali Panahi (p.alipanahi@student.tudelft.nl).

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Figure B.1: Informed Consent Form

Written consent: Your participation in this study is only possible if you freely and independently sign this consent to authorize us to use the data you provide. If you do not wish to do so, please do not participate in this study.

I hereby declare:
I am 18 years or older and am competent to provide consent................................. yes ○ no ○

I have been fully informed about the aims and purposes of the project................. yes ○ no ○

I understand that there is no compulsion to participate and, if I choose to participate, I may at any stage withdraw my participation.. yes ○ no ○

I have read, or had read to me, a document providing information about this research and this consent form. .... yes ○ no ○

I have had the opportunity to ask questions and all my questions have been answered to my satisfaction and understand the description of the research that is being provided to me .... yes ○ no ○

I agree that my data (collected by the monitoring tool, and via interviews, among other means) is used for scientific purposes and I have no objection that my data is published in scientific publications in a way that does not reveal my identity .... yes ○ no ○

I agree that my responses during the research activities are recorded .... yes ○ no ○

If the answer was NO in the previous statement, I agree that the researcher will only take notes during the research activities .... yes ○ no ○

I understand that, subject to the constraints above, no recordings will be replayed in any public forum or made available to any audience other than the current researchers/research team .... yes ○ no ○

I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights .... yes ○ no ○

I understand that I may refuse to answer any question and that I may withdraw at any time without penalty .... yes ○ no ○

I understand that anonymization and pseudonymization techniques will be applied in order to minimize the risk of misuse regarding my personal data .... yes ○ no ○

Information may be shared between any of the other researcher(s) and partners participating in this Project in an anonymous form .... yes ○ no ○

Signatures

Figure B.2: Informed Consent Form

__________________________ _________________________ ________

Name of participant [printed] Signature Date

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

Parisa Ali Panahi

________________________ __________________ ________

Researcher name [printed] Signature Date

Study contact details for further information: [*Name, phone number, email address*]

Figure B.3: Informed Consent Form

C | Data Management Plan

Plan Overview

A Data Management Plan created using DMPonline

Title: SCCALE203050 WP2 Monitoring Tool_v2

Creator: Thomas Hoppe

Principal Investigator: Thomas Hoppe

Contributor: Nthabi Mohlakoana, Michiel Fremouw

Affiliation: Delft University of Technology

Funder: European Commission

Template: TU Delft Data Management Plan template (2021)

ORCID iD: my-orcid?orcid=0000-0002-0770-4858

Project abstract:

There is yet no methodology on how to monitor progress in organizational maturity and professionalization of Energy Communities (ECs). Neither is there any monitoring tool to monitor project performance of ECs. This makes it difficult to have any indication on how they are performing (i.e. as an organization and on key performance indicators like tons of CO2 reduction. In SCCALE Deliverable 2.2 a monitoring tool was developed. Following a process of feedback and iteration the monitoring tool was improved in terms of conceptual completeness, functionality and user friendliness.

Research objective: To test a monitoring tool that is capable of both monitoring progress in organisational maturity and professionalization of ECs, and progress in performance on selected KPIs of local projects they run. This objective is researched in the situational context of the five community energy demonstration pilots of the SCCALE 20-30-50 project, and the respective replication sites.

Research approach: To apply the monitoring tool with the aim to monitor five SCCALE pilots using a longitudinal mixed methods research design (using both quantitative and qualitative data). The tool should also be useful for evaluation purposes (i.e. to measure progress and assess whether ECs and their projects act in line of achieving pre-set targets).

Research methodology: This consists of three parts: (1) longitudinal progress measurement of pilot projects, (2) a survey on organisational maturity and professionalization, and (3) case studies of SCCALE pilots with expert and practitioner interviews.

ID: 116789

Start date: 06-02-2023

End date: 31-05-2024

Last modified: 01-06-2023

Grant number / URL: 101033676

SCCALE203050 WP2 Monitoring Tool_v2

0. Administrative questions

1. Name of data management support staff consulted during the preparation of this plan.

Mr. Nicolas Dintzner, Data steward of the faculty of TPM, has reviewed this DMP on [date].
E-mail: N.J.R.Dintzner@tudelft.nl

2. Date of consultation with support staff.

2023-02-02

I. Data description and collection or re-use of existing data

3. Provide a general description of the type of data you will be working with, including any re-used data:

Type of data	File format(s)	How will data be collected (for re-used data: source and terms of use)?	Purpose of processing	Storage location	Who will have access to the data
Interview transcripts	Word	Conducting interviews with community energy experts and practitioners	Storage, so that it can be used for data analysis later (for a project report, a Master thesis, and one or more research papers)	TPM SURF drive	No-one accept for the TPM data steward and Thomas Hoppe, and project lead partner of the SCCALE203050 project.
Monitoring tool data	Excel	Requesting selected community energy experts (involved in the SCCALE 203050 project) to fill out the monitoring tool (survey + project data).	Storage, so that it can be used for data analysis later (for a project report and one or more research papers)	TPM SURF drive	No-one accept for the TPM data steward and Thomas Hoppe, and project lead partner of the SCCALE203050 project.

4. How much data storage will you require during the project lifetime?

- < 250 GB

II. Documentation and data quality

5. What documentation will accompany data?

- Data will be deposited in a data repository at the end of the project (see section V) and data discoverability and re-usability will be ensured by adhering to the repository's metadata standards
- Other - explain below
- Methodology of data collection

A report will be delivered in which a manual of the monitoring tool is present.
A file on methodology used in the SCCALE203050 has been developed and can be appended or shared.
Data will be stored in Surfdrive (Tu Delft-TPM).

III. Storage and backup during research process

6. Where will the data (and code, if applicable) be stored and backed-up during the project lifetime?

- SURFdrive
- Project Storage at TU Delft

Data will be stored in Surfdrive (TU Delft - TPM).

IV. Legal and ethical requirements, codes of conduct

7. Does your research involve human subjects or 3rd party datasets collected from human participants?

- Yes

8A. Will you work with personal data? (information about an identified or identifiable natural person)

If you are not sure which option to select, ask your Faculty Data Steward for advice. You can also check with the privacy website or contact the privacy team: privacy-tud@tudelft.nl

- Yes

1. Interview transcripts from which it is clear which person was interviewed.
2. Completed monitoring tool surveys and project information from which it is clear from which organisation (i.e. energy community) this derives.

8B. Will you work with any other types of confidential or classified data or code as listed below? (tick all that apply)

If you are not sure which option to select, ask your Faculty Data Steward for advice.

- No, I will not work with any confidential or classified data/code

9. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your Faculty Contract Manager when answering this question. If this is not the case, you can use the example below.

The datasets underlying the published papers will be publicly released following the TU Delft Research Data Framework Policy. During the active phase of research, the project leader from TU Delft will oversee the access rights to data (and other outputs), as well as any requests for access from external parties. They will be released publicly no later than at the time of publication of corresponding research papers.
In complying with GDPR and the Horizon 2020 project SCCALE 203050 fundamental ethical principles to scientific research will be applied. This also applies to respect for intellectual property.

10. Which personal data will you process? Tick all that apply

- Data collected in Informed Consent form (names and email addresses)
- Signed consent forms

- Email addresses and/or other addresses for digital communication
- Names and addresses

11. Please list the categories of data subjects

Energy communities: project managers, members
Energy cooperatives: project managers, members
Municipalities: civil servants
Potential other stakeholders from the energy sector like distributed system operators (DSOs).

12. Will you be sharing personal data with individuals/organisations outside of the EEA (European Economic Area)?

- No

15. What is the legal ground for personal data processing?

- Informed consent

16. Please describe the informed consent procedure you will follow:

All study participants will be asked for their written consent for taking part in the study and for data processing before the start of the interview or the start of the survey.

17. Where will you store the signed consent forms?

- Same storage solutions as explained in question 6

Surfdrive at TU Delft - TPM.

18. Does the processing of the personal data result in a high risk to the data subjects?

If the processing of the personal data results in a high risk to the data subjects, it is required to perform a Data Protection Impact Assessment (DPIA). In order to determine if there is a high risk for the data subjects, please check if any of the options below that are applicable to the processing of the personal data during your research (check all that apply).
If two or more of the options listed below apply, you will have to complete the DPIA. Please get in touch with the privacy team: privacy-tud@tudelft.nl to receive support with DPIA.
If only one of the options listed below applies, your project might need a DPIA. Please get in touch with the privacy team: privacy-tud@tudelft.nl to get advice as to whether DPIA is necessary.
If you have any additional comments, please add them in the box below.

- Systematic monitoring
- Evaluation or scoring

No, there are no high risks to the data subjects in the SCCALE203050 project. And neither any additional stakeholders that will be interviewed. We will also take measures to secure this like anonymization.
Evaluating, monitoring and scoring applies to the use of the SCCALE monitoring tool (developed by TU/D) on monitoring and evaluating performance of five community energy pilot projects. Data collection takes place on four moments in time: M0, M21, M30, and M36.

19. Did the privacy team advise you to perform a DPIA?

- No

22. What will happen with personal research data after the end of the research project?

- Anonymised or aggregated data will be shared with others
- Personal research data will be destroyed after the end of the research project
- Other - please explain below

According to GDPR and TPM data policy personal data will be terminated after the project has ended. However, according to the Ethics report of the SCCALE 203050 project datasets will be retained and made available for researchers and data analysis for ten years after the project has ended. However, these data will be anonymized.

23. How long will (pseudonymised) personal data be stored for?

- Other - please state the duration and explain the rationale below

According to the Ethics report of the SCCALE 203050 project datasets will be retained and made available for researchers and data analysis for ten years after the project has ended.

24. What is the purpose of sharing personal data?

- For research purposes, which are in-line with the original research purpose for which data have been collected

25. Will your study participants be asked for their consent for data sharing?

- Yes, in consent form - please explain below what you will do with data from participants who did not consent to data sharing

V. Data sharing and long-term preservation

27. Apart from personal data mentioned in question 22, will any other data be publicly shared?

- I do not work with any data other than personal data

29. How will you share research data (and code), including the one mentioned in question 22?

- My data will be shared in a different way - please explain below
- All pseudonymised data will be uploaded to 4TU.ResearchData with restricted access
- No data can be publicly shared - please explain below

According to the Horizon 2020 SCCALE 203050 project (Ethic report) data will be archived in a closed and certified repository such DANS-Easy repository. Access to this dataset will be restricted and under the supervision of the project coordinator. All published datasets will be preserved for at least 10 years. They will be given a DOI for increased findability, and will be fully documented to facilitate later re-use. All qualitative and quantitative data will be stored in open format (.ODF, .RTF for text; .CSV for spreadsheets). Datasets that can be made publicly available will be made available at the same time as the related publications, at the latest 6 months following the end of the project.

30. How much of your data will be shared in a research data repository?

- < 100 GB

31. When will the data (or code) be shared?

- Other - please explain

According to the Horizon 2020 SCCALE 203050 project (Ethic report) datasets that can be made publicly available will be made available at the same time as the related publications, at the latest 6 months following the end of the project.

32. Under what licence will be the data/code released?

- CC BY

VI. Data management responsibilities and resources

33. Is TU Delft the lead institution for this project?

- No - please provide details of the lead institution below and TU Delft's role in the project

The Lead Partner of the H2020 SCCALE20-30-50 project is:
REScoop.eu
ANTWERP OFFICE
Posthoflei 3/3
2600 Berchem
Belgium
info@rescoop.eu

34. If you leave TU Delft (or are unavailable), who is going to be responsible for the data resulting from this project?

I think ir. Michiel Fremouw (M.A.Fremouw@tudelft.nl). Faculty of Architecture and the Built Environment.

35. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

No resources for data management were foreseen in the project budget of SCCALE203050.
4TU.ResearchData is able to archive 1TB of data per researcher per year free of charge for all TU Delft researchers. We do not expect to exceed this and therefore there are no additional costs of long term preservation.

D | Checklist for Human Research Ethics

Delft University of Technology
HUMAN RESEARCH ETHICS
CHECKLIST FOR HUMAN RESEARCH
(Version January 2022)

IMPORTANT NOTES ON PREPARING THIS CHECKLIST

1. An HREC application should be submitted for every research study that involves human participants (as Research Subjects) carried out by TU Delft researchers
2. Your HREC application should be submitted and approved **before** potential participants are approached to take part in your study
3. All submissions from Master's Students for their research thesis need approval from the relevant Responsible Researcher
4. The Responsible Researcher must indicate their approval of the completeness and quality of the submission by signing and dating this form OR by providing approval to the corresponding researcher via email (included as a PDF with the full HREC submission)
5. There are various aspects of human research compliance which fall outside of the remit of the HREC, but which must be in place to obtain HREC approval. These often require input from internal or external experts such as Faculty Data Stewards, Faculty HSE advisors, the TU Delft Privacy Team or external Medical research partners.
6. You can find detailed guidance on completing your HREC application here
7. Please note that incomplete submissions (whether in terms of documentation or the information provided therein) will be returned for completion **prior to any assessment**
8. If you have any feedback on any aspect of the HREC approval tools and/or process you can leave your comments here

I. Applicant Information

PROJECT TITLE:	**Horizon 2020 SCCALE203050**
Research period: *Over what period of time will this specific part of the research take place*	**February 20223 – December 2024**
Faculty:	**TPM**
Department:	**MAS**
Type of the research project: *(Bachelor's, Master's, DreamTeam, PhD, PostDoc, Senior Researcher, Organisational etc.)*	**Research project including Senior Researcher, PostDoc, and Master student**
Funder of research: *(EU, NWO, TUD, other – in which case please elaborate)*	**EU (Horizon 2020)**
Name of Corresponding Researcher: *(If different from the Responsible Researcher)*	**Dr. Thomas Hoppe**
E-mail Corresponding Researcher: *(If different from the Responsible Researcher)*	**T.Hoppe@tudelft.nl**
Position of Corresponding Researcher: *(Masters, DreamTeam, PhD, PostDoc, Assistant/ Associate/ Full Professor)*	**Associate Professor**
Name of Responsible Researcher: ***Note**: all student work must have a named Responsible Researcher to approve, sign and submit this application*	**Dr. Thomas Hoppe, ~~mr.~~ ir. Michiel Fremouw. ~~M.Sc~~. dr. Nthabi Mohlakoana, and one or more future Master student~~s~~ Parisa Alipanahi ~~(not clear yet whom this will be).~~**
E-mail of Responsible Researcher: *Please ensure that an institutional email address (**no Gmail, Yahoo, etc.**) is used for all project documentation/ communications including Informed Consent materials*	**T.Hoppe@tudelft.nl**
Position of Responsible Researcher : *(PhD, PostDoc, Associate/ Assistant/ Full Professor)*	**Associate Professor**

II. Research Overview

NOTE**: You can find more guidance on completing this checklist **here

a) Please summarise your research very briefly (100-200 words)

What are you looking into, who is involved, how many participants there will be, how they will be recruited and what are they expected to do?

Add your text here – (please avoid jargon and abbrevations)
There is yet no methodology on how to monitor progress in organizational maturity and professionalization of Energy Communities (ECs). Neither is there any monitoring tool to monitor project performance of ECs. This makes it difficult to have any indication on how they are performing (i.e. as an organization and on key performance indicators like tonnes of CO2 reduction. In SCCALE Deliverable 2.2 a monitoring tool was developed. Following a process of feedback and iteration the monitoring tool was improved in terms of conceptual completeness, functionality and user friendliness. **Research objective:** To test a monitoring tool that is capable of both monitoring progress in organisational maturity and professionalization of ECs, and progress in performance on selected KPIs of local projects they run. This objective is researched in the situational context of the five community energy demonstration pilots of the SCCALE 20-30-50 project, and the respective replication sites. **Research approach:** To apply the monitoring tool with the aim to monitor five SCCALE pilots using a longitudinal mixed methods research design (using both quantitative and qualitative

Figure D.1: Data Management Plan

data). The tool should also be useful for evaluation purposes (i.e. to measure progress and assess whether ECs and their projects act in line of achieving pre-set targets). **Research methodology:** This consists of three parts: (1) longitudinal progress measurement of pilot projects, (2) a survey on organisational maturity and professionalization, and (3) case studies of SCCALE pilots with expert and practitioner interviews.

b) **If your application is an additional project** related to an existing approved HREC submission, please provide a brief explanation including the existing relevant HREC submission number/s.

Add your text here – (please avoid jargon and abbrevations)

c) **If your application is a simple extension of, or amendment to,** an existing approved HREC submission, you can simply submit an HREC Amendment Form as a submission through LabServant.

Figure D.2: Data Management Plan

III. Risk Assessment and Mitigation Plan

NOTE: You can find more guidance on completing this checklist here

Please complete the following table in full for all points to which your answer is "yes". Bear in mind that the vast majority of projects involving human participants as Research Subjects also involve the collection of Personally Identifiable Information (PII) and/or Personally Identifiable Research Data (PIRD) which may pose potential risks to participants as detailed in Section G: Data Processing and Privacy below.

To ensure alighment between your risk assessment, data management and what you agree with your Research Subjects you can use the last two columns in the table below to refer to specific points in your Data Management Plan (DMP) and Informed Consent Form (ICF) – **but this is not compulsory**.

It's worth noting that you're much more likely to need to resubmit your application if you neglect to identify potential risks, than if you identify a potential risk and demonstrate how you will mitigate it. If necessary, the HREC will always work with you and colleagues in the Privacy Team and Data Management Services to see how, if at all possible, your research can be conducted.

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
A: Partners and collaboration						
1. Will the research be carried out in collaboration with additional organisational partners such as: • One or more collaborating research and/or commercial organisations • Either a research, or a work experience internship provider[1] *[1] If yes, please include the graduation agreement in this application*	x		Our research depends on collecting data with the help of pilot leaders from five demonstration pilots in the SCCALE203050 projects. This also involves getting information and contacts in so called 'replication sites'. Potential risks: Unwillingness to collaborate; Delay in providing requested information; Delay in getting interviews done.	We will involve the project's lead partner to discuss and resolve the issue and persuade the pilot leader to provide us with the requested information.	x	
2. Is this research dependent on a Data Transfer or Processing Agreement with a collaborating partner or third party supplier? *If yes please provide a copy of the signed DTA/DPA*		x				
3. Has this research been approved by another (external) research ethics committee (e.g.: HREC and/or MREC/METC)? *If yes, please provide a copy of the approval (if possible) and summarise any key points in your Risk Management section below*		x				
B: Location						

Figure D.3: Data Management Plan

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
4. Will the research take place in a country or countries, other than the Netherlands, within the EU?	X	x	**The pilot leaders need to comply with their country regulations on implementing Energy Community projects. Some of these regulations may lead to delays in completing specific project tasks.**	We will ensure that all pilot leaders in the different countries are familiar with the regulations and encourage them to build relations and collaborate with their countries' regulatory bodies. In case problems or serious delay occurs we will involve the project's lead partner to discuss and resolve the issue.	x	
5. Will the research take place in a country or countries outside the EU?		x				
6. Will the research take place in a place/region or of higher risk – including known dangerous locations (in any country) or locations with non-democratic regimes?		x				
C: Participants						
7. Will the study involve participants who **may** be vulnerable and possibly (legally) unable to give informed consent? (e.g., children below the legal age for giving consent, people with learning difficulties, people living in care or nursing homes,).		x				
8. Will the study involve participants who **may** be vulnerable under specific circumstances and in specific contexts, such as victims and witnesses of violence, including domestic violence; sex workers; members of minority groups, refugees, irregular migrants or dissidents?		x				
9. Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children, own students or employees of either TU Delft and/or a collaborating partner organisation)? *It is essential that you safeguard against possible adverse consequences of this situation (such as allowing a student's failure to participate to your satisfaction to affect your evaluation of their coursework).*		x				
10. Is there a high possibility of re-identification for your participants? (e.g., do they have a very specialist job of which there are only a small number in a given country, are they members of a small community, or employees from a partner company collaborating in the research? Or are they one of only a handful of (expert) participants in the study?	x		In some of the countries in which we collect data from pilots there are only few energy communities, so the likelihood of re-identification may exist. But given the topic of our research, and it low sensitivity, we don't think this will an issue. So, there is low risk involved to the research participants.	We will anonimize data so as to safeguard privacy and confidentiality. In addition, we will involve the project's lead partner to discuss and resolve the issue in case problems occur.	x	X
D: Recruiting Participants						
11. Will your participants be recruited through your own, professional, channels such as conference attendance lists, or through specific network/s such as self-help groups	x		Recruitment will be done via the lead partner and other project partners in the SCCALE203050 project	In case problems or serious delay occurs we will involve the project's lead partner to discuss and resolve the issue.	X	

Figure D.4: Data Management Plan

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
12. Will the participants be recruited or accessed in the longer term by a (legal or customary) gatekeeper? (e.g., an adult professional working with children; a community leader or family member who has this customary role – within or outside the EU; the data producer of a long-term cohort study)		x				
13. Will you be recruiting your participants through a crowd-sourcing service and/or involve a third party data-gathering service, such as a survey platform?		x				
14. Will you be offering any financial, or other, remuneration to participants, and might this induce or bias participation?		x				
E: Subject Matter *Research related to medical questions/health may require special attention. See also the website of the CCMO before contacting the HREC.*						
15. Will your research involve any of the following: • Medical research and/or clinical trials • Invasive sampling and/or medical imaging • Medical and *In Vitro Diagnostic Medical* Devices Research		x				
16. Will drugs, placebos, or other substances (e.g., drinks, foods, food or drink constituents, dietary supplements) be administered to the study participants? *If yes see here to determine whether medical ethical approval is required*		x				
17. Will blood or tissue samples be obtained from participants? *If yes see here to determine whether medical ethical approval is required*		x				
18. Does the study risk causing psychological stress or anxiety beyond that normally encountered by the participants in their life outside research?		x				
19. Will the study involve discussion of personal sensitive data which could put participants at increased legal, financial, reputational, security or other risk? (e.g., financial data, location data, data relating to children or other vulnerable groups) *Definitions of sensitive personal data, and special cases are provided on the TUD Privacy Team website.*		x				
20. Will the study involve disclosing commercially or professionally sensitive, or confidential information? (e.g., relating to decision-making processes or business strategies which might, for example, be of interest to competitors)		x				
21. Has your study been identified by the TU Delft Privacy Team as requiring a Data Processing Impact Assessment (DPIA)? *If yes please attach the advice/ approval from the Privacy Team to this application*		x				
22. Does your research investigate causes or areas of conflict?		x				

Figure D.5: Data Management Plan

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
If yes please confirm that your fieldwork has been discussed with the appropriate safety/security advisors and approved by your Department/Faculty.						
23. Does your research involve observing illegal activities or data processed or provided by authorities responsible for preventing, investigating, detecting or prosecuting criminal offences *If so please confirm that your work has been discussed with the appropriate legal advisors and approved by your Department/Faculty.*		x				
F: Research Methods						
24. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places).		x				
25. Will the study involve actively deceiving the participants? (For example, will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study).		x				
26. Is pain or more than mild discomfort likely to result from the study? And/or could your research activity cause an accident involving (non-) participants?		x				
27. Will the experiment involve the use of devices that are not 'CE' certified? *Only, if 'yes': continue with the following questions:*		x				
• Was the device built in-house?		x				
• Was it inspected by a safety expert at TU Delft? *If yes, please provide a signed device report*		x				
• If it was not built in-house and not CE-certified, was it inspected by some other, qualified authority in safety and approved? *If yes, please provide records of the inspection*		x				
28. Will your research involve face-to-face encounters with your participants and if so how will you assess and address Covid considerations?		x	**No, only online.**			
29. Will your research involve **either:** a) "big data", combined datasets, new data-gathering or new data-merging techniques which might lead to re-identification of your participants **and/or** b) artificial intelligence or algorithm training where, for example biased datasets could lead to biased outcomes?		x				
G: Data Processing and Privacy						
30. Will the research involve collecting, processing and/or storing any directly identifiable PII (Personally Identifiable Information) including name or email	x		As with any online activity the risk of a breach is always possible. There is a risk that data 'leaks', but	To the best of our ability data ~~collecred~~collected will remain confidential. We guarantee privacy and we will	x	x

Figure D.6: Data Management Plan

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
address that will be used for administrative purposes only? (eg: obtaining Informed Consent or disbursing remuneration)			due to its low-sensitivity nature, we do not foresee this as an issue that will lead to any harm to the project and the pilot sites we are working with. ~~But honestly, I don't think that given the sensitivity of the research project this will be an issue.~~	not collect personally identifiable data. We will minimize any risks by storing the data collected in a safe and confidential way at Delft University of Technology (i.e., in Surfdrive), and by anonymizing survey and interview data. In a case a data breach occurs we will involve the project's lead partner to discuss and resolve the issue.		
31. Will the research involve collecting, processing and/or storing any directly or indirectly identifiable PIRD (Personally Identifiable Research Data) including videos, pictures, IP address, gender, age etc and **what other Personal Research Data** (including personal or professional views) will you be collecting?		x				
32. Will this research involve collecting data from the internet, social media and/or publicly available datasets which have been originally contributed by human participants		x				
33. Will your research findings be published in one or more forms in the public domain, as e.g., Masters thesis, journal publication, conference presentation or wider public dissemination?	x		Risk that respondents and their organisations are identified ~~(and suffer negative consequences)~~ via information presented in an academic publication like an academic journal article or conference paper, or wider dissemination.	Data and hence, results will be anonimyzed so as to safeguard confidentiality and privacy of respondents or interviewees.	x	x
34. Will your research data be archived for re-use and/or teaching in an open, private or semi-open archive?		x				

Figure D.7: Data Management Plan

H: More on Informed Consent and Data Management

NOTE: You can find guidance and templates for preparing your Informed Consent materials) here

Your research involves human participants as Research Subjects if you are recruiting them or actively involving or influencing, manipulating or directing them in any way in your research activities. This means you must seek informed consent and agree/ implement appropriate safeguards regardless of whether you are collecting any PIRD.

Where you are also collecting PIRD, and using Informed Consent as the legal basis for your research, you need to also make sure that your IC materials are clear on any related risks and the mitigating measures you will take – including through responsible data management.

Got a comment on this checklist or the HREC process? You can leave your comments here

IV. Signature/s

Please note that by signing this checklist list as the sole, or Responsible, researcher you are providing approval of the completeness and quality of the submission, as well as confirming alignment between GDPR, Data Management and Informed Consent requirements.

Name of Corresponding Researcher (if different from the Responsible Researcher) (print)

Thomas Hoppe

Signature of Corresponding Researcher:

Date: 04 May 2023

Name of Responsible Researcher (print)

Thomas Hoppe

Signature (or upload consent by mail) Responsible Researcher:

Date: 04 May 2023

Figure D.8: Data Management Plan

V. Completing your HREC application

Please use the following list to check that you have provided all relevant documentation

Required:

- **Always:** This completed HREC checklist
- **Always:** A data management plan (reviewed, where necessary, by a data-steward)
- **Usually:** A complete Informed Consent form (including Participant Information) and/or Opening Statement (for online consent)

Please also attach any of the following, if relevant to your research:

Document or approval	Contact/s
Full Research Ethics Application	After the assessment of your initial application **HREC will let you know if and when you need to submit additional information**
Signed, valid Device Report	Your Faculty HSE advisor
Ethics approval from an external Medical Committee	TU Delft Policy Advisor, Medical (Devices) Research
Ethics approval from an external Research Ethics Committee	Please append, if possible, with your submission
Approved Data Transfer or Data Processing Agreement	Your Faculty Data Steward and/or TU Delft Privacy Team
Approved Graduation Agreement	Your Master's thesis supervisor
Data Processing Impact Assessment (DPIA)	TU Delft Privacy Team
Other specific requirement	Please reference/explain in your checklist and append with your submission

Figure D.9: Data Management Plan