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## Summary

This thesis explains the influence of renewable energy cooperatives on consumer engagement within the context of distributed generation systems.

As part of the efforts to decarbonize the global energy system, an increasing number of bottom-up initiatives and grassroots organizations emerge to explore the benefits of decentralized energy systems. The rise of distributed generation systems provides opportunities to involve local citizens and civil communities in the global and local energy transition. However, this process must be complemented with the active engagement of citizens with these novel types of localized, small-scale, and renewables-based energy systems to guarantee their technical and financial viability. In particular, the re-emergence of the cooperative model in the energy sector can help to engage consumers with these innovative technologies.

The purpose of this thesis is to provide insights into the extent to which the structural characteristics of renewable energy cooperatives influence the attitudes and behaviours of their members. Two separate case studies located in the Netherlands, Blijstroom and Loenen Cooperative, are selected based on their structural and contextual characteristics, as well as the projects implemented, to empirically reflect on their similarities and differences. The primary qualitative data used in this research include semi-structured interviews and short embedded questionnaires conducted with the organizations' members. Secondary data comprises desktop research (documents, facts, and figures from the selected case studies as well as academic articles) to investigate specific structural characteristics of the cooperatives. By gathering perspectives and insights from the respondents, this research unveils and explains the effects of extrinsic structures on social actors' individual and collective engagement.

The data analysis performed in this research indicates that no distinct correlation between the variance in structures of renewable energy cooperatives and the variance in consumer engagement can be demonstrated. On the contrary, the study finds that, regardless of their characteristics, renewable energy cooperatives activate social norms and promote common interests, reducing the cognitive distance between energy generation and production, and providing incentives for local stakeholders to engage with innovative and decentralized energy systems. On one hand, this paper advocates conducting further research on different renewable energy cooperatives' structures, cross-country analysis on drivers and barriers of consumer engagement, and the role of renewable energy cooperatives in the urban energy transition. On the other hand, this study recommends policymaking to consider the importance of non-price-based mechanisms to harness the potential of local communities in the energy transition and to reflect on renewable energy cooperatives as key stakeholders to promote polycentric governance in urban areas.

## **Keywords**

Collaborative solar systems, community energy, consumer engagement, decentralized energy systems, distributed generation, renewable energy cooperatives, renewable energy technologies, smart grids, social acceptance, virtual power plants.

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- Remy Rupp, 2021

## Foreword

“All that is real in human history becomes irrational in the process of time.”

- Friedrich Engels

## Abbreviations

CE	Community Energy
CHP	Combined Heat and Power
CVPP	Community Virtual Power Plant
DER	Distributed Energy Resources
DG	Distributed Generation
EU	European Union
GHG	Greenhouse Gas
ICA	International Cooperative Alliance
IHS	Institute for Housing and Urban Development Studies
IPCC	Intergovernmental Panel on Climate Change
kW h	Kilowatt-hour
NIMBY	Not-In-My-Back-Yard
PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable Energy
REC	Renewable Energy Cooperative
RES	Renewable Energy Source
RET	Renewable Energy Technology
SG	Smart Grid
VPP	Virtual Power Plant

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# Chapter 1: Introduction

## 1.1. Background information

The limitations and challenges currently faced by energy systems, as well as the imperative transition to low-carbon societies are today widely recognized. As cities grow, populations increase, and economic activity expands, policies and technologies are confronted with the multifaceted problem of simultaneously meeting the growing energy demand and decarbonizing energy provision. Furthermore, in 2020, the 5.8% global energy-related CO<sub>2</sub> emissions reduction engendered by the Covid-19 pandemic and the resulting economic crisis, emphasized, once again, the world's heavy dependence on fossil fuels (International Energy Agency, 2021). Consequently, the concept of the energy transition understood as the changing composition structure of primary energy supply, achieved through the deployment of renewable energy sources (RES), has attracted wide interest (Smil, 2016). Conventionally, national governments and corporate actors have been the main entities tasked with governing energy supply and driving energy transitions. However, the idea that energy infrastructures should be isolated from citizen involvement and rely on centralized production has taken root only in the last decades. Dominant energy producers such as the German *RWE* or the Swedish *Vattenfall*, started as small, municipally governed production facilities, before evolving into ever-larger companies (van der Schoor & Scholtens, 2015).

In recent years, a fascinating debate has progressively raised the question of whether bottom-up initiatives developed by local communities foster the transition to low-carbon energy systems more efficiently than top-down structures and legally binding goals. Community energy (CE) initiatives have progressively emerged in this context, characterized as “formal or informal citizen-led initiatives which propose collaborative solutions on a local basis to facilitate the development of sustainable energy technologies and practices” (Bauwens et al., 2016, p. 136). Among this highly dynamic and multifaceted field, renewable energy cooperatives (REC) have been pinpointed as the most relevant form of CE initiatives and identified as potential key stakeholders in the transition to renewable energy (RE) systems. Their structures, enabling citizens to collectively invest in, own and manage RE projects at the local level, disrupt the traditional energy process and justify their spreading momentum. Currently, *REScoop*, the European federation of RECs, counts 1500 organizations within its federation, with a total of 1,250,000 European citizens as active members (REScoop, 2021).

In addition to their economic and technical benefits, the structures of RECs have been widely praised for their social and environmental impacts. In particular, research has shown that local ownership, spatial proximity and the involvement of communities in the decision-making process address the problem of social acceptance of RE innovations (e.g., Huybrechts & Mertens, 2014; Yildiz et al., 2015). To embrace a more active dimension of acceptance, academic literature has progressively investigated the potential of RECs in promoting the active engagement of citizens in locally managed energy projects. By stimulating essential socio-psychological mechanisms such as awareness and trust, their organizational structures are likely to influence and adjust the behaviour of consumers, and thus contribute to the active engagement of citizens in the diffusion of decentralized energy systems and renewable energy technologies (RET). In particular, the rise of distributed generation (DG) systems represents an alternative paradigm of generating electricity and heat locally. Based on a network of multiple, small-scale and geographically dispersed generating units, situated close to consumer sites and directly connected to the distribution network, these systems redefine the role of the consumer. Therefore, to become technically and financially viable, these localized energy systems require the active engagement of consumers. Complemented by the rise of co-providers of energy, or commonly referred to as *prosumers*, the structures of RECs thus provide major opportunities to actively engage citizens in DG systems.

## **1.2. Problem statement**

Despite these significant transformations, there is very limited knowledge about the precise structural components of RECs that influence the active engagement of consumers in their role as prosumers. Since most studies on CE initiatives in general and RECs in particular have focused on the factors that influence participation in local projects (see: Huybrechts & Mertens, 2014; van der Schoor & Scholtens, 2015; Bauwens, 2016; Hicks & Ison, 2018) very few studies have sought to explain to what extent they influence their members once involved in the organizations. Furthermore, whereas literature has presented a homogeneous picture of RECs, their differing structural components are likely to influence local consumers to varying degrees. Researching on the relationship between structural entities and a social phenomenon also implies appreciating the nature of their relationship. While awareness and trust have been extensively examined in academic literature, very few studies have conducted research on their determinant factors, or their influence on consumer engagement. Consequently, our research seeks to explore the structural components of RECs, understand how they influence their

members in terms of consumer engagement, identify the role played by awareness and trust, and thus explain the effects of extrinsic elements on social actors' perspectives and behaviours.

### **1.3. Relevance of the research topic**

#### **1.3.1. Scientific relevance**

The scientific relevance of our research is two-fold. First, there is a growing recognition that CE initiatives are essential to foster the involvement of local citizens and communities, in the context of the global energy transition and the decentralization of energy systems. Therefore, research conducted on RECs' structural components that influence the engagement of their members adds crucial knowledge to the literature on their environmental and social impacts. Secondly, academic literature has mostly focused on the issue of social acceptance to emphasize the critical role played by local communities in the transition toward RE systems. Although this concept is useful to explain the gap between the opportunities of large RE infrastructure projects and their slow scale of deployment, the emergence of DG systems requires a paradigm shift. Our research explores the main elements and determinants of consumer engagement in the context of DG systems, and therefore generate new insights on the active dimension of citizen involvement in the transition to decentralized RE systems.

#### **1.3.2. Social relevance**

In the current scheme of centralized global energy production, the spatial, and subsequently cognitive, distance between generation and consumption results in a lack of awareness, trust, and agency of local stakeholders (Pasqualetti, 1999). The insights generated from this study could serve to understand the potential of alternative organizational models in addressing contemporary environmental and social challenges. Taking it further, this research could accentuate the potential of polycentric governance (Ostrom, 2010), to enhance innovation, learning, adaptiveness, and achievement of more sustainable and effective outcomes at different levels. Moreover, it is recognized that the ultimate deployment of RETs and DG systems does not depend on the availability of the technologies, but on the users' willingness to integrate them into their daily life. Thus, this research could help to draw lessons for policymaking, to understand under which circumstances citizens are willing to actively interact

with innovative technologies and provide flexibility for decentralized infrastructures to avoid imbalances in the power systems engendered by the fluctuance and intermittence of RESs.

## 1.4. Research objectives

This research aims to theoretically and empirically investigate the social and environmental impacts of RECs. More specifically, we wish to identify the key elements of RECs that influence the active engagement of their members, and therefore make an important contribution to sustainable energy generation, consumption, distribution, and management. Therefore, the objectives for our research are the following:

- 1. Identify the main structural components of renewable energy cooperatives that actively influence consumer engagement
- 2. Identify the elements of consumer engagement with respect to distributed generation systems
- 3. Explain the mediating role of awareness and trust, as an outcome of renewable energy cooperatives' structures and as a determinant of consumer engagement
- 4. Identify and explain the causal relationships between the elements mentioned above

To reach our research objectives, this paper examines two case studies based in the Netherlands, *Blijstroom*, located in the city of Rotterdam and *Loenen Cooperative*. Their specific characteristics and contexts are thoroughly researched and exhibited in chapter 4. By investigating the different structural components of these organizations, our research aims to comprehend to what extent a possible variation in consumer engagement would be attributable to the variation in the structures of RECs.

## **1.5. Main research question and research sub-questions**

**Main Research Question:** To what extent do renewable energy cooperatives influence consumer engagement in the context of distributed generation systems?

### **Sub-questions:**

- 1. What are the main structural characteristics of renewable energy cooperatives that actively influence consumer engagement?
- 2. What is consumer engagement and how does it relate to distributed generation systems?
- 3. What is the role played by the mechanisms of awareness and trust?

## **1.6. Scope and limitations**

As outlined in the previous sections, this paper aims attention at specific elements and concepts related to our research objectives and questions. First of all, whereas the concept of CE initiatives will be briefly assessed, and other organizational entities introduced, this research exclusively focuses on RECs' structural components and their influence on consumer engagement. Secondly, when exploring the theoretical underpinnings of consumer engagement, a wide array of socio-psychological mechanisms could be addressed. However, only the mechanisms of awareness and trust, considered key in the context of our research, are examined. Finally, the context of this paper encompasses the implementation of DG projects and systems but does not include any theoretical conceptions or debates about the emergence of these grassroots energy innovations.

## Chapter 2: Literature Review

This literature review pursues three objectives: first, outline what is already known and what is missing about the researched topic; secondly, explore and define the concepts related to the research question; lastly, identify the elements in the theoretical framework that can be empirically investigated through the research design and methods. Section 2.1 starts by exploring the main characteristics of CE initiatives and the organizational forms of RECs. Then, section 2.2 defines consumer engagement and emphasizes why it should be studied. Section 2.4 exhibits the role of awareness and trust, and how these mechanisms influence consumer engagement through the structures of RECs. Last but not least, section 2.5 briefly concludes this chapter, whilst section 2.6 builds upon the findings of this chapter to present our conceptual framework.

### 2.1. Community energy initiatives and renewable energy cooperatives

#### 2.1.1. Community energy initiatives

##### 2.1.1.1. *An elastic concept*

Over the past decades, CE initiatives have emerged as a way of democratically implementing RET's and giving emphasis to various themes such as energy efficiency, social cohesion, and local engagement (Walker, 2008). However, CE is described as a “vague”, “elastic” and sometimes “problematic” concept (Hicks & Ison, 2018, p. 524) to characterise a disparate sector, involving diverse actors and organizational forms (van der Schoor & Scholtens, 2015), pursuing various goals and involving a large range of strategies, activities, and technologies (Gui & MacGill, 2018).

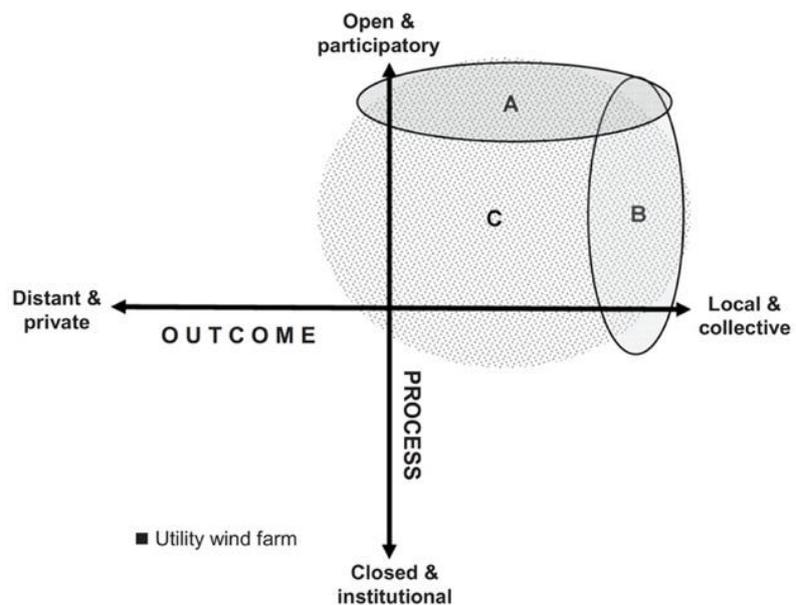
##### 2.1.1.2. *Defining community*

Research on the term *community* shows that it encapsulates various elements and meanings. Considering a range of environmental and energy-related uses of the term, Walker (2011, p. 777) outlines six “different but interconnected meanings”: a community can be understood as an *actor*, a *scale*, a *place*, a *network*, an *identity*, and even as a *process*. In the specific relation to community energy, multiple authors characterized the term *community* as a social network

linked to *communities-of-location* and *communities-of-interest* (Seyfang et al., 2013; Tarhan, 2015; Klein & Coffey, 2016). Whereas the former refers to geographically-bound communities, the latter relates to communities that are formed by individuals that are assembled around a topic of common interest, rather than bound by geographic boundaries. The latter classification, which is common to characterize energy communities in academic literature, is employed in this research to distinguish the different spatial characteristics among RECs.

### 2.1.1.3. Understanding community energy

To provide clarity on what differentiates CE projects from commercial projects, Walker & Devine-Wright (2007) highlight two dimensions, *process* and *outcome*, illustrated in figure 1. While the process dimension is concerned with who a project is developed and directed by, the outcome dimension is concerned



**Figure 1: Walker and Devine-Wright's understanding of community energy in relation to project process and outcome dimensions.**  
**Source: Walker & Devine-Wright, 2008.**

with how the outcomes of a project are socially and spatially distributed. Notwithstanding the usefulness of this definition, Hicks & Ison (2018) stress that the process and outcome dimensions are not detailed or specific enough to explain what constitutes a CE process or outcome. To bridge this gap, van Summeren et al. (2020) conducted a systematic literature review, emphasizing that CE must not only be described by the degree to which communities are involved but also through their organizational model.

In practice, CE initiatives are very heterogeneous in terms of legal forms and organizational models. Whereas the most common forms are energy cooperatives (EC), other entities such as *development trusts*, *community charities*, and *community organisations* have progressively emerged to allow for wide citizens' participation and ownership in RE schemes (Walker, 2008). These different models present different attributes: community charities mostly manage community buildings and activities, developments trusts represent the community's interests in revenue-generating schemes, and community organizations own shares in commercial projects. However, as specified in section 1.6, this research exclusively focuses on RECs, praised as the most relevant and fast-growing form of CE initiatives (Huybrechts & Mertens, 2014; Šahović & da Silva, 2016), and depicted as “a synthesis of technological and social change” (Yildiz et al., 2015, p. 70).

## **2.1.2. Renewable energy cooperatives**

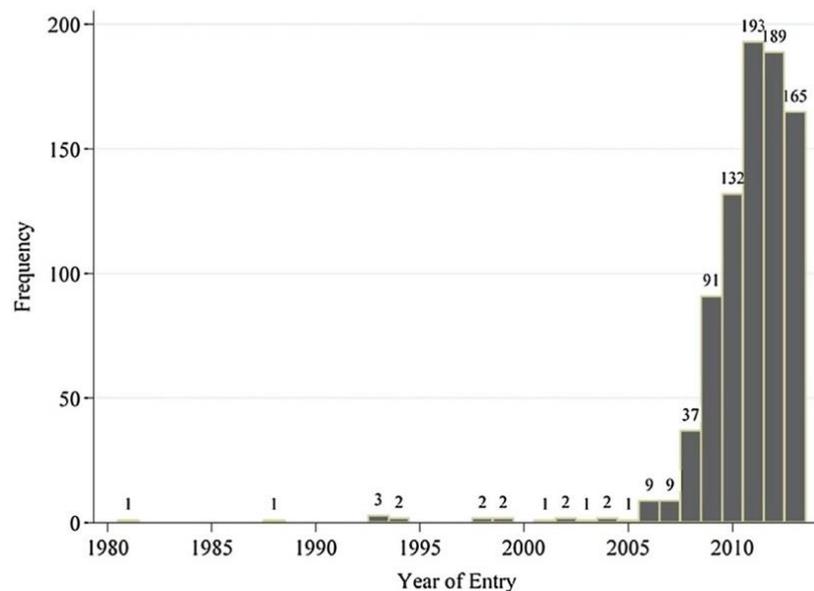
### ***2.1.2.1. The cooperative model***

In general terms, the cooperative model can be understood as a firm that is owned by its users, rather than by its investors. According to the International Cooperative Alliance (ICA), a cooperative is “an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise” (ICA, 2018 in Schmid & Meister, 2020, p. 124).

Two elements should be highlighted in the definition provided by the ICA for this research. First of all, most aspects join van Summeren et al.'s (2020) idea that a CE initiative should not only be understood by the degree to which the community is involved but also how members and users are organized and interact. Secondly, social characteristics are important determinants of members' involvement and engagement in the organizational entities of cooperatives, including in their roles as consumers.

### 2.1.2.2. Defining renewable energy cooperatives

Multiple authors have explored the history of EC's and the emergence of RECs to explain their contemporary predominance. In particular, the work of Yildiz (2013) has been a landmark study concerning the history of German EC's, whose history traces back to the 19<sup>th</sup> century. The latter demonstrates that local actors



**Figure 2: Newly formed RECs in Germany, 1980-2013.**

**Source: Yildiz et al., 2015.**

formed EC's, mostly in rural areas, to provide basic energy infrastructures. While EC's remained globally powerful until World War II, the economic recovery and the surge in electricity demand paved the way for centralized energy infrastructures (Huybrechts & Mertens, 2014). However, the cooperative model started to re-emerge as an organizational entity in the energy sector with the rise of RET's (Yildiz et al., 2015). Hentschel et al. (2018) provide two reasons for this phenomenon. Firstly, the disparate features of RET's lead to decentralization and active participation of the property owners who are willing to engage in these installations. Furthermore, a cooperative may "increase the value and reduce the cost of renewable resources for individual producers, aside from the social benefits that may accrue" (Hentschel et al., 2018, p.121).

Whereas the latter reason partly highlights the reasons for stakeholders to get involved in RECs, the former reason stresses that the diffusion of RET's implies an active engagement of their owners. Furthermore, Šahović & da Silva (2016) affirm that the re-emergence of RECs as a major organizational form in the energy field is essential to foster the engagement of citizens with social, financial, and technological aspects of RET deployments, and provide an alternative model for the production and consumption of RE.

### ***2.1.2.3. Characteristics of renewable energy cooperatives***

The re-emergence of the cooperative model in the field of RE has triggered extensive research on their roles, assets, impacts and barriers (see: Huybrechts & Mertens, 2014; Tarhan, 2015; Yildiz et al., 2015; Hentschel et al., 2018). Nonetheless, an exhaustive theory-based typology and classification of RECs are still missing. Whereas literature has presented a homogenous picture of RECs, based on technical and economic dimensions, they differ in terms of their objectives, level of ownership, and operating areas. Besides, Yildiz et al. (2015, p. 68) emphasize that RECs must be studied as “social entities, characterized by multiple social relationships featuring individual and collective actions”. This makes it essential to consider not only the structural models of RECs but also the individual characteristics of their members at the micro level. The structural components exhibited below only encompass the elements that are researchable through empirical fieldwork and are likely to vary among different RECs.

#### ***Objective***

Firstly, RECs differ in terms of their “objective” (Šahović & da Silva, 2016, p. 55). Yildiz et al. (2015, p. 62) distinguish RECs according to their primary activities, or what they name their “value chain approach”: RECs can range from the generation of RE, the distribution of RE, the trading of RE, or any hybrid form involving one of the previous elements. Furthermore, the classification of energy sources can be useful to further differentiate the major group of generation RECs (Yildiz et al., 2015). These range from biomass, wind energy, solar energy, geothermal, biogas, to tidal energy production (Yildiz et al., 2015; Heras-Saizarbitoria et al., 2018). The type of energy generated is important since the visual impact and noise levels of RE installations are likely to greatly influence the perceptions and attitudes of its users (Wüstenhagen et al., 2007; Warren & McFayden, 2011).

### ***Level of ownership***

Secondly, RECs generally exhibit strong features of community ownership by local stakeholders. However, different models of legal ownership over the entities and assets can be found. These range from 100% owned by the community to co-owned with the private sector (Schreuer & Weismeier-Sammer, 2010; Walker et al., 2010). Moreover, through their respective case studies on wind energy ownership in Japan and Scotland, Maruyama et al. (2007) and Warren & McFayden (2010, p. 205), emphasize the *symbolic* dimension of citizen ownership, underlining that a subjective “sense of ownership” can be significant for local communities.

### ***Spatial characteristics***

It is essential to specify that the spatial characteristics of RECs also play an essential role in the engagement of their members. Depending on whether Recs are formed by a *community-of-interest* or a *community-of-location*, they entail different models of ownership and varying degrees of inclusiveness and collectiveness (Tarhan, 2015). Spatial proximity also plays an essential role to facilitate the activation of social norms in a group and foster the exchanges of information and the enhancement of trust (Bauwens, 2016). The spatial characteristics of RECs also determine their business model. Whereas most RECs have a local or regional focus, some range from a fully integrated REC, a network of RECs, to RECs with a multi-stakeholder governance model, or even non-energy-focused-organizations (Heras-Saizarbitoria et al., 2018).

### ***Member characteristics***

Finally, a closer look at the characteristics of REC members may also further add to our understanding of the heterogeneity of these organizations. Huybrechts & Mertens (2014) demonstrate that RECs tend to comprise multiple stakeholder types (producers, consumers, workers), rather than a homogeneous or dominant stakeholder. Moreover, the period of membership of REC members is depicted as an essential indicator to understand their level of engagement and their energy behaviour (Bauwens, 2016; Hoppe et al., 2019).

The findings of this section indicate that the organizational form and the structural components of RECs may profoundly diverge according to the elements explored. Besides, academic literature has already emphasized that different organizational and member characteristics imply different dynamics of participation and motivations to join RECs (see: Bauwens, 2016; Bauwens et al., 2016; Bauwens & Devine-Wright, 2018). However, the actual level of engagement of their members, and their behaviour in their role as consumers has been largely ignored. In the next section, we explore the traditional concept of *social acceptance*, before emphasizing why the emergence of novel forms of energy technologies require a more active dimension, such as *consumer engagement*.

## 2.2. From social acceptance to consumer engagement

### 2.2.1. Social acceptance

#### 2.2.1.1. The concept of social acceptance

There has been a broad consensus in the academic literature that the success of RET installations depends on the willingness of societal stakeholders to accept their technical and social aspects. The traditional concept in literature refers to *social acceptance*, an area of study that has “blossomed over the last decade” (Devine-Wright et al., 2017, p. 27).

The most influential paper on this concept is Wüstenhagen et al. (2007), which introduces the three dimensions

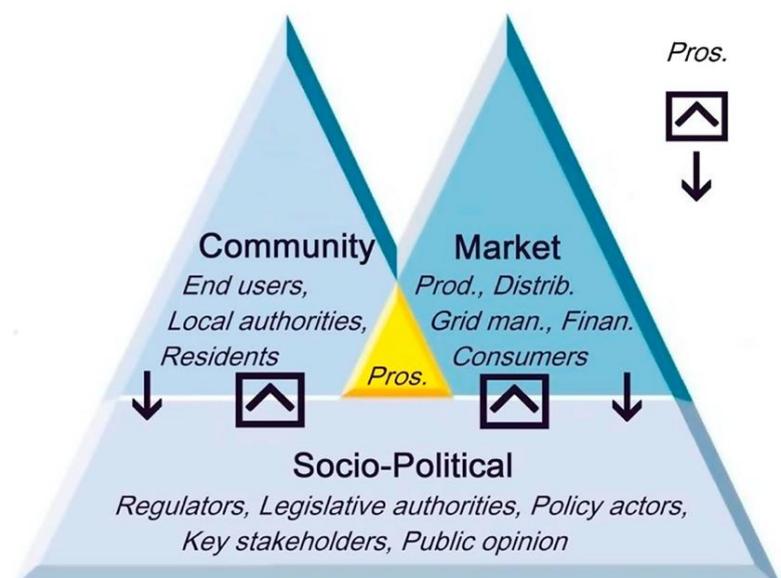


**Figure 3: The three dimensions of social acceptance of renewable energy innovation.**  
Source: Wüstenhagen et al., 2007.

of social acceptance, represented in figure 3. Firstly, *socio-political acceptance* refers to the willingness among key societal stakeholders to generate an institutional change to create favourable conditions for technological innovation. Then, *market acceptance* refers to the process of market approval of an innovation. Finally, *community acceptance* refers to the “specific acceptance of siting decisions and renewable energy projects by local stakeholders, particularly residents and local authorities” (Wüstenhagen, 2007, p. 2685). While there has been uninterrupted debate about these dimensions, there are two things this research needs to stress.

On one hand, Wüstenhagen et al.’s (2007) distinctions underline the curious contradiction between the general public support for RET’s and the resistance to specific local projects. This phenomenon has been broadly explained by the NIMBY (Not-In-My-Back-Yard) concept, suggesting that people are willing to support RETs as long as they are out of their sight. However, NIMBY-ism has been heavily criticized for oversimplifying people’s actual motives. Several authors argue that a multiplicity of other factors is responsible for the public attitudes towards local energy projects (Wolsink, 2006; Warren & McFayden, 2010) and that the acceptance of RET’s is not a purely individual characteristic, but the result of a continuous social and psychological process (Wolsink, 2018).

On the other hand, while Wüstenhagen et al. (2007) establish a distinction between the three dimensions of social acceptance, Wolsink (2012, p. 827) notices the similarity between *community acceptance* and *market acceptance*, which are both concerned with “the integration of renewable power generation at a particular location and in a community”, and the “willingness to pay or to invest” in RET projects. As part of the complex diffusion of decentralized RET’s and DG configurations, this



**Figure 4: Wüstenhagen et al. ‘s (2007) three dimensions of social acceptance of RE innovation updated with the role of prosumers in the co-production process.**

**Source: Wolsink, 2018.**

conceptual similarity highlights the convergence between the roles of consumer, producer, and investor, depicted in figure 4.

The elements stressed in this section underline the need to differentiate public from private attitudes, the importance of ownership to foster community and market acceptance of RE projects, as well as the emergence of the *prosumer* role in the co-provision process of RE.

### **2.2.1.2. *The active dimension of social acceptance***

The distinction between *passive* and *active* social acceptance (Schweizer-Ries, 2008) is a crucial element to frame our research. Whereas the implementation of single large-scale RE infrastructure projects generally implies passive consent from local communities, the emergence of DG systems and locally managed RET's require more active approval by individuals. Indeed, their operation does not depend on the availability of the technology, but on the willingness of social actors to provide capital investments, conduct behavioural changes, and concede space for the installations of these technologies. Consequently, the installation of DG systems, or RET's combined with Information and Communication Technologies (ICT), such as smart grids (SG) and virtual power plants (VPP), involves the redefinition of the consumer's role, who becomes "prosumer" of energy services (Luo et al., 2014). This neologism, composed of the terms *producer* and *consumer*, designates the newly emerging relationship between energy producers and consumers.

Given the importance of the active dimension of acceptance, Batel et al. (2013, p. 2) emphasize that the term *acceptance*, characterized by "passivity and non-decision", is not the right concept to use. Instead, the authors suggest *social support* to imply agency for and engagement with CE projects and RET installations. However, in this paper, we follow Huijts et al.'s (2012) distinction between citizen and consumer acceptance to emphasize the new role consumers have to assume in the way and the extent to which energy is produced. To simultaneously differentiate passive and active acceptance, and focus on consumers rather than on citizens, we decide to join Bauwens' (2013) definition of *consumer engagement*. In the next section, we will define consumer engagement and outline its core dimensions.

## **2.2.2. Consumer engagement**

### ***2.2.2.1. Defining consumer engagement***

As previously emphasized, the success of the widespread implementation of RET's and DG systems is determined by the active engagement of consumers in these emerging types of technologies. Within this perspective, the notion of consumer engagement seeks to address the complexity of the required behavioural change (Gangale et al., 2013), by taking into account social and psychological dimensions (Devine-Wright, 2007; Huijts et al, 2012). Moreover, consumer engagement can be understood as a context-specific notion. Bauwens (2013, p. 12) underlines that “the determinants of consumer engagement depend on the type of technology involved, and on the scale at which it is deployed”. Therefore, taking into account the latter elements, consumer engagement can be defined as the social, psychological, and contextual process that converts the users of a specific technology into active and engaged consumers. To the author's best knowledge, a major scientific gap still prevails around the concept of consumer engagement and its relationship to RECs and DG systems.

### ***2.2.2.2. Elements of consumer engagement***

Along with the study of Sauter and Watson (2007), we define the process of consumer engagement as being expressed in the form of individual attitudes, financial investments and energy behaviours.

#### ***Attitudes toward technologies***

This form mainly refers to two elements. On the one hand, drawing on the theory of planned behaviour (Ajzen, 1991) which predicts that the positive attitude towards an act, favourable social norms, and perceived behavioural control lead to a specific attitude, Huijts et al. (2012, p. 4) assert this notion relates to the attitudes towards “technologies as such”. The latter thus encompass the perception of users and consumers about RET's and decentralized energy infrastructures. Following Bauwens' (2013) argument, this element depends on the type of technology involved. For instance, whereas combined heat and power (CHP) installations are quasi-invisible for the consumers, wind turbines and solar photovoltaic (PV) panels represent new devices for households and may induce a new set of expectations and attitudes.

Specifically, wind power development has been the technology most contested to date (Devine-Wright, 2007; Warren & McFayden, 2011), primarily motivated by the perceived impact on “natural” landscapes, visual impacts, noise pollution, and the damage caused on flora and fauna (Warren & McFayden, 2011, p. 205).

On the other hand, attitudes refer to the specific behaviour in response to the availability or implementation of the technology (Huijts et al., 2012), or specifically, the willingness of consumers to accept the physical features of RET’s in their private households. As Bauwens (2013, p. 13) puts it, “since a distributed generation model implies the development of generation units close to consumer sites or even in people’s homes, the willingness to provide space for their installation depends on their private attitudes towards technologies”. Furthermore, in energy infrastructures using ICT’s, consumers must be willing to actively participate in the co-provision of flexible generation and distribution of energy (Gangale et al., 2013; Kubli et al., 2018).

### ***Investments in the REC***

To ensure the market uptake of emerging RET’s such as DG configurations, consumers need to invest in the concerned organizations (Bauwens, 2013). Such investments involve “up-front costs that are balanced by annual savings in form of reduced energy consumption”, determining the payback time (Sauter & Watson, 2007, p. 2775). In the case of RECs, investments are operated by buying shares of the organization, giving the right to a regularly paid dividend (Bauwens, 2013). Moreover, return on investment is very low in RECs, making them less attractive for investors seeking to exploit an economic return (Huybrechts & Mertens, 2014), and making consumer and member investments a crucial element.

### ***Energy consumption behaviours***

In addition to the reduction of domestic carbon emissions due to on-site energy production and consumption, DG systems might also lead to behavioural change in terms of energy conservation. Academic literature has acknowledged that DG technologies and decentralized energy systems provide “opportunities for consumers to become more aware of their energy use and impacts” through greater contact with energy generation technologies at the domestic

level (Keirstead, 2007, p. 4129; Hoppe et al., 2019). This awareness may in turn encourage behavioural changes in household's consumption patterns towards lower consumption levels and load shifting (Stedmon et al., 2013; Hope et al., 2018). Thus, for individual households, energy conservation can be understood as the effort made to reduce energy consumption. This can be achieved through two behaviour-related dimensions: curtailment behaviour and efficiency behaviour (Hoppe et al., 2019). "The former concerns ongoing day-to-day actions to reduce consumption, such as setting thermostats or switching off lights when leaving home. The latter concerns one-time actions to save energy, such as investing in home improvements like thermal insulation or energy-efficient appliances" (Hoppe et al., 2019, p. 3).

### **2.3. The determinants of consumer engagement**

In exploring the theoretical underpinnings of consumer engagement and drawing on a set of socio-psychological factors, Bauwens (2013) listed five determinants of consumer engagement, related to the structure of RECs. In the context of this research, we focus on two of them to explain the variation in consumer engagement.

#### **2.3.1. Awareness**

##### ***Related to consumer engagement***

In a comprehensive review of factors representing major barriers to engaging consumers in local energy projects, Frederiks et al., (2015) emphasize the essential character of awareness. In the academic literature related to energy technology acceptance, awareness levels reflect two elements. On one hand, one's knowledge of problems related to the current energy system (Huijts et al., 2012), such as environmental (air pollution, noise pollution, climate change) or social effects (scarcity of energy sources, increasing energy costs). On the other hand, one's knowledge of energy prices, costs, developments, as well as the functioning of technology in the changing energy landscape (Koirala et al., 2018).

##### ***Related to Renewable Energy Cooperatives***

On one hand, Sauter & Watson (2007) and Stedmon et al. (2013) assert that the active engagement of households in social structures through local ownership may contribute to

reducing “information asymmetry” (Huybrechts & Mertens, 2014, p. 205) and foster higher awareness of energy generation and consumption among consumers. In particular, Stedmon et al. (2013, p. 442) emphasize the learning processes of energy consumption by “highlighting the affective dimension to learning and the importance of the context within which learning happens”. On the other hand, in a major study on RECs economic and social impacts, Tarhan (2015) assumes that the lack of awareness and information is majorly attributable to the spatial and consequently cognitive, distance between energy generation and use, triggered by the current scheme of centralized energy systems. Thus, “the spatial proximity of members is likely to encourage social interactions, which in turn, facilitate exchanges of information and enhance trust and other social norms among members” (Bauwens, 2013, p. 16). Moreover, the characteristics of REC members, such as their role in the REC and their period of membership, might also influence their level of awareness, and thus their engagement as consumers (Bauwens, 2016).

### **2.3.2. Level of trust**

#### ***Related to consumer engagement***

The concept of trust has attracted a great deal of interest in recent years, although no agreement exists in the academic literature about the exact definition of trust and types of trust. Nonetheless, trust is depicted as both necessary and as an outcome of RET and CE projects (Walker et al., 2010), and has been found to promote the active involvement of local stakeholders and determine consumers’ attitudes toward technologies (Huijts et al., 2012). On the other hand, lack of trust is found to significantly hamper the involvement and engagement of citizens in the co-production of RE (Wolsink, 2018). According to Walker et al. (2010), trust can be both understood as interpersonal (in other people) and social trust (institutions).

#### ***Related to Renewable Energy Cooperatives***

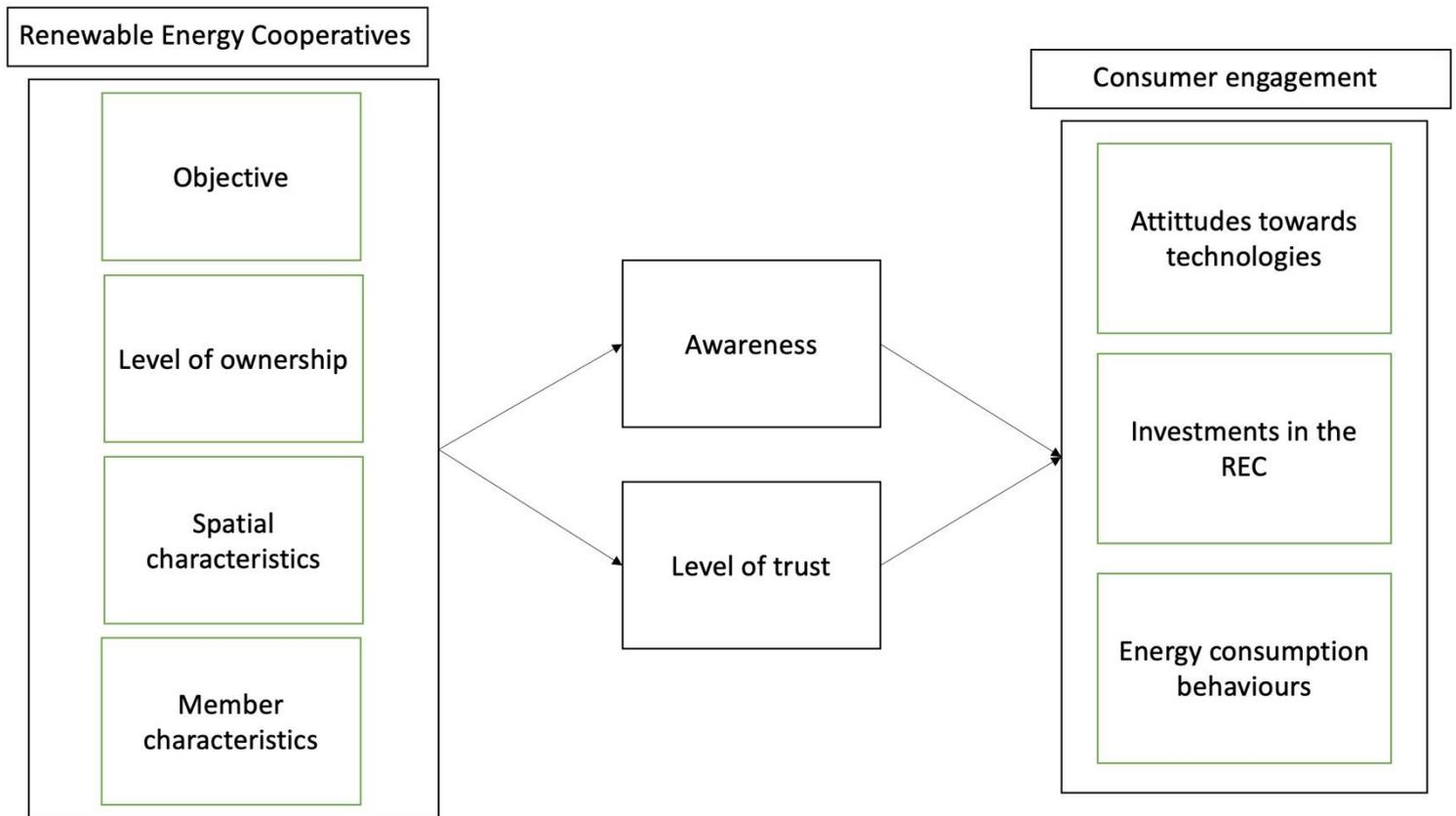
The literature on the deployment of RET’s underlines that consumers are effectively engaged, when they can strive for strong links with the local community, as a result of spatial proximity and high community involvement in the ownership of the projects (Walker & Devine-Wright, 2008; Gangale et al., 2013; Huybrechts & Mertens, 2014). Thus, both the spatial characteristics and community ownership of RECs are likely to foster a high level of trust, and influence

consumer engagement. Tarhan (2015) asserts that within communities-of-location, existing levels of trust are higher, while increased spatial distance, such as in communities-of-interest, may reduce the behavioural impacts of RECs. Using the same distinction between communities-of-location and communities-of-interest, Bauwens (2019) empirically demonstrates that the social networks and spatial proximity of the former produce enhanced frameworks for consumer investments. Finally, the level of trust is also likely to vary according to the individual characteristics of REC members. For instance, a longer period of membership can result in enhanced social interactions with other members and can thus be a determinant of the level of trust (Bauwens, 2016).

## **2.4. Conclusion**

Following Yildiz et al. (2015), this literature review has emphasized the necessity to apprehend RECs as social entities, and not only as purely technical and economic organizations. RECs must thus be studied from a social perspective, at a micro level, to understand the influence they exert on individual and collective actions. Whereas academic literature significantly lacks a classification of RECs, it is increasingly recognized that their structures influence the perceptions and attitudes of their members as well as RET users. Moreover, our findings indicate that the concept of social acceptance, introduced by Wüstenhagen et al. (2007), has been progressively criticized for its passive dimension, whereas the emergence of prosumers and DG technologies require the elaboration of a new concept. Our exploration of literature has emphasized the process of consumer engagement, and the socio-psychological mechanisms of awareness and trust as suitable concepts to the extent to which REC members are influenced by these latter organization's structural components.

## 2.5. Conceptual framework



**Figure 5: Conceptual framework.**  
Source: Author, 2021

This conceptual framework consists of three parts. Firstly, it outlines our hypothesis that specific structural components of RECs indirectly exert an influence over the consumer engagement of their members. Thus, the first layer outlines the elements of REC structures that are likely to influence consumer engagement. The second layer is composed of two mediating variables, levels of awareness and trust, that aim to explain the nature of the relationship displayed between the independent variable, REC structures, and the dependent variable, consumer engagement. Last but not least, the third layer outlines the elements, identified in academic literature, that could indicate a variance in consumer engagement.

## **Chapter 3: Research Design and Methods**

This chapter outlines and illustrates the research design selected to answer our research question. It contains the research strategy, conceptualization and operationalization of variables and indicators used, primary and secondary data collection methods, sampling methods, and the data analysis technique. Furthermore, the validity, reliability and limitations of the research are addressed in the conclusion of this chapter.

### **3.1. Description of the research design and methods**

This research used multiple case studies as a strategy. Following Van Thiel (2014), the selection of a single case study delivers the means to investigate complex social phenomena in a real-life setting. According to this strategy, the context in which the case study is inserted is perceived as especially pertinent, as it is presumed to influence the phenomenon under study. If research considers multiple case studies, the same rules apply, but in a comparative design (Bryman, 2012). Several homogeneous or heterogeneous cases can be selected, to generate in-depth knowledge on the similarities and/or differences between the cases.

According to Baxter & Jack (2008), the multiple case study strategy has specific advantages and disadvantages. On the one hand, the evidence created from the multiple case studies can be considered “robust and reliable” (Baxter & Jack, 2008, p. 550), since creating evidence on a detailed social phenomenon. In his influential book, Yin (2014) adds that if the researcher considers heterogeneous case studies, variation in the independent variable might strongly emphasize the causal relationship to the dependent variable. On the other hand, practical issues can create barriers for the multiple case studies research; this type of research design can be expensive to conduct and time-consuming (Baxter & Jack, 2008). The researcher can also encounter difficulties to gain access to cases or getting individuals or organizations to cooperate (Van Thiel, 2014). Finally, it is important to point out that comparative case study strategies differ according to their epistemological approaches. Whereas positivism, realism and social constructivism have been the most noticeable ones, new epistemologies such as critical realism are emerging, intending to apprehend the nature and the mechanisms of social phenomena (Bryman, 2012).

The elements and approaches introduced above underline that there is not one single way to conduct a multiple case study analysis. In our research, both positivism and critical realism were considered to simultaneously identify and reflect on the structures that generate specific “events and discourses of the social world” (Bryman, 2012, p. 29). As exhibited in the conceptual framework, the influence of REC structures on consumer engagement is likely to be determined by multiple characteristics, inherent to their structural components. Since these structures are expected to vary according to each organization and their specific context, and with our independent variables having been previously identified in the theory review, we followed a deductive approach and selected a set of two contrasting cases based on the characteristics of RECs.

On one hand, we decided to study *Blijstroom*, Rotterdam’s first REC, founded in 2013. On the other hand, we selected *Energie Coöperatie Loenen UA* (hereinafter referred to as *Loenen Cooperative*), situated in the Dutch province of Gelderland, founded in 2019. Since both RECs display different objectives, levels of ownership, spatial characteristics and member characteristics, our research sought to determine to what extent a possible variation in consumer engagement would be attributable to the variation in the structures of RECs. Moreover, both RECs diverge in terms of technologies implemented; whereas Blijstroom members invest in collectively owned solar roofs, Loenen Cooperative developed a community virtual power plant (cVPP), aggregating the capacities of heterogeneous distributed energy resources (DER) into one coordinated portfolio. The structural components and contexts of Blijstroom and Loenen Cooperative, as well as technical details about the DG systems, are accurately outlined in section 4.1.

### 3.2. Conceptualization

This section displays our conceptualization table, defining each variable and sub-variable based on the findings outlined in the theory review and exhibited in the conceptual framework shown in figure 5.

Concept	Variable	Definition	Sub Variable	Definition
<b>Renewable Energy Cooperatives</b>	Objective	Purpose of the REC	Value chain approach	Primary function of the REC (Yildiz et al., 2015)
			Technology used	Technology-in-use to fulfil the primary function (Yildiz et al., 2015, Heras-Saizarbitoria, 2018)
	Level of ownership	Legal or sense of ownership over the entities and assets	Legal ownership	Legal ownership and management of energy-related assets (Irena, 2020)
			Sense of ownership	Symbolic dimension of citizen ownership (Maruyama et al., 2007; Warren & McFayden, 2010)
	Spatial characteristics	Nature of the REC and its community	Geographical location	<i>Communities-of-interest vs Communities-of-location</i> (Seyfang et al, 2013; Tarhan, 2015; Klein & Coffey, 2016)
			Business model	Focus of REC (Heras-Saizarbitoria, 2018)
	Member characteristics	Characteristics of the members in the REC	Stakeholder type	Whether stakeholders are producers, consumers, or workers (Huybrechts & Mertens, 2014)
			Period of membership	Time for which citizens have been members of REC (Bauwens, 2016; Hoppe et al., 2019)

<b>Concept</b>	<b>Variable</b>	<b>Definition</b>	<b>Sub variable</b>	<b>Definition</b>
<b>Consumer engagement</b>	Attitudes toward technologies	Attitude of consumers towards the implemented technologies and decentralized energy systems (Sauter & Watson, 2007)	Perception of consumers about RET's and decentralized energy infrastructures	Attitude of consumers towards "technologies as such" (Huijts et al., 2012, p. 4)
			Behaviour in response to the availability or implementation of the technology	Willingness of consumer to accept the physical features of RET's in their private households (Bauwens, 2013)
	Investments in the REC	Investment operated by the consumers	Number of shares purchased	Numbers of shares REC members have purchased within their membership period (Bauwens, 2019)
			Intention to purchase more	Intention of REC members to purchase more shares of the organization (Bauwens, 2019)
	Energy consumption behaviours	Efforts made to reduce energy consumption (Hoppe et al., 2019)	Curtailment behaviour	"Day-to-day actions to reduce consumption, such as setting thermostats or switching off lights when leaving home" (Hoppe et al., 2019, p. 3).
			Efficiency behaviour	"Investing in home improvements like thermal insulation or energy-efficient appliances" (Hoppe et al., 2019, p. 3).

<b>Concept</b>	<b>Variable</b>	<b>Definition</b>	<b>Sub-variable</b>	<b>Definition</b>
<b>Awareness</b>	Level of knowledge	Knowledge of environmental/social effects caused by current energy systems (Huijts et al., 2012) and knowledge of developments of alternative sources of energy (Koirala et al., 2018)	Knowledge of environmental and social effects related to current energy systems	Environmental (air pollution, noise pollution, climate change) and social effects (scarcity of energy sources, increasing energy costs) (Huijts et al., 2012)
			Knowledge of developments of alternative sources of energy	Developments of the changing energy landscape including local energy projects (Koirala et al., 2018)
<b>Trust</b>	Level of trust	“Trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another” (Rousseau et al., 1998, p. 395 in Huijts et al., 2012, p. 8)	Interpersonal trust	Trust in other people (Walker et al., 2010)
			Social trust	Trust in institutions (Walker et al., 2010)

**Table 1: Conceptualization table: concepts, variables, and sub-variables.**  
**Source: Author, 2021.**

### 3.3. Operationalization

The concepts developed in chapter 2 and outlined in the conceptual framework are operationalized in this section. They are translated into specific variables and indicators, that were introduced in the literature review, and can be measured through primary and secondary data collection methods. Furthermore, the following table presents the scales of measurement of our indicators, designating the type of data that is expected to be collected.

<b>Concepts</b>	<b>Variables</b>	<b>Indicators</b>	<b>Scales of measurement</b>	<b>Data collection methods</b>
<b>Renewable Energy Cooperatives</b>	1. Objective	1.1 Value chain approach 1.2 Technology used	1.1 Qualitative nominal 1.2 Qualitative nominal	Primary data (semi-structured interviews) and secondary data (desktop research)
	2. Level of ownership	2.1 Legal ownership 2.2 Sense of ownership	2.1 Qualitative ordinal 2.2 Qualitative nominal	Primary data (semi-structured interviews) and secondary data (desktop research)
	3. Spatial characteristics	3.1 Geographical location 3.2 Business model	3.1 Qualitative nominal 3.2 Qualitative nominal	Primary data (semi-structured interviews) and secondary data (desktop research)
	4. Member characteristics	4.1 Stakeholder type 4.2 Period of membership	4.1 Qualitative nominal 4.2 Quantitative continuous	Primary data (semi-structured interviews and questionnaire)

<b>Consumer engagement</b>	5. Attitudes towards technologies	5.1 Perception of consumers about RET's and decentralized energy infrastructures 5.2 Behaviour in response to the availability or implementation of the technology	5.1 Qualitative nominal and quantitative continuous 5.2 Qualitative nominal and quantitative continuous	Primary data (semi-structured interviews and questionnaire)
	6. Investments in the REC	6.1 Number of shares purchased 6.2 Intention to purchase more	6.1 Quantitative continuous 6.2 Qualitative nominal	Primary data (semi-structured interviews)
	7. Energy consumption behaviours	7.1 Curtailment behaviour 7.2 Efficiency behaviour	7.1 Qualitative nominal 7.2 Qualitative nominal	Primary data (semi-structured interviews)
<b>Awareness</b>	8. Level of knowledge	8.1 Knowledge of environmental and social problems related to current energy systems 8.2 Knowledge of developments of alternative sources of energy	8.1 Qualitative nominal and quantitative continuous 8.2 Qualitative nominal and quantitative continuous	Primary data (semi-structured interviews and questionnaire)
<b>Level of trust</b>	9. Level of trust	9.1 Interpersonal trust 9.2 Social trust	9.1 Qualitative nominal and quantitative continuous 9.2 Qualitative nominal and quantitative continuous	Primary data (semi-structured interviews and questionnaire)

**Table 2: Operationalization table: concepts, variables, indicators, scales of measurement, and data collection methods.**

**Source: Author, 2021.**

### **3.4. Data collection methods and sampling**

#### **3.4.1. Data collection methods**

The primary qualitative data used in this research was collected through semi-structured interviews. According to Van Thiel (2013), interviews are one of the most flexible methods in the case study protocol, permitting the collection of *non-factual* information, such as perceptions, opinions or relationships otherwise difficult to obtain. The questions were formulated based on the operationalization of our variables and aimed to generate in depth-knowledge about the causal relationship between the structures of RECs and consumer engagement, as well as the role played by our mediating variables. Specifically, the semi-structured format of interviews was chosen to simultaneously elaborate a coherent guideline for our questions and enable a flexible data collection process. Moreover, a short questionnaire, in the form of close-ended questions, was embedded into our interviews, to collect quantifiable/quantitative data where possible, and simplify certain aspects of the research. Respondents were thus asked to answer the questionnaire by rating on a Likert scale from 1 to 6 on specific questions during the interviews. Besides, it is essential to specify that the same questions were asked to the respondents of both RECs, except when specific information was needed on the structural and contextual components of the organizations.

Finally, primary data were triangulated through the collection of secondary data to increase the validity and reliability of our findings. Secondary data was collected through desktop research to determine certain features of RECs that might be essential when reflecting on their structures. In particular, documents, facts and figures from Blijstroom and Loenen Cooperative were gathered through their websites and academic articles found on Google Scholar.

#### **3.4.2. Sampling**

Apart from the questions of *what* was studied, we want to draw attention to *who* was studied. Following Van Thiel (2014, p. 45), a sample is “a selection from the total population (N) of possible units of study”. In the context of our research, we employed purposive and snowball samples to identify five suitable and well-informed respondents in each cooperative, cumulating in a total of 10 (N) interviews. The respondents had to fulfil at least two criteria's: being a member of the REC and being a prosumer, thus having actively invested in one of the

organization's projects. Moreover, we tried to draw a representative sample by choosing an even amount of male and female respondents in both RECs. Following the RECs functions and technologies employed, Blijstroom respondents can be characterized as energy producers, whereas Loenen Cooperative members can be considered as both energy producers and consumers.

### **3.5. Data analysis**

Bryman (2012, p. 13) emphasizes that the data analysis stage is “fundamentally about *data reduction*”, concerned to reduce the large corpus of information gathered during the data collection stage, to make sense of it. To reduce our data, the semi-structured interviews were recorded, with the consent of each respondent, allowing the researcher to stay focused on the interactions and discussion with the interlocutors. The recordings were transcribed, read and analysed, to highlight the most relevant outputs generated by the interviews. Then, the data was structured through a deductive coding process whereby they were broken down into their component parts and supplemented with labels, based on the indicators exhibited in our operationalization table. The analysis of our interview transcripts was performed with the software *Atlas TI*, helping to create codes, categories, and networks, to search for recurrences and relationships between variables. Ultimately, different analysis tools of *Atlas TI*, such as the co-document and co-occurrence tables, were employed to investigate insights of and relationships between variables. Last but not least, the results of the questionnaire were exported to an Excel sheet and imported into *R Studio*, a programming language used to analyse quantitative data. Once organized, the data were visualized to determine specific relationships between our independent and mediating variables. Examples of coding sequences, co-document and co-occurrence tables, retrieved from Atlas Ti and R, are included in annexe 2 of this paper.

### **3.6. Reliability and validity**

Following Van Thiel (2014), the reliability of research is determined by the accuracy and consistency with which the variables are measured. The former refers to the measurement instruments, the correct and precise definition of the variables, and the distinction between the different values a variable can assume, which are depicted in tables 1 and 2. Then, consistency

revolves around the idea of repeatability, whether or not the same measurement would lead to similar results under similar circumstances. This second element is harder to achieve in social science research, given the evolving nature of the circumstances of the study. To improve the reliability of our primary data collection method, a fixed interview manual was developed to ensure the replicability of the conversations. Moreover, multiple pilot interviews were conducted with fellow researchers, to foster a flawless knowledge of the theoretical, and subjective, aspects of the study.

The validity of research involves two basic forms: namely, internal and external validity (Van Thiel, 2014). On one hand, internal validity refers to the cogency of the study, the extent to which the researcher has measured what he intended to measure. This element involves two aspects: whether the operationalization adequately captures the theoretical construct, and whether the modelled relationship between variables does exist. To address these challenges, the operationalization of the research must be clearly defined and exclusive. On the other hand, external validity refers to the extent to which the research can be generalized. However, in qualitative studies and case study strategies, the findings are intrinsic to each case and context, making it difficult to apply the conclusions of a study outside the context of that study. To improve the internal validity of our research, the questions posed in the semi-structured interviews and embedded questionnaires were elaborated as close as possible to the theoretical framework and the operationalization depicted in table 2.

Literature on social sciences methodologies also pinpoints the idea of data triangulation as a sound means to enhance reliability and validity (Baxter, 2008; Bryman, 2012; Van Thiel, 2014). The term refers to the combination of multiple research methods when studying a social phenomenon, to double-check the data collection and research findings. Furthermore, Carter et al. (2014) identify four types of data triangulation: method triangulation, investigator triangulation, theory triangulation, and data source triangulation. This research employed two data triangulation methods. Firstly, method triangulation was applied, by combining semi-structured interviews with a short embedded questionnaire and desktop research, to simultaneously collect and analyse quantitative and qualitative data on specific sub-variables. Then, data source triangulation, which refers to the collection of data from different types of people, was employed, by selecting respondents with different sample characteristics, exhibited in sub-sections 4.1.1.4 and 4.1.2.4, to conduct our interviews.

### **3.7. Limitations**

Given the recent momentum of DG systems and RECs, the greatest limitation of our research was certainly the scarcity of case studies available. RECs having actively developed and implemented these kinds of technologies remain marginal to some extent yet. Moreover, DG systems are likely to strongly vary according to the context of each case study, which makes the comparison between different case studies challenging. Each system entails different technical and social aspects to be integrated by consumers and is connected to a different extent to the grid. Besides, to avoid the complexity of dealing with contradictory legal aspects between different countries, it was also compulsory to find two case studies located in the same country. Additionally, our research risked encountering the honeymoon effect, insinuating that the responses gathered from our units of study were likely to be biased by their enthusiasm for the recent adoption of DG systems and RET's. Given the ambitious character of our research, available time and resources, but also the difficulty to translate theoretical vocabulary into practical elements, can be pinpointed as further critical limitations. Furthermore, due to a lack of data availability, as well as resources and time constraints, the data triangulation method was operated only on a specific number of sub-variables, presented in the next chapter.

Last but not least, this research was carried out during the Covid-19 pandemic, having direct effects concerning the data collection process. The interviews were conducted online (Zoom and Teams), complicating the communication between the researcher and the interlocutor, whereas no direct primary data collection method, such as observations or focus groups, was possible to realize.

## Chapter 4: Research Findings and Analysis

This chapter presents detailed information about the case studies and an analysis of the collected data. The variables and sub-variables exhibited in the conceptual framework and the operationalization table are assessed through a qualitative and quantitative analysis of their importance and relationships. The chapter starts by describing our case studies, the contexts they are embedded in, and the main characteristics of our samples. Section 4.2 presents an overview of the qualitative data analysis performed with the software Atlas Ti, complemented with a quantitative data analysis performed with R. Additionally, this section highlights the most important inputs and insights addressed by the respondents of Blijstroom and Loenen Cooperative during our semi-structured interviews. Section 4.3 builds upon these insights and outlines the relationships found between the selected variables. Finally, section 4.4. discusses the results of our data collection and analysis by reflecting on the theoretical findings of chapter 2. Our research findings are thus presented following a logical structure consistent with the answers provided to our research questions in the next chapter.

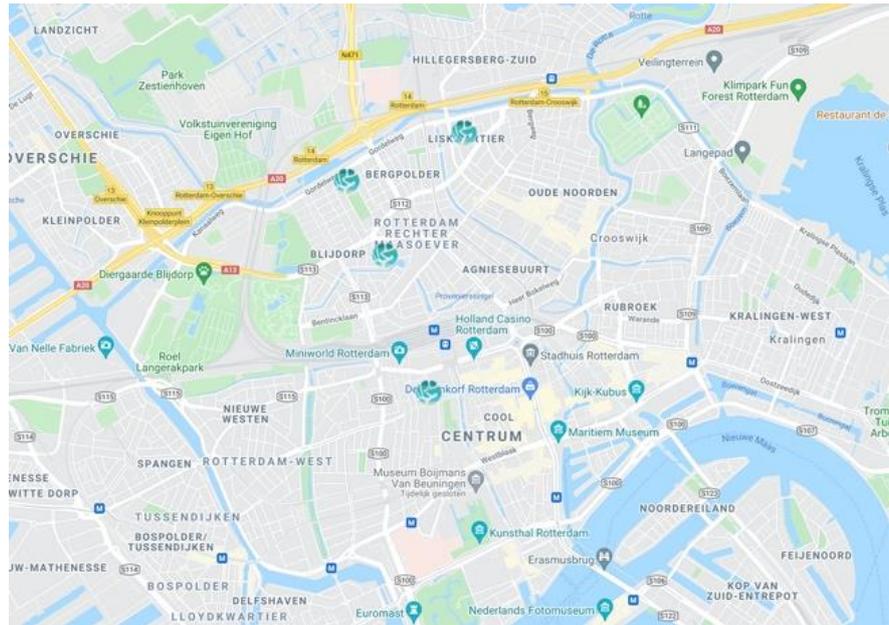
### 4.1. Case studies and contexts

The description of our case studies and their contexts was done based on the characteristics and classification of RECs displayed in the literature review, using both primary and secondary data. The data was mainly collected through websites and academic articles and was later complemented with the data acquired from the interviews.

#### 4.1.1. Blijstroom

Founded in 2013 and funded by the municipality of Rotterdam through the *CityLab010* platform, the REC Blijstroom was created on the initiative of a dozen citizens from various backgrounds, to create sources of clean energy in the northern neighbourhoods of Rotterdam (Blijstroom). The financial structure of the REC provides its members with the opportunity to invest in collectively owned solar roofs, from which they receive part of the profit. Currently, Blijstroom counts approximately 250 members, including 150 prosumers who have invested in one of the four rooftops with shared solar panels, depicted in figure 6 (Blijstroom; Blijstroom, n.d.). The first sunroof was opened in June 2017, at the sports hall on Noorderhavenkade, the second in September 2018 at the SKAR studios on Ackersdijkstraat, the

third in June 2020 on a multi-company building in Batavierenstraat and the last one to date in September 2020 on top of De Margriet public primary school on Nolensstraat, aggregating a total of circa 800-900 solar panels. Whereas the membership at Blijstroom costs 25 euros



**Figure 6: Spatial distribution of Blijstroom solar roofs.**  
**Source: Blijstroom, n.d.**

per year, a panel share can be bought from 200 euros. A panel share differentiates from a solar panel, insofar as it represents a financial share in the entire sunroof. For instance, the roof installed on Noorderhavenkade has 192 solar panels, divided into 366 panel parts, meaning that a single panel share represents 1/366 of the total generated power (Blijstroom, n.d.).

#### **4.1.1.1 Objective**

First of all, Blijstroom can be classified as a generation REC, characterized as an organization “that possesses power generation facilities or holds investments in companies that operate them” (Yildiz et al., 2015, p. 62). Moreover, Blijstroom delivers the energy that is generated to an energy company within the framework of a power purchase agreement (PPA) and can thus also be characterized as a trading cooperative. Since 2018, the energy supplier *Green Choice* purchases solar energy from Blijstroom, converts the equivalent of the kilowatt-hour (kW h) generated into money and compensates Blijstroom investors by reducing that exact amount from their energy bills. Thus, investors earn back their investment with the electricity generated but do not directly consume the energy they generate through their collectively owned PV panels (Blijstroom).

#### ***4.1.1.2 Level of ownership***

The entirety of the REC's assets is owned and operated by its members. Whereas most of Blijstroom's members are private individuals, some shares are owned by private investors, such as small businesses or foundations (Blijstroom).

#### ***4.1.1.3 Spatial characteristics***

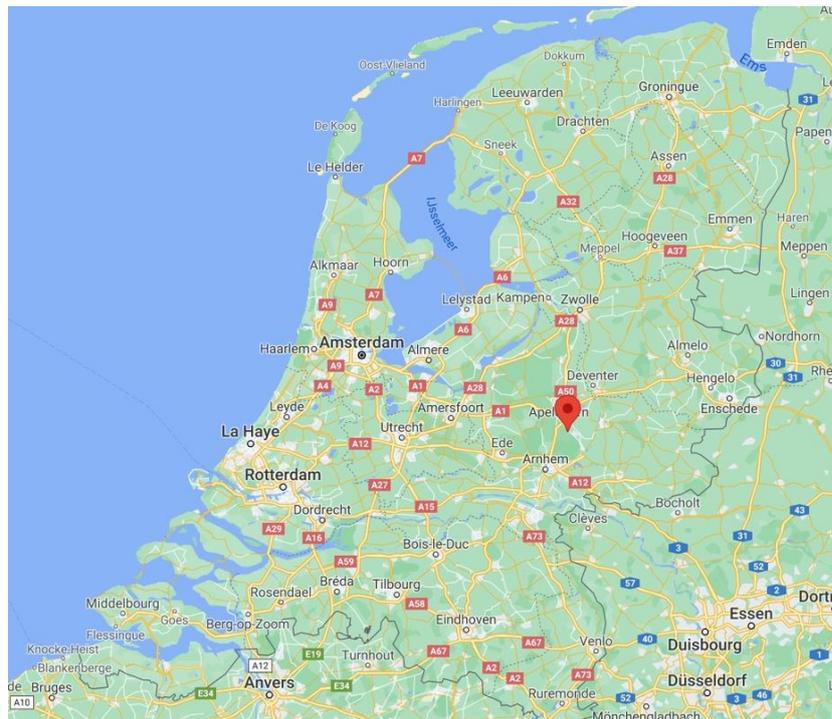
Based on the definitions of CE initiatives identified in the academic literature, Blijstroom can be characterized as a community-of-interest. Located in an urban area, the organization does not focus on generating electricity for local consumption, or on addressing the problems of a specific location. Rather, the membership base of Blijstroom forms a community that shares financial and environmental interests, by collectively owning the solar roofs located in the northern neighbourhoods of Rotterdam (Blijstroom, n.d.). However, in terms of business model, the organization follows a local focus by centring its activities around specific areas, emphasizing that the spatial location of the Blijstroom community might play a role in the interests followed by the REC members (Blijstroom).

#### ***4.1.1.4 Member characteristics and sample***

The sample drawn from Blijstroom includes a diversity of social features. The five members who participated in our research outline similar characteristics in terms of age (25-64), employment status (employed or self-employed), type of household (living with a partner), and net monthly household income characteristics (2500-above). Variation mainly concerns the following characteristics: sex (male or female), education level (either high school or university), and working hours per week (either 11-20, 21-30, or 31-40). Moreover, in accordance with the organization's energy production function, all five respondents can be characterized as energy producers, since having invested in the organization's solar roof projects. Finally, the period of membership varies between 3 and 6 years, depending on the members interviewed.

### 4.1.2. Loenen cooperative

As its name suggests, Loenen Cooperative is situated in the Dutch village of Loenen, located in the municipality of Apeldoorn, in the province of Gelderland. In 2013, a group of citizens from Loenen won a contest called *Energetic Villages*, organized by the municipality of Apeldoorn, as part of which villages were asked to suggest ideas to become more sustainable. In the context of this project, the village received 200,000 euros and created a foundation,



**Figure 7: Location of the Loenen village.**  
Source: Google maps, n.d.

*Loenen Energy Neutral* (LEN), to manage a revolving fund intended to encourage residents to invest in solar panels, domestic insulation and other sustainable innovations (van Summeren et al., 2020). After having invested over a million euros in the revolving fund, the community aimed to find a flexible way to manage and distribute the energy generated by the solar panels. Thus, the village implemented a cVPP, in collaboration with partners from Belgium and Ireland, with an 850.000 euros subsidy from the European Union (EU) (van Summeren et al., 2020). Locally renamed *DE power station*, the cVPP pilot project is a smart energy management system, consisting of multiple local power generation stations, mostly solar panels in the case of Loenen (Energie Coöperatie Loenen, 2020). Thus, Loenen Cooperative was founded in May 2019 to manage the cVPP towards the end of the project, which is currently owned by the foundation *Duurzame Projecten Loenen* (DPL), established in 2017. To the present day, there are about 105 members in Loenen Cooperative, paying an amount of 10 euros per year for the membership within the cooperative, and about 100 households, not all members of the REC, participating in the cVPP project (Loenen Cooperative). Contrary to Blijstroom, one share purchased from the organization represents one solar panel that can be installed on domestic roofs and possibly monitored through the cVPP system.

#### ***4.1.2.1 Objective***

Following Yildiz et al.'s (2015) classification, the activities of Loenen Cooperative can be characterized as hybrid. Firstly, Loenen Cooperative is a generation REC, as it owns power generation assets, mostly solar panels installed on member's domestic roofs. Then, the organization also covers the distribution type, subsequently operating a local electricity and heating grid with help of the cVPP. Finally, whereas the energy that is produced by the REC members is mainly consumed by themselves, another cooperative, *OM Energy*, purchases the surplus of energy from the prosumers and redistributes it to other clients in the village (Loenen Cooperative). Thus, in addition to its generation and distribution activities, Loenen Cooperative can also be characterized as a trading REC.

#### ***4.1.2.2 Level of ownership***

As specified above, Loenen Cooperative displays different levels of ownership. Concerning the solar panels installed on domestic and private roofs throughout the village, 100% of the assets are owned by members of the organization. On the other hand, the cVPP pilot project is currently owned by the DPL foundation (Loenen Energie Neutraal, 2020).

#### ***4.1.2.3 Spatial characteristics***

The distinction between different types of communities allows us to consider Loenen Cooperative as a community-of-location. Situated in a rural area, the organization is bound by geographic boundaries and formed by individuals who focus on generating electricity for local consumption and address local economic, social and environmental needs through their various projects. Inherent to its spatial location, Loenen Cooperative displays a local focus as business model, centring its activities around the specific area of the village (Loenen Cooperative)

#### ***4.1.2.4 Member characteristics and sample***

The sample drawn from Loenen Cooperative includes five respondents who share very similar social features. They exhibit similar education levels (university), employment status (employed or self-employed), and net household income (2500-above). Only the sex (male or female), type of households (either living with a partner, without kids, or living with a partner, with one kid), and working hours per week (either 21-30, 31-40, or 40-above) differ between the respondents. Moreover, all five interviewees are simultaneously members of Loenen

Cooperative and participants of the cVPP project, thus taking on the role of energy producers and consumers. Finally, the period of membership of our sample slightly varies between 1 and 2 years.

### 4.1.3. Classification table

The following table summarizes the characteristics of Blijstroom and Loenen Cooperative, as well as the attributes of the respondents who participated in our research, based on the classification operated in chapter 2 and the data presented in this section.

<b>REC / Characteristics</b>	<b>Blijstroom</b>	<b>Loenen Cooperative</b>
<b>Value chain approach</b>	Generation and trading REC	Hybrid REC (Generation, distribution and trading functions)
<b>Technology used</b>	Solar energy	Solar energy and cVPP
<b>Legal ownership</b>	100% owned by its members	Different levels of ownership (solar panels owned by the REC members, cVPP owned by the DPL foundation)
<b>Geographical location</b>	Community-of-interest	Community-of-location
<b>Business model</b>	Local focus	Local focus
<b>Stakeholder type</b>	Energy producers	Energy producers and consumers
<b>Period of membership</b>	Between 3 and 6 years	Between 1 and 3 years

**Table 3: Summary and classification of Blijstroom’s and Loenen Cooperative’s characteristics.  
Source: Author, 2021**

## 4.2. Data preparation and analysis

This section presents an overview of the data analysis performed with Atlas Ti based on the data collected through semi-structured interviews. To understand the significance of the variables and sub-variables identified in the theory review and researched within the context of our case studies, the following co-document tables, retrieved from Atlas Ti, display the number of quotes attributed to each one of them.

The tables 4 and 5 start by showing the respective number of quotes attributed to each variable for Blijstroom and Loenen Cooperative, to provide an overview of their content. The concepts and variables of the following tables are presented in the same order as the rest of the section.

<b>Concepts</b>	<b>Variables</b>	<b>Quotes</b>
<b>Renewable Energy Cooperatives</b>	Objective	12
	Level of ownership	11
	Spatial characteristics	14
	Member characteristics	11
	<b>Total</b>	<b>48</b>
<b>Awareness</b>	Level of knowledge	<b>32</b>
<b>Level of trust</b>	Level of trust	<b>24</b>
<b>Consumer engagement</b>	Attitudes towards technologies	39
	Investments in the REC	12
	Energy consumption behaviours	13
	<b>Total</b>	<b>65</b>
<b>Total</b>		<b>169</b>

**Table 4: Number of quotes per concept and variable for Blijstroom respondents.  
Source: Author, 2021.**

<b>Concepts</b>	<b>Variables</b>	<b>Quotes</b>
<b>Renewable Energy Cooperatives</b>	Objective	12
	Level of ownership	12
	Spatial characteristics	20
	Member characteristics	12
	<b>Total</b>	<b>56</b>
<b>Awareness</b>	Level of knowledge	<b>37</b>
<b>Level of trust</b>	Level of trust	<b>27</b>
<b>Consumer engagement</b>	Attitudes towards technologies	30
	Investments in REC	10
	Energy consumption behaviours	16
	<b>Total</b>	<b>56</b>
<b>Total</b>		<b>176</b>

**Table 5: Number of quotes per concept and variable for Loenen Cooperative respondents.  
Source: Author, 2021.**

#### **4.2.1 Quotes linked to renewable energy cooperatives**

This section outlines the insights that were generated through our interviews on the structural components of the RECs. More specifically, it aims to complement the data presented in section 4.1, and to find out how and to what extent the structural components of Blijstroom and Loenen Cooperative influence the perceptions of their members.

#### 4.2.1.1 Objective

<b>Code / REC</b>	<b>Value chain approach</b>	<b>Technology used</b>
<b>Blijstroom</b>	6	6
<b>Loenen Cooperative</b>	7	5

**Table 6: Number of quotes for the *objective* variable.  
Source: Author, 2021**

First of all, the following table shows that interviewees from both RECs address the value chain-approach and the technology used by the organizations to operate their primary functions during the interviews. On one hand, Blijstroom members predominantly emphasize their satisfaction to participate in an organization without having to install or maintain generation assets on their roofs: “homeowners like us can participate without having the actual solar panels on our roof, which is for some houses not possible” (Blijstroom); “you don’t have to maintain it yourself, so that was very attractive“ (Blijstroom). On the other hand, Loenen Cooperative members highlight the benefits, as well as the individual and collective responsibility intertwined with the cVPP: “the cooperative offers an energy monitoring device for your house to see how much energy you are using, but also how much energy your solar panels are providing” (Loenen Cooperative); “the cVPP is an interesting development for the village, but also needs some kind of monitoring of your energy. It has to be done from a very specific place, for instance, my home” (Loenen Cooperative).

#### 4.2.1.2 Level of ownership

<b>Code / REC</b>	<b>Legal ownership</b>	<b>Sense of ownership</b>
<b>Blijstroom</b>	2	9
<b>Loenen Cooperative</b>	4	8

**Table 7: Number of quotes for the *level of ownership* variable.  
Source: Author, 2021**

Table 7 demonstrates that in both cases, the respondents attach less importance to the legal ownership they have over the RECs assets and projects than the subjective sense of ownership they are provided with. For Blijstroom members, this latter element is mainly related to the “added values” (Blijstroom) of collectively owning the solar panels installed on the roofs. Moreover, most members assert that their sense of ownership is not intrinsic to the physical property of the RE assets: “we feel owners, but we don’t care that it’s not on our roof” (Blijstroom). Blijstroom members also claim that their sense of ownership is amplified by the communication inside the organization, and the feeling to exert an influence over the decision-making process. Similarly, Loenen Cooperative interviewees link the influence over energy systems to the impression to be provided with agency. Furthermore, the sense of ownership expressed by the respondents from Loenen Cooperative is closely related to the technical elements of the cVPP project. For instance, the “feeling to participate in an interesting energy development” (Loenen Cooperative), the technical information provided over the REC assets, such as the electricity production and carbon reduction performance, or “the possibilities to share self-generated energy on the market” (Loenen Cooperative), constitute essential elements of their answers.

#### 4.2.1.3 Spatial characteristics

<b>Code / REC</b>	<b>Geographical location</b>	<b>Business model</b>
<b>Blijstroom</b>	8	6
<b>Loenen</b>	15	5

**Table 8: Number of quotes for the *spatial characteristics* variable.  
Source: Author, 2021**

The following table illustrates that respondents from Blijstroom and Loenen Cooperative deem the spatial proximity with other members, as well as the local focus of their organizations, as important elements of their functioning. However, while Blijstroom members consider spatial proximity as a crucial element contributing to their “individual well-being” (Blijstroom) and the “organizational capacity” (Blijstroom) of REC projects, they tend to consider common interests as more central to the REC’s structure and operation. On the other hand, the recurrence of codes linked to the geographical location of the organization indicates that spatial proximity takes higher importance for Loenen Cooperative members. Respondents from the latter organization assert that the spatial proximity inside the village provides multiple added values to the organization, such as “local commitment” (Loenen Cooperative) and a certain “feeling of belonging” (Loenen Cooperative). Interestingly, when alluding to the advantages of rural areas, multiple respondents draw comparisons to urban areas: “in big cities, people are not so involved in social cohesion and do not have this kind of added value” (Loenen Cooperative).

#### 4.2.1.4 Member characteristics

<b>Code / REC</b>	<b>Stakeholder type</b>	<b>Period of membership</b>
<b>Blijstroom</b>	4	7
<b>Loenen</b>	5	7

**Table 9: Number of quotes for the *member characteristics* variable.  
Source: Author, 2021.**

In chapter 2, we emphasized the need to study the characteristics of REC members to understand whether individual features influence their level of engagement as consumers. However, during the data collection process, neither the stakeholder type nor the period of membership, despite the recurrence of codes, were emphasized as of significant importance by Blijstroom's and Loenen Cooperative's respondents. These elements will be further investigated in section 4.3 to appreciate their relationship to the mediating variables.

#### 4.2.2. Quotes linked to awareness and level of trust

In this sub-section, we present the number of codes attributed to our mediating variables, levels of knowledge and trust, as well as the most important insights generated during our interviews on these elements. Moreover, table 11 exhibits the means calculated on a Likert scale from 1 to 6, with the answers provided by Blijstroom and Loenen Cooperative respondents to our questionnaire. The means suggest that the levels of interpersonal trust and knowledge of energy developments, are slightly higher in Loenen Cooperative than in Blijstroom.

<b>Variables</b>	<b>Cooperative / Questions (out of 6)</b>	<b>Blijstroom</b>	<b>Loenen Cooperative</b>
<b>Level of knowledge</b>	Do you consider yourself aware of the environmental and social problems linked to current centralized fossil-fuel energy systems?	5,6	5,6
	Do you consider yourself aware of the developments of alternative sources of energy?	4,6	5
<b>Level of trust</b>	How much do you trust other members of the REC?	5	5,6
	How much do you trust institutions?	3,2	3

**Table 10: Calculated means of the responses provided by Blijstroom’s and Loenen Cooperative’s members on the short questionnaire on the mediating variables. Source: Author, 2021.**

#### 4.2.2.1 Level of knowledge

<b>Code / REC</b>	<b>Knowledge of environmental and social problems related to current energy systems</b>	<b>Knowledge of developments of alternative source of energy</b>
<b>Blijstroom</b>	13	19
<b>Loenen</b>	12	25

**Table 11: Number of quotes for the level of knowledge variable. Source: Author, 2021.**

First and foremost, tables 10 and 11 indicate that Blijstroom and Loenen Cooperative members hold a high level of knowledge related to the problems of current energy systems and the developments of alternative sources of energy. However, it is important to mention that, during the interviews conducted with Blijstroom members, the level of knowledge seemed to be

already solid before their involvement in the organization. Still, the respondents stress that their knowledge and interest in energy matters are positively influenced by the REC structure. In particular, knowledge on the possibilities of “developing decentralized energy systems in urban areas” (Blijstroom), such as collaborative solar systems, as well as “energy conservation measures” (Blijstroom), are referred to. On the other hand, members of Loenen Cooperative also indicate remarkably strong levels of knowledge before joining the organization. Similarly, their knowledge is positively influenced, especially concerning “local technical sustainable developments” (Loenen Cooperative), and the “importance to foster bottom-up initiatives within the global energy transition” (Loenen Cooperative).

#### 4.2.2.2 Trust

<b>Code / REC</b>	<b>Interpersonal trust</b>	<b>Social trust</b>
<b>Blijstroom</b>	18	6
<b>Loenen</b>	23	4

**Table 12: Number of quotes for the *level of trust* variable.  
Source: Author, 2021.**

The table depicted above illustrates that, when discussing the variable of *level of trust*, the respondents persistently refer to interpersonal trust, and more precisely to the trust they have towards other members of the REC. For Blijstroom respondents, the absence of direct communication and spatial proximity with other members plays a minor role: “I don't know them personally, but I trust that they have the same interests in regard of energy than I have” (Blijstroom). Their level of trust towards other members is influenced by the REC structure insofar that it is linked to the “feeling to follow common interests” (Blijstroom) through the organization. On the other hand, most respondents from Loenen Cooperative also indicate a high level of interpersonal trust. However, whereas some interviewees indicate that the size of the organization and the spatial proximity between members play an important role, resulting in what they designate as a process of “social control” (Loenen Cooperative), other

respondents' reactions remain lukewarm about the REC's impact "I don't trust the other members that always have social aspects as number one priority" (Loenen Cooperative).

### 4.2.3 Quotes linked to consumer engagement

This section presents the data collected and the number of codes associated with the three elements of consumer engagement presented in the literature review: the attitudes towards technologies, the investments in the REC, and the energy consumption behaviours.

#### 4.2.3.1 Attitudes towards technologies

<b>Code / Cooperative</b>	<b>Perception of consumers about RET's and decentralized energy infrastructures</b>	<b>Behaviour in response to the availability of the technology</b>
<b>Blijstroom</b>	35	5
<b>Loenen</b>	25	5

**Table 13: Number of quotes for the *attitudes towards technologies* variable.  
Source: Author, 2021.**

Table 13 illustrates that the perception of consumers about RET's and decentralized energy infrastructures are for both RECs the most recurrent element of the respondent's answers. Moreover, to simultaneously collect and analyse quantitative and qualitative data on the sub-variables of attitude towards technologies, we decided to mix open-ended questions with the short questionnaire. The following table exhibits the means calculated, on a Likert scale from 1 to 6, based on the interviewees' answers in both RECs.

<b>Concepts</b>	<b>Cooperative / Questions (out of 6)</b>	<b>Blijstroom</b>	<b>Loenen Cooperative</b>
<b>Perception of consumers about RET's and decentralized energy infrastructures</b>	Do you consider decentralized energy supply as a feasible alternative to centralized energy infrastructure?	4,4	5,2
	Do you support further deployment of decentralized energy supply and local community initiatives?	5	5,8
	Do you oppose larger, centralized energy infrastructures?	2,8	2
	Do you consider that renewable energies have negative impacts on their environments?	1,5	3,2
	Do you feel responsible for the production and distribution of energy at the local level?	5,2	5,4
<b>Behaviour in response to the availability or implementation of the technology</b>	Do you accept to provide space for the installation of battery in your household?	5,6	5.4

**Table 14: Calculated means of the responses provided by Blijstroom's and Loenen Cooperative's members on the short questionnaire on the variable *attitude towards technologies*. Source: Author, 2021.**

Based on the questionnaire's results, table 14 demonstrates that the attitudes towards technologies tend to be slightly more positive for Loenen Cooperative members than for Blijstroom members. In particular, their responses indicate strong support for decentralized energy infrastructures and local energy initiatives, which constitute a "crucial part of the solution" (Loenen Cooperative), or even "the only way to do it" (Loenen Cooperative). Interestingly, variation is found in the member's answers provided to the question about the negative impacts of RE infrastructures on their natural environments. Whereas Loenen Cooperative members consider that "large fields with solar panels do not make our village a nicer place to be" (Loenen Cooperative), Blijstroom members generally consider that "there is no negative impact on putting solar panels on flat roofs" (Blijstroom). Besides, in both cases, no blatant opposition towards centralized energy infrastructures is detected. Rather, the respondents maintain that "a certain amount of basic infrastructure must be provided"

(Blijstroom) with a higher consideration for communities' local needs: “we have to look very carefully how we can integrate these systems” (Loenen Cooperative). Regarding the behaviour in response to the availability or implementation of technology, respondents indicate a positive response, with some slight variation, towards the physical features of these emerging technologies.

#### 4.2.3.2 Investments in the REC

<b>Code / REC</b>	<b>Number of shares purchased</b>	<b>Intention to purchase more</b>
<b>Blijstroom</b>	9	3
<b>Loenen</b>	8	2

**Table 15: Number of quotes for the *investments in the REC* variable.**  
**Source: Author, 2021.**

This table exhibits the number of quotes linked to the financial dimension of consumer engagement. It suggests that for respondents of both organizations, the investments made are considered as a determinant feature of their consumer engagement, and as a way to guarantee the durability of the projects. Indeed, except for one interviewee in Loenen Cooperative, all respondents bought shares in the projects developed and implemented by the organizations.

#### 4.2.3.3 Energy consumption behaviours

<b>Code / REC</b>	<b>Curtailement behaviour</b>	<b>Efficiency behaviour</b>
<b>Blijstroom</b>	5	8
<b>Loenen</b>	6	10

**Table 16: Number of quotes for the *energy consumption behaviours* variable.  
Source: Author, 2021.**

Table 16 emphasizes that respondents in both RECs adopt behavioural changes towards energy conservation, however in different ways. In terms of curtailment behaviour, Blijstroom members conduct actions such as switching lights off and lowering house temperature when leaving home. On the other hand, interviewees from Loenen Cooperative follow their energy production and consumption monthly through the cVPP system. Intriguingly, the respondents of Loenen Cooperative emphasize that their curtailment behaviour has become a “hobby” (Loenen Cooperative), or a “sport” (Loenen Cooperative) between members of the organization. In terms of efficiency behaviour, respondents from both RECs display high levels of engagement. In Blijstroom, interviewees emphasize that they take various efficiency measures since being members of the REC. For instance, some of the members invested in home improvements, such as thermal insulation, or switched to LED light bulbs. Although in Loenen, most respondents had invested in efficiency already measures before joining the organization, they underline that the REC transmits important knowledge on efficiency measures.

### 4.3. Relationships between variables

This section presents the various relationships observed between the variables and sub-variables displayed in the conceptual framework and the operationalization table, building upon the insights and information outlined in the previous sections. In particular, four co-occurrence tables retrieved from Atlas Ti, disaggregating the codes exposed in tables 4 and 5 into sub-variables, are included to address the most important relationships. Moreover, they will be completed with a quantitative analysis of selected sub-variables, performed with R.

#### 4.3.1. Relationships between *renewable energy cooperatives*, and *awareness and level of trust*

This sub-section introduces the relationships found between the sub-variables of the REC variables, and our mediating variables, levels of knowledge and trust. Tables 17 and 18, created based on the co-occurrence tool of Atlas Ti, display these relationships.

Variables	Sub-variables	Level of knowledge		Level of trust	
		Knowledge of problems related to current energy systems	Knowledge of developments of alternative sources of energy	Interpersonal trust	Social trust
Objective	Value-chain approach	0	0	3	0
	Technology used	0	1	0	0
Level of ownership	Legal ownership	0	0	1	0
	Sense of ownership	0	0	3	0
Spatial characteristics	Geographical location	0	3	4	0
	Business model	0	0	2	0
Member characteristics	Stakeholder type	1	0	2	0
	Period of membership	1	1	1	0

**Table 17: Co-occurrence table for sub-variables of *REC* variables and sub-variables of *awareness and level of trust* variables in Blijstroom.**

**Source: Author, 2021.**

Variables	Sub-variables	Level of knowledge		Level of trust	
		Knowledge of problems related to current energy systems	Knowledge of developments of alternative sources of energy	Interpersonal trust	Social trust
Objective	Value-chain approach	2	2	1	0
	Technology used	0	1	0	0
Level of ownership	Legal ownership	1	1	2	0
	Sense of ownership	0	3	0	0
Spatial characteristics	Geographical location	1	5	9	0
	Business model	0	0	2	0
Member characteristics	Stakeholder type	0	2	1	0
	Period of membership	0	1	1	0

**Table 18: Co-occurrence table for sub-variables of *REC* variables and sub-variables of awareness and level of trust variables in Loenen Cooperative.**  
Source: Author, 2021.

#### 4.3.1.1 Objective

In the first place, tables 17 and 18 reveal that both the value-chain approach and the technology used by the RECs exert an influence on the levels of knowledge and trust. For Blijstroom members, the energy generation function of the organization primarily reinforces trust among members who consider the collective purpose of feeding RE into the electricity grid: “I do not feel responsible for my own use, but rather for the collective generation” (Blijstroom). Moreover, Blijstroom members acknowledge the non-profit character of the organization “if you're able to install solar panels by yourself, it's also more profitable” (Blijstroom), and rather emphasize the “social” (Blijstroom) aspect of collaborative energy systems. For Loenen Cooperative members, the hybrid function of the organization, and thus the physical proximity to the assets influences the knowledge of energy developments: “if you have a wind generator or solar panels inside of your village you see them on a day-to-day basis. That can increase your awareness, your interest in energy systems, and also help you to reduce your demand”

(Loenen Cooperative). Interestingly, when discussing Loenen Cooperative's hybrid functions and individual accountability towards the energy system, one of the respondents mentions Elinor Ostrom's "tragedy of the commons" (Loenen Cooperative), indicating strong knowledge of problems related to the current energy system.

#### ***4.3.1.2 Level of ownership***

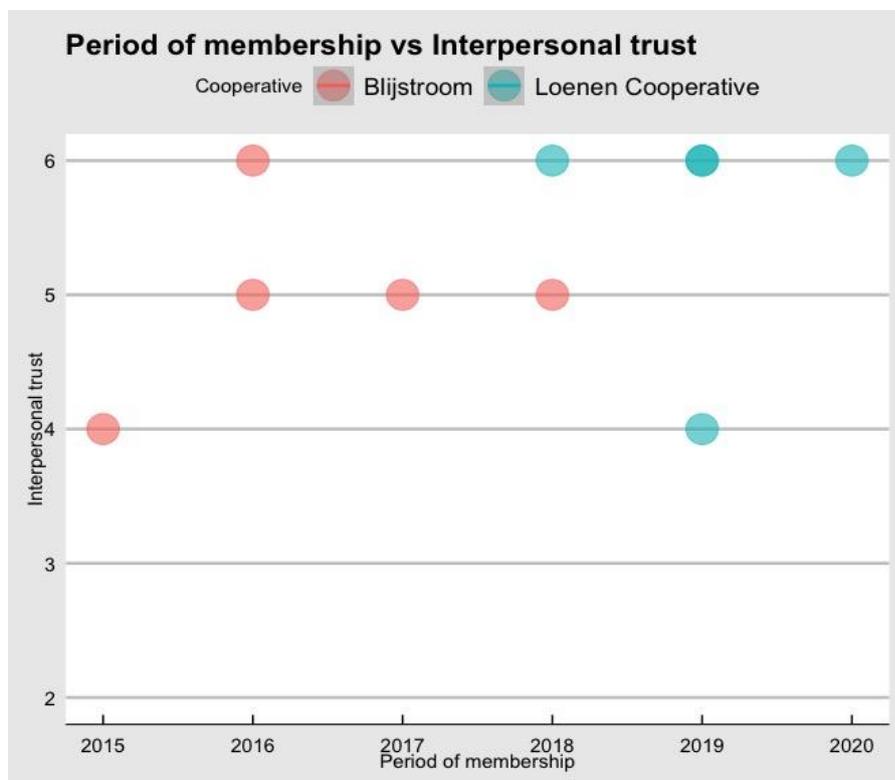
Table 17 bolsters the idea that, for Blijstroom members, the sense of ownership takes higher importance than legal ownership. The sense of ownership, and more specifically the feeling of collectively owning the assets and pursuing common interests, influence the interpersonal trust; "One of the nice aspects of Blijstroom is: together we own all the panels, and I cannot say panel 13 B is mine and that production goes to me" (Blijstroom). On the other hand, table 17 supports the insight that the sense of ownership, linked to the cVPP project and the technical information provided over the assets, influence the knowledge of energy developments. Furthermore, legal ownership also plays a role: Loenen Cooperative members stress that the "ownership and the right use of the grid" (Loenen Cooperative), as well as the accountancy required by legal ownership modalities, foster the development of interpersonal trust among REC members.

#### ***4.3.1.3 Spatial characteristics***

We emphasized in the previous section that spatial proximity plays a central role for both RECs. Tables 17 and 18 reveal that this feature predominantly exerts an influence over the knowledge on energy developments and interpersonal trust. For Blijstroom members, the various meetings organized in the neighbourhoods of Rotterdam Centrum and Noord, now adapted to the Covid-19 pandemic, play an essential role for their knowledge on energy issues: "there is knowledge around you, so you can act" (Blijstroom), and their level of interpersonal trust: "with the different evenings they organized to meet other people, that's how they gained my trust" (Blijstroom). Nonetheless, table 17 highlights that spatial proximity takes even greater importance for Loenen Cooperative members. Interviewees claim that this type of "close community" (Loenen Cooperative) promotes the opportunities to "self-learn from each other" (Loenen Cooperative), and "meet other people who are also involved and interested in this kind of development" (Loenen Cooperative).

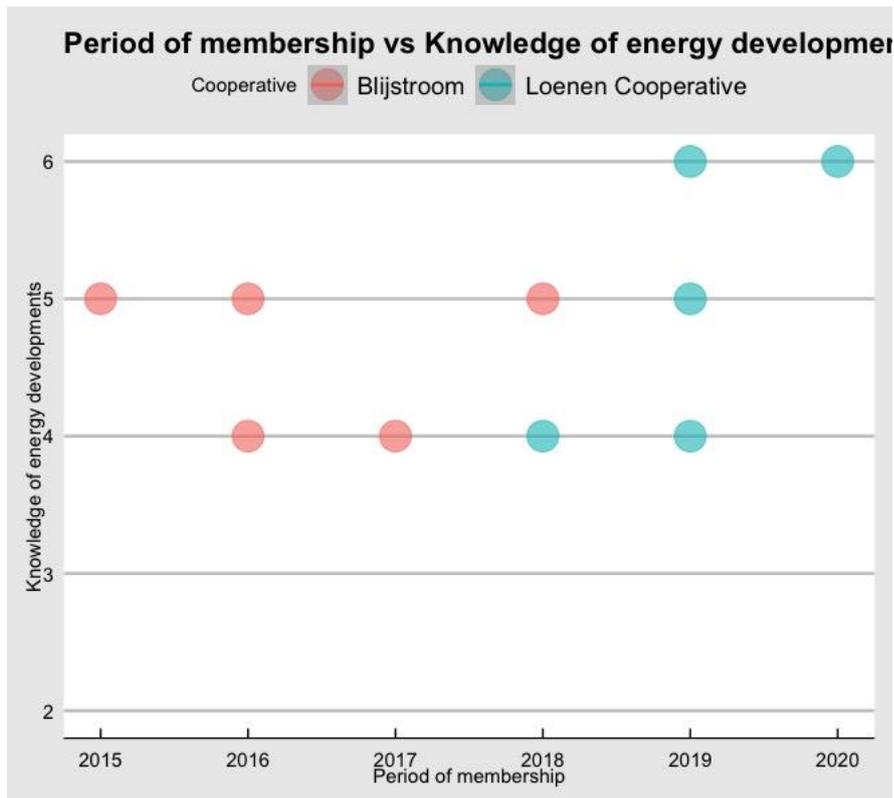
#### 4.3.1.4 Member characteristics

Finally, tables 17 and 18 sustain the idea that individual characteristics do not play a significant role to explain the variation in levels of awareness and trust. However, the data shows that the different stakeholder types of Blijstroom and Loenen Cooperative exert different influences on the levels of knowledge and trust, following the elements underlined in the previous subsections, in particular the objectives of the RECs. Whereas Loenen Cooperative members are physically close to energy generation assets and able to monitor their energy consumption through the cVPP management system, consequently increasing their level of knowledge, the collective ownership and production of solar energy enhance trust among Blijstroom members: “all together we produce energy and then we divide the money into the shares, and that creates trust” (Blijstroom). Regarding the period of membership, the co-occurrence tables illustrate its minor influence on the levels of awareness and trust. Moreover, we exemplify with the data generated through the short questionnaires how quantitative data can help to triangulate qualitative data. The following figures, created with R, visualize the correlation between the period of membership and the highest varying sub-variables of our mediating variables.



**Figure 8: Correlation between the sub-variables *period of membership* and *level of interpersonal trust*.**

**Source: Author, 2021.**



**Figure 9: Correlation between the sub-variables *period of membership* and *knowledge of developments of alternative sources of energy*.**  
**Source: Author, 2021.**

No clear pattern can be recognized in figures 8 and 9, supporting the idea that the variation in the period of membership does not play a significant role to explain the levels of knowledge and trust. However, figure 9 could indicate that the latest members to have joined Loenen Cooperative, are the most knowledgeable about energy developments.

#### **4.3.2. Relationships between *awareness* and *level of trust*, and *consumer engagement***

The relationships found between the sub-variables of our dependent variable, *consumer engagement*, and our mediating variables, *level of knowledge* and *level of trust*, are shown in tables 19 and 20, created with the co-occurrence tool of Atlas Ti.

Variables	Sub-variables	Level of knowledge		Level of trust	
		Knowledge of problems related to current energy systems	Knowledge of developments of alternative sources of energy	Interpersonal trust	Social trust
Attitudes towards technologies	Perception of consumers	1	4	3	1
	Behaviour in response to the availability	0	2	0	0
Investments in the REC	Shares purchased	0	0	2	0
	Intention to purchase more	0	0	0	0
Energy consumption behaviours	Curtailment behaviour	0	1	0	0
	Efficiency behaviour	1	3	1	0

Table 19: Co-occurrence table for sub-variables of *consumer engagement* variables and sub-variables of *awareness* and *level of trust* variables in Blijstroom.

Source: Author, 2021

Variables	Sub-variables	Level of knowledge		Level of trust	
		Knowledge of problems related to current energy systems	Knowledge of developments of alternative sources of energy	Interpersonal trust	Social trust
Attitudes towards technologies	Perception of consumers	2	3	3	1
	Behaviour in response to the availability	0	1	0	0
Investments in the REC	Shares purchased	0	1	2	0
	Intention to purchase more	0	0	0	0
Energy consumption behaviours	Curtailment behaviour	0	2	0	0
	Efficiency behaviour	1	3	1	0

Table 20: Co-occurrence table for sub-variables of *consumer engagement* variables and sub-variables of *awareness* and *level of trust* in Loenen Cooperative.

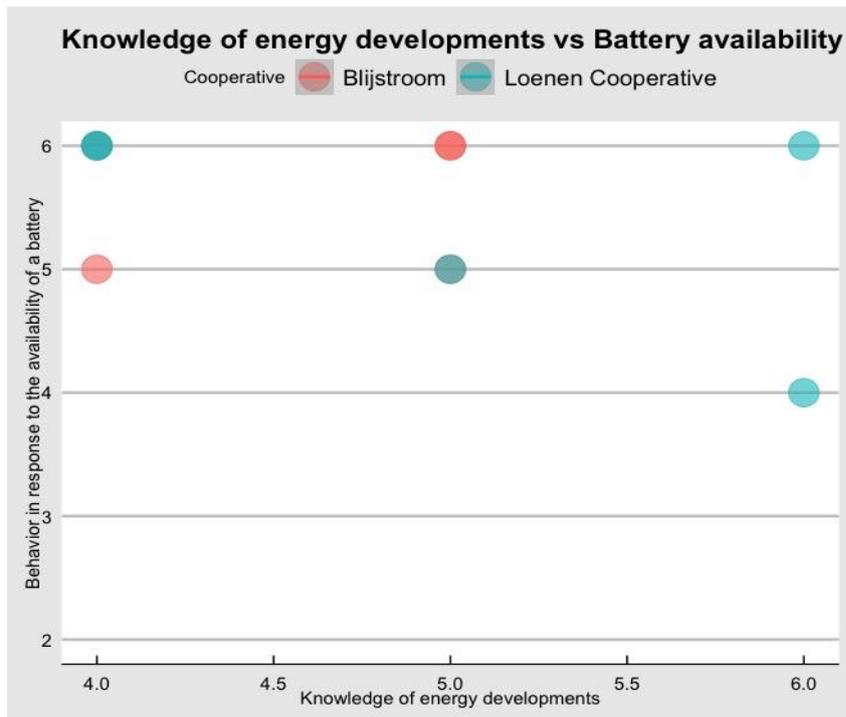
Source: Author, 2021.

#### ***4.3.2.1. Attitudes towards technologies***

First of all, tables 18 and 19 emphasize that in both RECs the perception of consumers, and thus the strong support for decentralized energy infrastructures and local energy initiatives illustrated in sub-section 4.2.3.1, are influenced by the levels of knowledge and trust.

For Blijstroom members, the interpersonal trust, the common interests and the perception of RE technologies display a relationship of reciprocity: “I feel that we all have the same mindset towards RE and towards the assets. I think that automatically builds the trust” (Blijstroom). Moreover, the perception is influenced by the knowledge of environmental problems and energy developments: “My views and my involvement have changed over the years, and that’s due to the way they can get people to know about climate change and what we can do about it” (Blijstroom). For Loenen Cooperative, the strong levels of knowledge illustrated in the previous section impact respondents’ perception of RET’s and emphasize the necessary concessions of the energy transition: “there will always be impacts” (Loenen Cooperative), “the question is whether the impact is bigger or more negative than the impact of fossil-fuel systems” (Loenen Cooperative). Moreover, interviewees from Loenen Cooperative mention that the organization provides them with “power to influence this process” (Loenen Cooperative), and their collective involvement in the cVPP makes them responsible to “make profit, not as money, but for the community” (Loenen Cooperative).

Concerning the behaviour in response to the availability or implementation of the technology, such as home energy storage devices, tables 19 and 20 show that the high scores displayed in table 14 are in both cases determined by the knowledge of energy developments: “I’m convinced that without storage we are not going to get it working. And for me, it’s part of the cVPP” (Loenen Cooperative). However, figure 10 shows that the variation in knowledge of energy developments does not necessarily explain a variation in the behaviour towards the availability of a home battery. On the opposite, one of Loenen Cooperative’s respondents remains reluctant towards the adoption of batteries due to their financial costs and chemical pollution, emphasizing that “you have to avoid batteries as long as possible” (Loenen Cooperative).



**Figure 10: Correlation between the sub-variables *knowledge of developments of alternative sources of energy* and *behaviour in response to the availability or implementation of the technology*.**

**Source: Author, 2021.**

#### 4.3.2.2. Investments in the REC

The co-occurrence tables 19 and 20 illustrate that the sub-variable *interpersonal trust* influences the investment in the REC, in particular the number of shares purchased. Whereas some respondents from Loenen Cooperative underline the financial benefits coupled with the investments, members of both RECs emphasize the social aspects of financial participation “so we thought it was very social for everybody who doesn't have a roof or much money to invest, can still do a good thing” (Blijstroom); “we also have people with one share, but they also are fairly connected with the corporation” (Loenen Cooperative). Moreover, figure 10, based on the data generated by the questionnaires, confirms the causal link between interpersonal trust and the number of shares purchased.



**Figure 11: Correlation between the sub-variables *interpersonal trust* and *number of shares purchased*.**

**Source: Author, 2021.**

#### ***4.3.2.3 Energy consumption behaviours***

According to the co-occurrence tables, in both RECs, the energy consumption behaviours of the respondents are influenced by both their knowledge of energy developments and knowledge of problems related to current energy systems. In Blijstroom, the curtailment behaviour is linked to the knowledge shared between members: “you're surrounded by people who know a lot about possibilities to decrease your energy consumption” (Blijstroom). Similarly, the efficiency behaviour is linked to the share of knowledge “the organization provided us with some additional ideas on how to renovate our house. So, a lot of other Blijstroom members also have been insulating their houses, building and renovating” (Blijstroom). In Loenen, the knowledge is rather linked to the information provided by the cVPP: “I am aware of my energy consumption and I'm trying to reduce it by following on a monthly basis, the development of my energy use, but also the production of energy on my roof” (LC). Furthermore, participation in this development “stimulates also to take next steps and to think about batteries or to think about flexibility in your energy dependence and everything. So, it takes it to a higher level” (LC).

## 4.4. Discussion

Drawing on the findings exhibited in chapter 2, this section summarizes and discusses the results, strengths and limitations of our results. First of all, the insights provided on the case studies, displayed in section 4.1, demonstrate that RECs cannot be regarded as one homogeneous form of CE initiatives. Blijstroom and Loenen Cooperative exhibit heterogeneous characteristics, following their structural and contextual components. Furthermore, the results outlined in sections 4.2 and 4.3 indicate that the socio-psychological mechanisms of awareness and trust are strongly influenced by the structural components of RECs and play a crucial role in shaping the elements of consumer engagement. Last but not least, the data analysis exposed in this chapter indicates that, despite a slight variance in consumer engagement, no distinct correlation between the variance in structures of RECs and the variance in consumer engagement can be demonstrated.

The sub-sections 4.2.1.1 and 4.3.1.1 illustrate that the RECs' objectives determine the level of trust and awareness to different extents. Whereas Blijstroom's collective generation units foster strong levels of trust between members of the organization, Loenen Cooperative's hybrid activities enhance the levels of knowledge, linked to the essential role taken on by prosumers within the cVPP system. Furthermore, the sense of ownership plays a fundamental role, endorsing the *symbolic* dimension of ownership identified by Maruyama et al. (2007) and Warren & McFayden (2010) through their studies on wind energy. On one hand, the involvement of Loenen Cooperative members in state-of-the-art energy developments, such as the cVPP pilot project, enhances the exchange of information and knowledge, emphasizing that the sense of ownership is not inherently linked to legal ownership. On the other hand, the collective ownership of solar panels in Blijstroom fosters high levels of interpersonal trust. Surprisingly, the distinction between Blijstroom and Loenen Cooperative, respectively identified as a community-of-interest and a community-of-location, does not result in a variation in the level of trust, nor does lead to cognitive distance with the RE assets, contradicting the claims of Tarhan (2015) and Bauwens (2019). Conversely, the common interests followed by Blijstroom members promote the conception of a social network prone to social interactions and collective learning. However, it is important to relativize this finding, by emphasizing that the local focus displayed by Blijstroom facilitates and encourages the pursuit of common interests between its members. Another important finding implies that the

period of membership, outlined by Bauwens (2016) and Hoppe et al. (2019) as a causal feature for their engagement, does not influence the variation in levels of awareness and trust. This unexpected result can be plausibly explained by the fact that Blijstroom and in particular Loenen Cooperative members expressed high levels of awareness and trust before their involvement in the organizations.

The low correlation between the variance in RECs' structures and the variance in consumer engagement can be interpreted in two different, yet complementary, ways. On one hand, reflecting on Ajzen's (1991) theory of planned behaviour, consumer engagement can be defined as a social and psychological outcome, shaped by the willingness of social actors to join a specific organization. The high levels of consumer engagement displayed in Blijstroom and Loenen Cooperative can thus be explained by the behavioural intentions of consumers having already individually decided to actively engage with DG systems and RET's before their involvement in the organizations. On the other hand, considering Yildiz et al.'s (2015) recommendation to apprehend RECs as social entities, the results indicate that the social relationships intrinsic to the organizations' structural components enhance consumer engagement, regardless of their characteristics. RECs activate social norms and promote common interests, reducing the cognitive distance between energy generation and production and fostering active engagement in terms of individual attitudes, financial investments and energy behaviours. Reflecting on both interpretations, the results of this chapter indicate that exclusive structural and contextual components of RECs provide specific individuals with knowledge, trust, and agency, as a socio-psychological process enhancing and promoting the active engagement of their members.

Last but not least, it is essential to discuss the strengths and limitations of this research. To the author's best knowledge, this study is the first to conduct theoretical and practical research on the relationship between REC structures and consumer engagement. The theoretical findings, the conceptual model, as well as the research design and methods employed in this research, can thus serve as landmark material for future research in this field. Nonetheless, whereas the uniqueness of this study constitutes an indisputable strength, it also implies noteworthy limitations. With the absence of similar studies on this issue, the results exhibited in this chapter cannot be compared or contrasted with different results. Moreover, the epistemological approach of critical realism implies that the conceptualization of our variables does not actually reflect reality, but rather "a way of knowing that reality" (Bryman, 2012, p. 29). The usage of

inductive coding would thus be valuable to uncover unexpected outcomes during the data analysis process. Besides, whereas we exemplified how quantitative data can be used to triangulate qualitative data, the samples remain too small to outline precise correlations between the variables. Lastly, following the positivist approach, social reality can only be studied, and qualitative research conducted, through extended contact with the respondents (Bryman, 2012). In this paper, the perspectives and insights gathered strongly rely on the speculations of the interviewees about the researcher's intentions and/or expectations. To outreach the passive description of social reality, and actively participate in generating it, ethnographic research would be an interesting starting point to dive further into the topic.

## **Chapter 5: Conclusions, implications and recommendations**

This final chapter concludes this paper by answering our research questions, emphasizing the implications of this investigation, and outlining recommendations for future research and policymaking.

### **5.1. Conclusions**

#### **5.1.1. Sub-question 1: What are the main structural characteristics of renewable energy cooperatives that actively influence consumer engagement?**

The contemporary re-emergence of RECs as a major organizational form in the energy field demands a meticulous reflection upon their structural components. Based on a set of two heterogeneous case studies, this research demonstrated that specific structural elements can be investigated to determine the influence of RECs on consumer engagement. Whereas the member characteristics play a less important role, the objectives, level of ownership, and spatial characteristics strongly influence REC members' perspectives and behaviours and determine the nature of the social networks which emerges within the respective communities. In particular, depending on the contexts and stakeholders involved, the level of ownership and the spatial characteristics of RECs can be identified as the main drivers of consumer engagement. In Blijstroom, the sense of ownership, and more specifically the feeling of collectively owning the RE assets influence the trust between members of the organization and mostly results in positive attitudes, financial investments and sustainable energy behaviours. In Loenen Cooperative, the spatial proximity between members of the organization significantly impacts the levels of awareness, leading to a slightly higher consumer engagement than in Blijstroom.

#### **5.1.2. Sub-question 2: What is consumer engagement and how does it relate to distributed generation systems?**

Based on the theoretical findings of this research, consumer engagement was defined as the social, psychological, and contextual process that converts the users of a specific technology into active and engaged consumers. Supplemented with the results of chapter 4, consumer engagement is defined as both a process and an outcome, shaped by the motivation of consumers to engage with innovative RET's. Within the context of DG systems, the

engagement of consumers specifically relates to three aspects: the positive attitude towards RE assets and the willingness to provide space for the physical aspects of RET's, capital investments, and behavioural changes towards energy conservation. These elements are essential to ensure the widespread diffusion of RET's and DG systems, as well as their technical and financial viability. Furthermore, the case studies we conducted research on empirically illustrated that consumer engagement is context-specific. On one hand, the functioning of the cVPP smart management system in Loenen Cooperative requires an active role taken on by consumers. On the other hand, the collaborative solar systems developed by Blijstroom demand less active interaction with the RE assets but require active financial participation and positive attitudes. Therefore, whereas the elements of consumer engagement vary according to the contextual and structural components of RECs, the implementation of DG systems is inherently linked to the active participation and engagement of local stakeholders.

### **5.1.3. Sub-question 3: What is the role played by the mechanisms of awareness and trust?**

The process of consumer engagement largely depends on the stimulation of socio-psychological mechanisms, through which the structural components of RECs enhance the engagement of consumers. As illustrated in chapter 4, the mechanisms of awareness and trust play a mediating role between the variables and exhibit the nature of the relationship relating the structures of RECs to consumer engagement. The sharing of knowledge and the enhancement of trust contribute to lowering the cognitive distance between energy generation and consumption, reducing information asymmetry, and providing local actors with agency, leading to strong engagement in the co-production process of RE. Moreover, the levels of awareness and trust vary based on the contexts the case studies are embedded in, thus depending on the nature of the social networks fostered by the RECs' structural characteristics.

### **5.1.4. Main Research Question: To what extent do renewable energy cooperatives influence consumer engagement in the context of distributed generation systems?**

Building upon the answers provided to the three previous questions, this research theoretically and empirically demonstrated that RECs do influence consumer engagement to various extents, depending on their structural and contextual characteristics. First, the differing objectives, levels of ownership, and spatial characteristics of RECs determine the levels of trust and

awareness displayed in the respective communities. Then, these socio-psychological mechanisms play a crucial role in fostering consumer engagement, which takes different dimensions in terms of private attitudes, financial investments and energy behaviours. However, considering the slight, but insignificant, variance found on consumer engagement, this research primarily reveals that the structural and contextual differences displayed between Blijstroom and Loenen Cooperative do not play a significant role in explaining the varying levels of consumer engagement. The specific social networks formed by RECs foster the activation of social norms and the promotion of common interests, which provide incentives for local stakeholders to engage with these novel types of localized, small-scale, and renewables-based energy systems. Consequently, this research shows that the REC model is appropriate to foster the share of knowledge, the enhancement of trust, and the active engagement of citizens in the co-provision process of flexible generation and distribution of energy.

## **5.2. Implications and recommendations**

### **5.2.1. Implications**

After having answered our research questions, it is essential to discuss the implications of this research. First of all, this research endorses Bauwens' (2013) hypothesis that the REC model is suitable to involve citizens in the diffusion of DG systems, located close to consumer sites. Whereas Bauwens (2013) does not investigate the specific elements of RECs which promote the engagement of consumers into new types of RET's, the elements outlined in the conceptual model, and the results exhibited in chapter 4, yield new insights on the subject. Secondly, this research contributes a clearer understanding of the theoretical, practical, and contextual elements of the active dimension of social acceptance, consumer engagement, introduced by Sauter & Watson (2007). Finally, the results build on Yildiz et al.'s (2015) recommendation to apprehend RECs as social entities and thus emphasize the importance to consider non-price-based factors, such as the socio-psychological mechanisms of awareness and trust, as essential elements to foster local engagement in decentralized energy systems.

## 5.2.2. Recommendations

### 5.2.2.1. Recommendations for further research

Given the ground-breaking character of this paper, there are several gaps in the knowledge around RECs and consumer engagement that follow from our findings, and would benefit from further research:

1. To better understand the implications and generalizability of our results, future studies could start by investigating RECs with different structural components. In particular, it would be interesting to research how RECs with different business models impact the implementation of DG systems and local consumer engagement. Moreover, since the latter strongly depend on the type of technology involved and on the scale at which it is deployed (Bauwens, 2013), it is equally important to figure out how the integration of new RETs impact the engagement of REC members.
2. Secondly, future research should take the cultural, institutional, legal and/or technical elements that foster the deployment of RECs and encourage the participation and engagement of citizens in DG systems into account. Reflecting on Šahović & da Silva's recommendations (2016), this analysis could include a cross-country analysis on drivers and barriers of consumer engagement, appraisal of RECs' structural components in different countries, research on the political, institutional and/or legal frameworks, or the transferability of REC models to countries where citizens are not active in the field of RET's.
3. Finally, multiple lead authors have recently pinpointed the crucial role played by cities in the energy transition (e.g., Smil, 2016; Droege, 2018; van den Dobbelsteen et al., 2019; Eicker, 2019). The results exhibited in chapter 4 indicate that Blijstroom members express a lower concern about the visual impact of the RE assets, although both RECs use solar energy as their main technology to fulfil their functions. Therefore, future research can include a thorough assessment of the social, technical, and financial role played by RECs in the urban energy transition, and more specifically to what extent they are likely to actively engage urban dwellers as part of this socio-technical change.

### **5.2.2.1. Recommendations for policymaking.**

In addition to the suggestions outlined above, several recommendations could be drawn for policymaking from this research:

1. In August 2021, the Intergovernmental Panel on Climate Change published its sixth assessment report (IPCC, 2021) declaring that climate change is unequivocally caused by anthropogenic greenhouse gas (GHG) emissions and unequivocally affecting the global environment. As attention turns to the energy sector, policymakers should take non-price-based factors into accounts, alongside conventional approaches relying on financial incentives, to harness the potential of grassroots initiatives and social networks in the transition to low-carbon energy systems. Moreover, this research can serve as a guide to understand under which circumstances local stakeholders are willing to engage with innovative technologies and provide flexibility for decentralized infrastructures.
2. In recent years, cities across the world gradually went from being viewed as key targets of the energy transition to being hailed as key instruments of delivering it (e.g., Hodson & Marvin, 2010; Rutherford & Coutard, 2014; Basu et al., 2019). Consequently, this research can help to draw lessons for the new local governance of decentralized energy systems in urban areas. RECs can help to give dynamic to creativity, promote innovation, learning and adaptiveness, as well as foster the achievement of more sustainable and resilient urban energy systems. Finally, RECs can serve as interface capacities between public authorities and civil society, creating opportunities to promote polycentric governance in urban areas (Ostrom, 2010).

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# **Annexe 1: Research Instruments**

**Erasmus University Rotterdam, The Netherlands, Institute for Housing and Development Studies (HIS)**

**MSc. Urban Management and Development – UMD 17**

**July 2021**

## **1. Introduction of the interview**

Good morning, my name is Rémy Rupp. I thank you for your time and collaboration for this interview. I am a 24-years old student at the Institute of Housing and Urban Development Studies, Erasmus University Rotterdam. I am conducting research on Renewable Energy Cooperatives and the influence they exert on their members. Basically, this research aims to understand to what extent the organizational structure of Renewable Energy Cooperatives can influence the consumer engagement of their members, in the context of Distributed Generation systems.

This interview will last for approximately 20/25 minutes and will be constituted of a mix between closed and open question format. If, at any time, there is an element or a question of the interview you do not understand, please feel free to tell me.

I would like to ask you for permission to record the interview since it will facilitate the process of data analysis. The interview conversation will be used exclusively for the purposes of this academic research and I guarantee that the interview will be confidential. I assure you that privacy, confidentiality, and anonymity will be respected throughout the whole process of this interview and the coding process and data analysis that will follow.

Moreover, if you find the research study interesting, I will be glad to provide you with the final copy of my research report. Please, feel free to add comments or questions to enhance a fruitful conversation for both of us.

## 2. Questions (contents)

### Part 1: Questions on independent variables

- How long have you been member of the cooperative?
- Do you consider that the REC provides you with a sense of ownership?
- Do you consider the spatial proximity with other REC members as an essential element of the organization?

### Part 2: Questions on mediating variables

#### Awareness

Do you consider yourself aware of the environmental and social problems linked to current centralized fossil-fuel energy systems?					
1	2	3	4	5	<b>6</b>

Do you consider yourself aware of the developments of alternative sources of energy?					
1	2	3	<b>4</b>	5	6

- Would you say that the REC influenced this awareness?

#### Trust

How much do you trust other members of the REC?					
1	2	3	4	5	<b>6</b>

How much do you trust institutions (federal government / local governments)?					
1	2	3	4	5	6

- Would you say that the REC influenced this trust?

### **Part 3: Questions on consumer engagement**

#### Attitude towards technologies

Do you consider decentralized energy supply as a feasible alternative to centralized energy infrastructure?					
1	2	3	4	5	6

Do you support further deployment of decentralized energy supply and local community initiatives?					
1	2	3	4	5	6

Do you oppose larger, centralized energy infrastructures?					
1	2	3	4	5	6

Do you consider that Renewable Energies have negative impacts on their environments?					
1	2	3	4	5	6

Do you accept to provide space for the installation of a X technology in your house?					
1	2	3	4	5	6

Do you feel responsible for the production and distribution of energy? (At the local level?)					
1	2	3	4	5	6

### Investments in RET's

- **How many shares of the organization did you purchase an REC member?**
- **Do you have the intention to purchase more?**

### Changes in energy consumption

- **Do you take any actions to attempt to decrease your energy consumption?**
  - **If yes, which one?**
  - **If no, do you think about doing so?**
- **Did you invest in any home improvements, such as thermal insulation or energy efficient appliances?**
  - **If yes, which one?**
  - **If no, do you think about doing so?**

### **3. Conclusions and thank you**

Thank you very much for answering my questions this far. I am grateful for interviewing with you today.

### Questions about characteristics

<b>Name</b>	
<b>Gender</b>	<ul style="list-style-type: none"><li>● Male</li><li>● Female</li><li>● Other</li></ul>
<b>Age</b>	<ul style="list-style-type: none"><li>● Children (0-14)</li><li>● Youth (15-24)</li><li>● Adult (25-64)</li><li>● Senior (65 and over)</li></ul>
<b>Number of people in the household</b>	
<b>Type of household?</b>	<ul style="list-style-type: none"><li>● Living alone</li><li>● Single parent</li><li>● Living with partner, no kids</li><li>● Living with housemates</li><li>● Other</li></ul>
<b>Education</b>	<ul style="list-style-type: none"><li>● No schooling</li><li>● Primary school</li><li>● High school</li><li>● University</li></ul>

<b>Last university degree (if applicable)</b>	<ul style="list-style-type: none"> <li>• Bachelor</li> <li>• Master</li> <li>• PhD</li> </ul>	
<b>Employment status</b>	<ul style="list-style-type: none"> <li>• Employed</li> <li>• Unemployed</li> <li>• Pensioner</li> <li>• Student</li> <li>• Other</li> </ul>	
<b>Working hours per week</b>	<ul style="list-style-type: none"> <li>• 0 (unemployed/retired)</li> <li>• 1-20</li> <li>• 11-20</li> <li>• 21-30</li> <li>• 31-40</li> <li>• Other</li> </ul>	
<b>Average monthly net household income (in EURO)</b>	<ul style="list-style-type: none"> <li>• Less than 900</li> <li>• 900-1500</li> <li>• 1500-2000</li> <li>• 2000-2500</li> <li>• 2500-above</li> </ul>	
<b>House tenure</b>	Owner	Renter
<b>Membership period</b>	<ul style="list-style-type: none"> <li>• &lt; 1 year</li> <li>• 1-2 years</li> <li>• 2-5 years</li> <li>• 5-10 years</li> </ul>	
<b>Number of shares purchased</b>	<ul style="list-style-type: none"> <li>• 1 to 9 shares</li> <li>• 10 to 19 shares</li> <li>• 20 to 29 shares</li> <li>• 30 to 39 shares</li> <li>• 40 to 49 shares</li> <li>• 50 shares or more</li> </ul>	

## Conclusion

That is officially the end of this interview, thank you very much for your time and your honesty. As I mentioned at the beginning, you could be provided with the final copy of my research report if you wish so. Good-bye, have a wonderful day.

## Annexe 2: Examples of coding sequences, co-document and co-occurrence tables

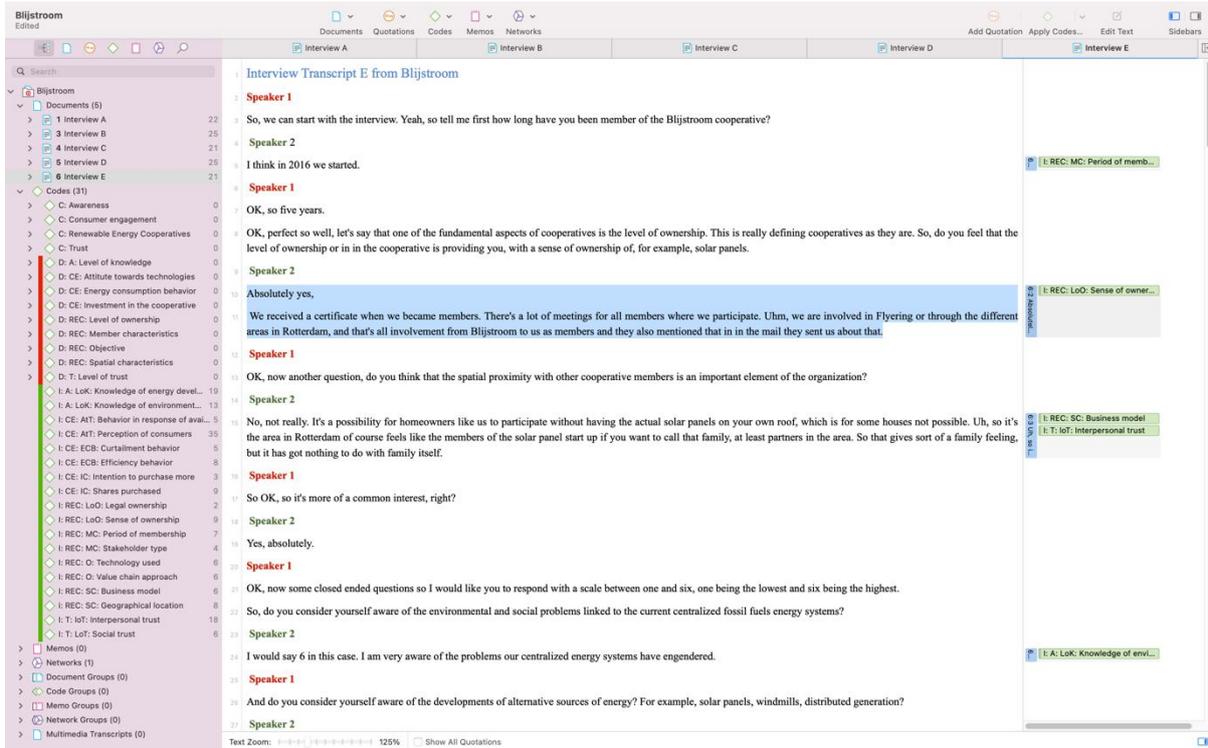
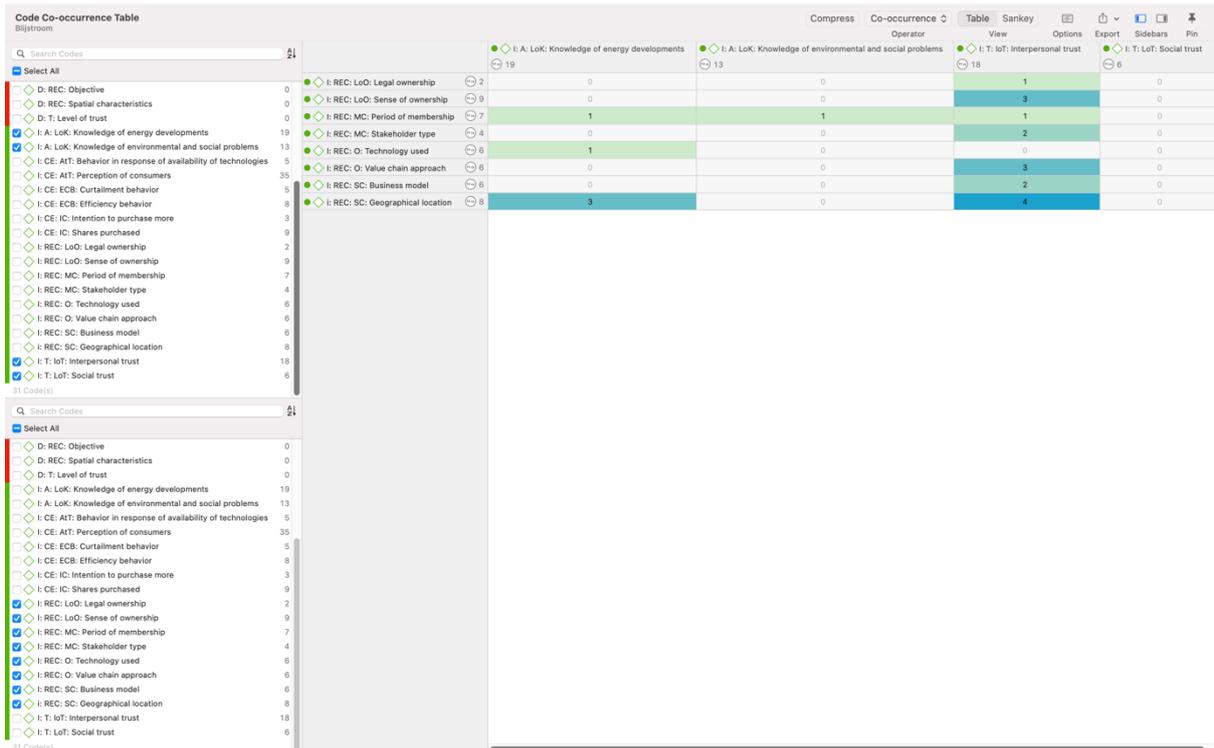


Figure 12: Example of coding sequence for Blijstroom retrieved from Atlas Ti. Source: Author, 2021.

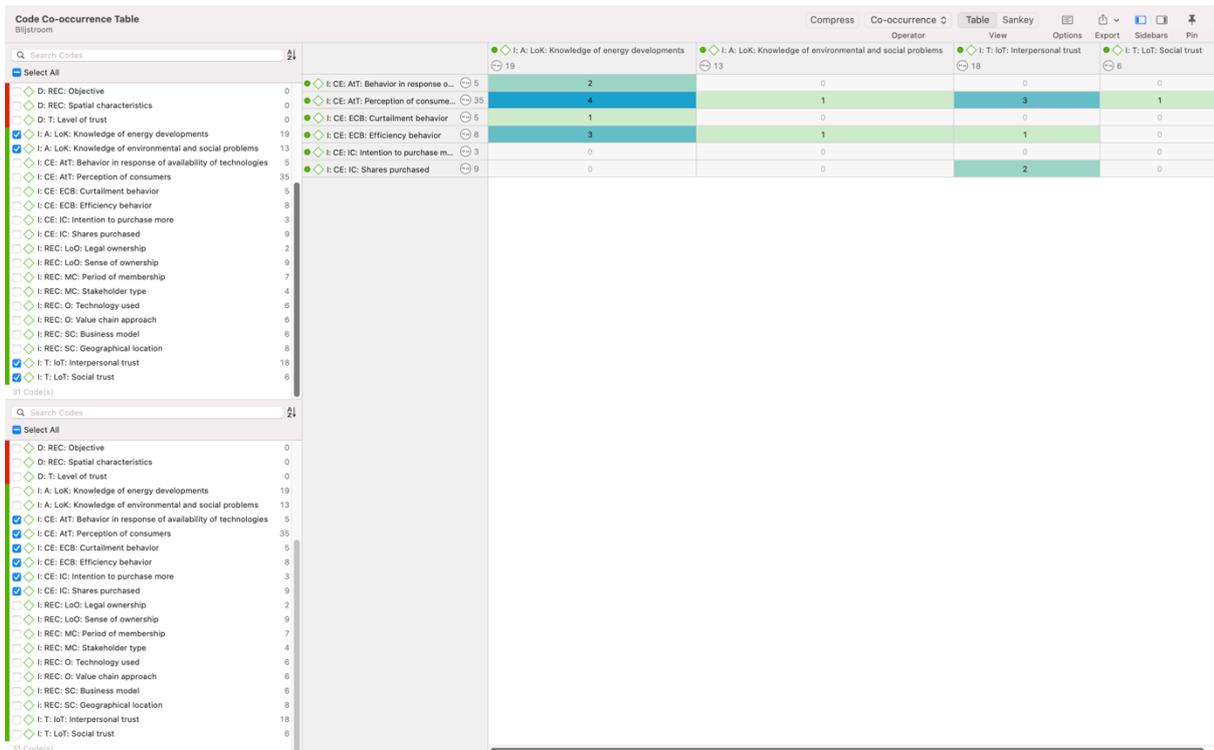
The screenshot shows the 'Code-Document Table' in Atlas Ti. It is a grid where rows represent codes and columns represent documents (Interview A through Interview E). The cells contain numerical counts of how many times each code was applied to each document. A 'Totals' column on the right sums the counts for each code across all interviews. The interface includes search bars for codes and documents, and a sidebar for selecting codes and documents.

Code	1 Interview A	3 Interview B	4 Interview C	5 Interview D	6 Interview E	Totals
I: A: LoK: Knowledge of energy developments	19	3	6	3	3	19
I: A: LoK: Knowledge of environmental and social problems	13	2	5	2	3	13
I: CE: ATT: Behavior in response of availability of technologies	5	2	2	1		5
I: CE: ATT: Perception of consumers	35	2	9	8	10	35
I: CE: ECB: Curtailment behavior	5	1	1	2	1	5
I: CE: ECB: Efficiency behavior	8	1	1	4	1	8
I: CE: IC: Intention to purchase more	3			1	1	3
I: CE: IC: Shares purchased	9	3	1	1	2	9
I: REC: LoO: Legal ownership	2	1		1		2
I: REC: LoO: Sense of ownership	9	1	2	2	3	9
I: REC: MC: Period of membership	7	2	2	1	1	7
I: REC: MC: Stakeholder type	4	1	2	1		4
I: REC: O: Technology used	6	2	1	1	1	6
I: REC: O: Value chain approach	6	2	1	1	1	6
I: REC: SC: Business model	6		1	1	2	6
I: REC: SC: Geographical location	8	2	2	1	2	8
I: T: IoT: Interpersonal trust	18	4	3	3	4	18
I: T: LoT: Social trust	6	1	1	2	2	6
<b>Totals</b>	<b>30</b>	<b>40</b>	<b>30</b>	<b>39</b>	<b>30</b>	<b>169</b>

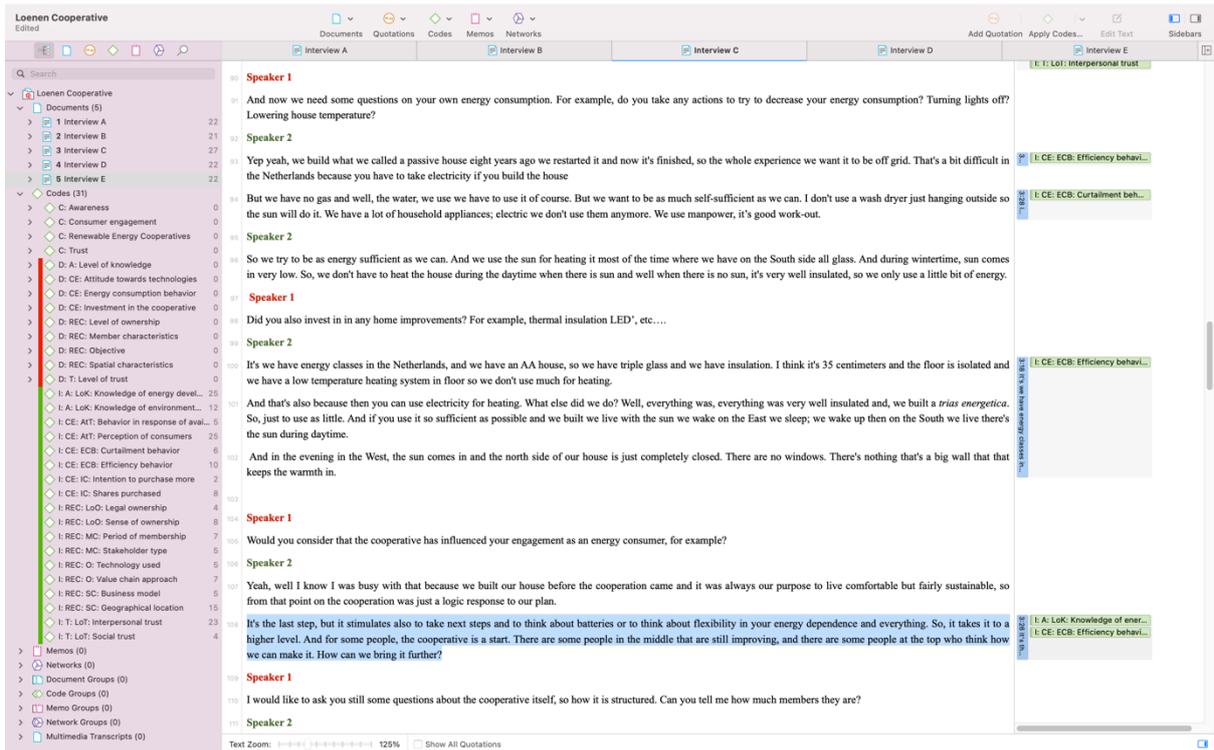
Figure 13: Co-document table for Blijstroom retrieved from Atlas Ti. Source: Author, 2021.



**Figure 14: Co-occurrence table for sub-variables of *REC* variables and sub-variables of awareness and level of trust variables for Blijstroom retrieved from Atlas Ti.**  
Source: Author, 2021.



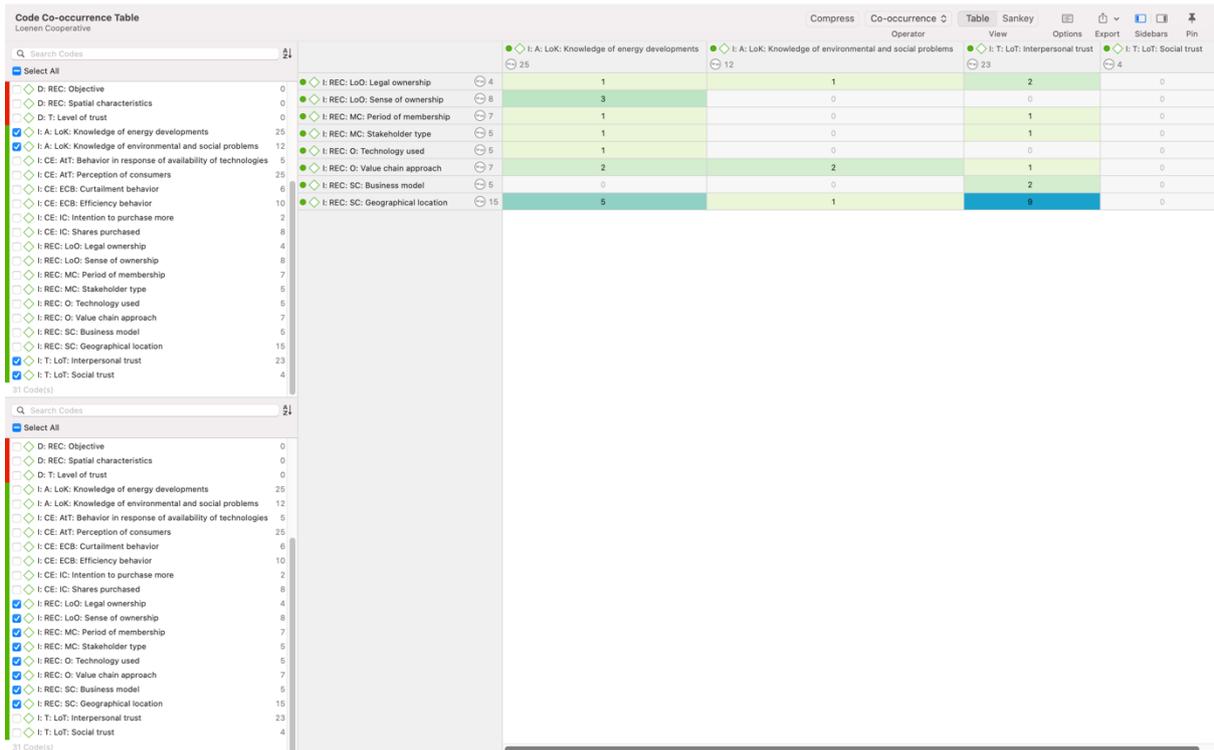
**Figure 15: Co-occurrence table for sub-variables of awareness and level of trust variables and sub-variables of consumer engagement variables for Blijstroom retrieved from Atlas Ti.**  
Source: Author, 2021.



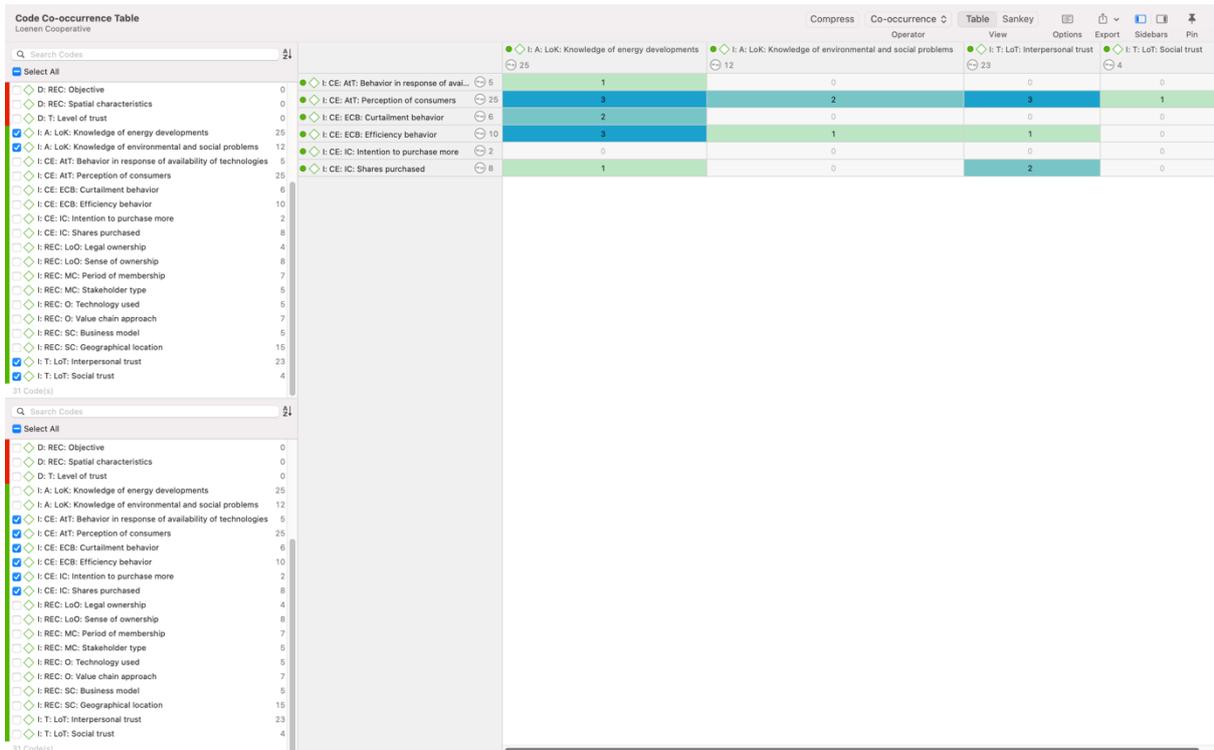
**Figure 16: Example of coding sequence for Loenen Cooperative retrieved from Atlas Ti.**  
 Source: Author, 2021.

Code	1 Interview A	2 Interview B	3 Interview C	4 Interview D	5 Interview E	Totals
I: A: LoK: Knowledge of energy developments	9	2	5	5	4	25
I: A: LoK: Knowledge of environmental and social problems	2	3	2	3	2	12
I: CE: ATT: Behavior in response of availability of technologies	5	1	1	1	1	5
I: CE: ATT: Perception of consumers	25	5	6	3	5	25
I: CE: ECB: Curtailment behavior	6	1	1	1	2	6
I: CE: ECB: Efficiency behavior	10	1	1	5	2	10
I: CE: IC: Intention to purchase more	2				2	2
I: CE: IC: Shares purchased	8	2	1	2	1	8
I: REC: LoO: Legal ownership	4		2	2		4
I: REC: LoO: Sense of ownership	8	2	1	1	3	8
I: REC: MC: Period of membership	7	2	1	1	2	7
I: REC: MC: Stakeholder type	5	1	1	1	1	5
I: REC: O: Technology used	5	1	1		3	5
I: REC: O: Value chain approach	7	1	4	1	1	7
I: REC: SC: Business model	5	1		3	1	5
I: REC: SC: Geographical location	15	3	3	3	2	15
I: T: LoT: Interpersonal trust	23	3	6	6	4	23
I: T: LoT: Social trust	4	2	1		1	4
<b>Totals</b>	<b>37</b>	<b>35</b>	<b>42</b>	<b>30</b>	<b>32</b>	<b>176</b>

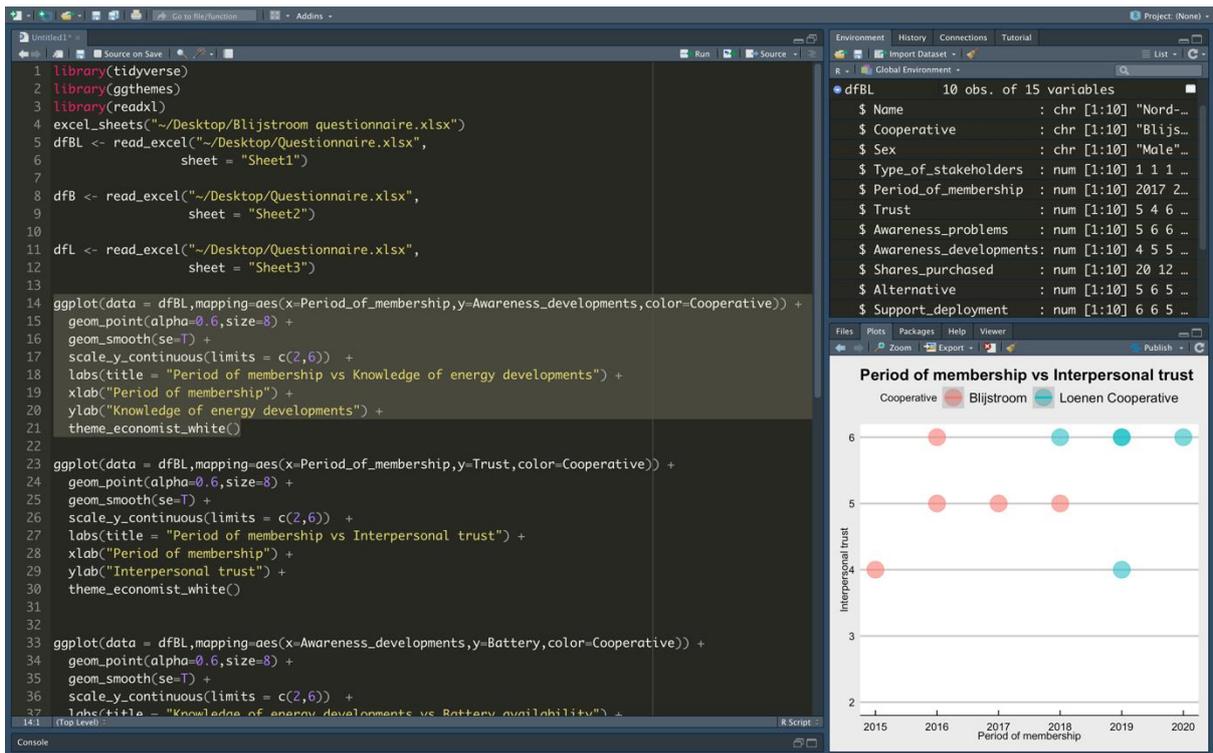
**Figure 17: Co-document table for Loenen Cooperative retrieved from Atlas Ti.**  
 Source: Author, 2021.



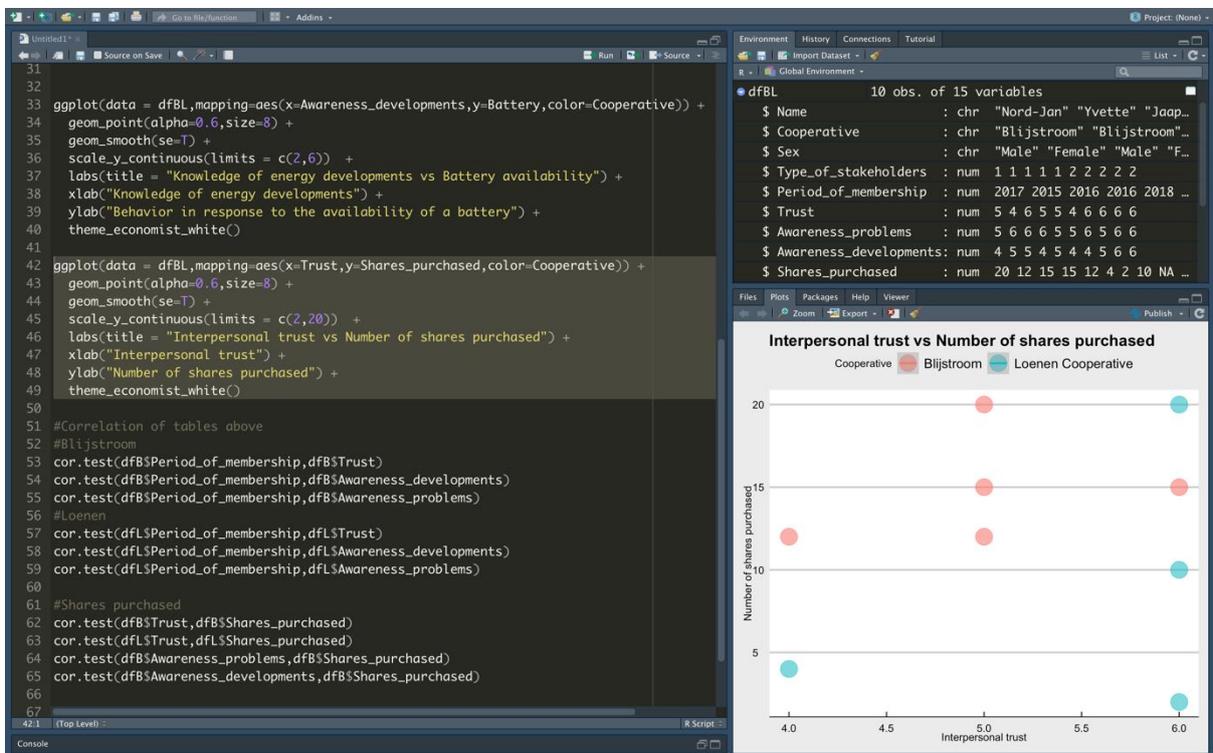
**Figure 18: Co-occurrence table for sub-variables of *REC* variables and sub-variables of awareness and level of trust variables for Loenen Cooperative retrieved from Atlas Ti.**  
Source: Author, 2021.



**Figure 19: Co-occurrence table for sub-variables of awareness and level of trust variables and sub-variables for consumer engagement variables for Loenen Cooperative retrieved from Atlas Ti.**  
Source: Author, 2021.



**Figure 20: Example of coding sequence for the correlation between *period of membership* and *interpersonal trust* sub-variables retrieved from R Studio.**  
Source: Author, 2021.



**Figure 21: Example of coding sequence for the correlation between *interpersonal trust* and *number of shares purchased* sub-variables retrieved from R Studio.**  
Source: Author, 2021.

## Annexe 3: Work plan

<b>Phases</b>	<b>Research Proposal</b>	<b>Data collection</b>	<b>Data analysis</b>	<b>Thesis writing</b>	<b>Submission draft thesis</b>	<b>Thesis writing</b>	<b>Submission of final thesis</b>
<b>Dates</b>	25th May	1 <sup>st</sup> June – 20 <sup>th</sup> July	21 <sup>st</sup> July – 28 <sup>th</sup> July	29 <sup>th</sup> July- 8 <sup>th</sup> August	9 <sup>th</sup> August	10 <sup>th</sup> August- 29 <sup>th</sup> August	30 <sup>th</sup> August

**Table 21: Work plan for the research (2021).  
Source: Author, 2021.**

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### Annex 4: IHS copyright form

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