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Citizen perception of different set-ups for solar community

Identification of drivers and challenges to engagement in solar communities

Master's thesis in Management and Economics of Innovation

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CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2024
www.chalmers.se

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Abstract

Amongst an ongoing climate crisis and environmental concerns, there have been demands to transform the energy system to be based on renewable sources. A part of transforming the energy system also involves placing citizens at the centre, taking a more active role, and having increased agency in energy questions. The response has been the emergence of solar communities. This thesis explores citizens' perceptions towards solar community set-ups in Sweden. The focus is on identifying drivers and challenges associated with becoming a member of solar communities and how these drivers and challenges affect the ideal set-up of solar communities. It is a qualitative study employing a mixed-method approach, combining a theoretical framework, a comprehensive survey, and a focus group interview. The study's findings show that there exist numerous drivers and challenges for non-members to engage in solar communities in Sweden. Numerous motives are identified as drivers to engage, with economic motives viewed as the strongest, followed by environmental motives. The former strongly influences views on the ideal set-up, such as decision-making. Individual characteristics such as being a house owner, make solar communities a more serious alternative for saving on electricity. Substantial challenges are found and are primarily due to a lack of awareness and understanding of the concept. Moreover, the national context of Sweden, with both significant advances in green energy supply and strong social norms, is acting as a challenge to becoming a member. Social norms act as a strong challenge and affect views on engagement with particular influence on social participation where it is deemed unwanted.

Keywords: energy communities, solar energy communities, sustainable transitions, adoption

Acknowledgments

I want to thank everyone who has been involved and has helped in some way in this study. Thank you to everyone who took the time to answer the survey and an extra thank you to those who participated in the focus group session.

I want to especially thank my supervisor and examiner at Chalmers University of Technology, Anna Bergek, for her support and patience throughout this process. Her feedback and discussions have been of great importance during this study.

Hedda Wingårdh,
Gothenburg, June 2024

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1 Introduction

In the past few years, the alarming effects of global warming have become evident. With climate change and its growing impact, the need for a sustainable transition away from fossil fuels has become apparent. Many directives have been signed, and a global commitment to lessen the impacts of global warming and climate change has been taken, something the Paris Agreement is evidence of. At the last Conference of the Parties, COP, meeting held in Dubai in December 2023, leaders also agreed on transitioning away from fossil energy (COP, 2023).

The European Union aims to become the first climate-neutral continent by 2050, as outlined in the European Green Deal (European Commission, 2021). The initiative includes a series of policy measures designed to propel the EU towards a sustainable future, striving to achieve climate neutrality by 2050. Its objective is to facilitate the development of the EU into an equitable and thriving community supported by a modern and competitive economy. A crucial focus of the European Green Deal is the energy sector's transformation towards renewable energy sources. The plan aims to increase the share of renewable energy to a minimum of 42.5% by 2030, nearly doubling the current proportion in the EU (European Commission, 2021). Further, the Clean Energy Package was adopted in 2019 with the aim to help decarbonise the EU's energy system in line with the objectives of the European Green Deal (European Commission, n.d.). In addition to the Clean Energy Package, geopolitical tensions and ongoing conflicts within the EU have emphasised and reinforced the need to end dependence on Russian fossil fuels. This is seen in the project REPowerEU which was launched in May 2022 as a response to global energy market disruptions caused by Russia's invasion of Ukraine (European Commission, 2022). It aims to support the green transition and decrease dependency on Russian fossil fuels, to diversify the energy supply as well as invest in renewables.

Whilst recognising the need for a green transition, the European Commission also underscores the need for such a transition to be socially balanced and fair (European Commission, 2024). Both the European Green Deal and the Clean Energy Package highlight the objective of empowering consumers and helping EU countries tackle energy poverty (European Commission, 2019). In the Clean Energy Package, the European Commission states that consumers are at the heart of the energy transition and argues for a shift towards a decentralised energy system which empowers consumers, fostering increased democracy and enabling citizens to make informed decisions about their preferred energy sources. Likewise, in the World Energy Outlook 2023, the International Energy Agency highlights the need to change the energy system itself and to have a people-centred transition (OECD, 2023). The involvement of local communities is thus regarded as vital in the clean energy transition where a people-centred transition includes energy access, affordability, employment and behaviour change (IEA, 2023).

As a response to both the need for a sustainable energy transition and the focus on citizens in this transition, "energy community" has emerged as a concept. This concept has been described in numerous ways, but typically, an energy community is defined 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, 2016, p. 3).

From a policy perspective, energy communities are important since they are considered to be fair and to contribute to the green transition. The European Commission views them as crucial for transforming the energy system whilst keeping citizens at its centre. Indeed, the European Commission holds a very positive narrative on energy communities, stating that energy communities have the potential to both boost public support for renewable energy initiatives and facilitate the attraction of private investments for a smoother transition to clean energy. By empowering citizens to actively participate in the local energy transition, it is argued that these communities can play a crucial role in restructuring energy systems, leading to improved energy efficiency, lower bills, diminished energy poverty, and increased local green job opportunities (European Commission, n.d.).

Similar arguments for benefits can be found in the academic literature on energy communities. Energy communities are essential in ensuring the overall success of the energy transition (Lowitzsch et al., 2020). Participation of citizens in the energy transition is not only something the European Commission advocates for but also Wahlund and Palm (2022) also point out three advantages: it raises energy consciousness and literacy, it contributes to equal distribution of benefits, and lastly, it accelerates the transition and increases public acceptance. Additionally, it is seen to foster long-term economic growth, enhance energy security, promote clean energy initiatives, create job opportunities, and be resilient against potential financial and environmental adversities (Thakur & Wilson, 2024). Other benefits of energy communities are reducing carbon emissions, increasing social cohesion, changing behaviours, tackling fuel poverty, and developing energy independence (Nolden et al., 2020).

Whilst numerous political expectations and views exist within policy and research about the potential benefits of energy communities, willingness and ability to participate in energy communities are varied. Understanding motives and barriers to engagement in energy communities is hence important if potential benefits of energy communities are to be reached. It is essential to understand the motives and challenges under which energy communities operate and how these affect the set-up of energy communities. As such, it is important to understand who participates, why they do so, and how they want to participate. Research has identified various motives for people engaging in energy community initiatives, with Radtke and Bohn (2023) grouping these motives into economic, environmental, and social factors. Economic motives to participate in energy communities centre around the financial benefits that an engagement yields (Bauwens, 2016; Seyfang et al., 2013), with expected savings on electricity bills as an important financial benefit. Environmental motives to engage in energy communities stem from awareness and concerns about climate change (Seyfang et al., 2013; Walker, 2008; Sloot et al., 2019) and contribute to improving the environment (Walker, 2008). Social factors also affect participation, where the desire to be part of a collective community identity influences participation positively (Bomberg & McEwen, 2012).

Understanding the different motives for engaging in energy communities is important since motives can affect the set-up of energy communities. Radtke and Bohn (2023) argue that socio-characteristics influence attitudes toward energy communities and the practices within them. As such, people motivated by different motives might prefer different energy community set-ups. A person driven by social factors might prefer to see a lot of interaction within the energy community compared to someone motivated by economic factors.

Beyond different motives affecting willingness to engage, the ability to engage varies. As such, despite the numerous potential benefits of energy communities, willingness and ability

to engage varies. Hanke and Lowitzsch (2020) show that engaging in energy communities is challenging for certain groups. They mention that individual characteristics such as access to funds, time, and knowledge are important factors that act as barriers to adoption (Hanke & Lowitzsch, 2020). They also point out that the complexity of the energy market and fully understanding the opportunity one can engage in also acts as a barrier. The fact that willingness and ability to engage vary is also seen in solar communities, where members are very homogenous (Bergek & Palm, 2023). A majority of members are older white males. This raises the question of what factors affect willingness and ability and whether there are challenges for other groups to engage in solar communities compared to the homogenous group of existing members. It points to the importance of understanding motives and capacity and how this affects engagement. The theoretical ideal set-ups of solar energy communities found through research can be argued not to be grounded in reality and that there is a gap in understanding the ideal set-ups for underrepresented groups.

In conclusion, while strides have been made towards a sustainable energy transition, further research and action are needed to ensure that energy communities are accessible and beneficial for all members of society. By addressing barriers and promoting inclusivity, energy communities can play a pivotal role in driving the EU towards its climate neutrality goals while fostering social equity and resilience. Understanding these barriers and developing more inclusive approaches is vital for achieving a fair and socially just transition.

Against this background, more research is needed to understand non-members' perceptions of solar communities. This calls for investigating the reasons why more people are not engaged in solar communities and under what circumstances they would like to be engaged, i.e., their ideal set-up. As such, questioning the ideal set-up of energy communities for non-members is warranted.

1.1 Purpose

The aim of the thesis is to increase the understanding of underrepresented groups and their relations to and perception of solar communities. More specifically, the purpose is to identify the underlying reasons underrepresented groups have yet to become members in solar communities and under what conditions they could be encouraged to become members.

Getting a better understanding of underrepresented groups and their perception of solar communities can help accelerate the energy transition and create conditions for it to become more socially just. The results can act as a guideline for how to get a broader group of citizens involved in solar communities and, by extension, the green transition. The results can aid local authorities, current solar communities, and policy makers.

2 Theoretical framework

The following section starts by introducing relevant literature on energy communities, technology and innovation adoption, and sustainable transitions, which together lay the foundation for the analytical framework of the thesis. The literature on energy communities is provided to understand the concept better, exploring different perspectives and factors that affect participation. The literature on adoption offers useful insights into the factors that influence the adoption of new technologies and innovations, more generally, potentially shedding light on new perspectives and understandings lacking in the energy community literature. The literature on sustainability transitions and socio-technical systems provides a broader understanding of the surrounding context. It demonstrates the complexity of transitions and sheds light on their multifaceted nature. It introduces institutional conditions as having significant implications for engagement. With a better understanding of the literature and existing gaps, the purpose is clarified, and the research questions are formulated. Lastly, based on this literature, an integrated analytical framework is developed.

2.1 Energy communities

The following chapter introduces literature on energy communities. It begins by outlining, in general terms, what is considered an energy community and exploring different perspectives on it. The chapter then discusses factors affecting participation in energy communities, including motives, individual capacity, and contextual conditions. Understanding why and under what conditions citizens are willing and able to engage in energy communities and identifying challenges to engagement is crucial for countering exclusion and promoting inclusive participation.

2.1.1 Perspectives on energy communities

In the literature, energy communities have been discussed widely, and numerous definitions have been proposed. As has been seen before, Bauwens (2016, p. 3) defines energy community 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."* Yet, there is no consensus on a formal definition nor on what an ideal energy community looks like. Within energy communities, different schools of thought exist on what ground communities are founded on and how they could be categorised. Two well-known terms are communities of place (COP) and communities of interest (COI).

A COP is defined as a community where actors are from and engage within a specific geographical location (C. Walker et al., 2022). Opposing this is COI, which includes members from all locations beyond the actual location of the project, thus welcoming members based on shared interests (C. Walker et al., 2022). COPs offer benefits such as helping to educate and promote energy citizenship, fostering environmental behaviour, acting as a new source of local income, and creating jobs (C. Walker et al., 2022). COPs are considered to have higher levels of local support and contribute to trust and legitimacy in the local community (ibid). On the other hand, COIs, with their wider geographical reach, can overcome barriers cornered with a lack of local capacity, interest, and investment, which in turn facilitates scale-up (C. Walker et al., 2022). Additionally, COIs are more inclusive due to

membership not being tied to a specific location and the capacities and resources of said location (ibid).

Beyond the perspective of energy communities categorised based on place and interest, numerous other ways exist to describe energy communities. Bergek and Palm (2023) use the dimensions of process, outcome, place, interest, organisation, and social interaction to describe energy communities. Across these dimensions, different views exist of what is considered an ideal energy community. For example, in combining both process and outcome, Walker and Devine-Wright (2008, p. 498) view an ideal community as *"entirely driven and carried through by a group of local people and which brings collective benefits to the local community (however that might be defined)—a project that is both by and for local people"*. Another example is the presence of different views on organisational aspects of energy communities, where decision-making can look different. Hicks and Ison (2018) state that in a weak community, the decision-making is concentrated to a few actors, whereas in a strong community, all members are involved in decision-making. As such, different views exist on different set-ups for energy communities.

2.1.2 Factors affecting participation in energy communities.

Understanding why and under what conditions citizens are willing and able to engage in energy communities and identifying challenges to participation is crucial. This understanding guides how energy communities should be designed to reach a wider group. This is, on the one hand, connected to individuals' motives to engage in energy communities and, on the other hand, to the characteristics and capacities of different individuals, which influence the conditions for their participation. Lastly, engagement is also affected by contextual factors.

2.1.2.1 Motives

Individuals join energy communities for various reasons, including environmental, economic and social motives (Radtke & Bohn, 2023). These motives can be seen as drivers for participation in energy communities.

Environmental motives to participate in energy communities are primarily driven by awareness and concerns about climate change (Seyfang et al., 2013; Walker, 2008; Sloot et al., 2019) and a commitment to improving the environment (Walker, 2008). Individuals with a higher environmental awareness are more likely to participate in energy initiatives (Sloot et al., 2018). This is supported by Kalkbrenner and Roosen (2016), who found that environmental concern can both foster and constrain willingness to participate in such schemes. They noted that a higher environmental concern is positively associated with a willingness to engage in energy community initiatives. Similarly, Koirala et al. (2018) and Stauch and Gamma (2020) emphasise that intrinsic motives, such as environmental concern, influence individuals' decision to join energy communities.

Pursuing energy independence is another important factor influencing engagement in energy communities. Seyfang et al. (2013) and Koirala et al. (2018) note that infrastructural objectives such as improving energy independence are motives that affect participation. This can be seen as a form of instrumental environmental motive, where the practical benefits of owning and utilising energy technology drive engagement (Bergek & Mignon, 2017).

Bomberg and McEwen (2012) further support this by stating that the desire for energy autonomy influences individuals' willingness to engage in energy initiatives. The literature indicates that energy independence not only provides practical advantages but also aligns with broader environmental goals, thereby motivating engagement in energy communities.

Economic incentives are frequently cited in the literature as a significant motivation for joining energy communities. Financial benefits, such as compensation and savings on energy bills, play a crucial role in affecting participation (Bauwens, 2016; Bomberg & McEwen, 2012; Seyfang et al., 2013; Sloot et al., 2019; Walker, 2008).

Devine-Wright (2012) emphasises that financial savings are one of the most essential motivators for participation in energy communities. However, recent critiques have emerged regarding the emphasis on financial motives, with Sloot et al. (2019) arguing that the significance of financial incentives may be exaggerated.

Social motives for participating in energy communities revolve around creating a sense of belonging and shared identity. Having a group or community identity positively impacts participation in energy communities (Bomberg & McEwen, 2012; Kalkbrenner & Roosen, 2016; Mees, 2022). The term community identity compromises attachment to one's community, trust, social norms and environmental concerns (Kalkbrenner & Roosen, 2016). The aspect of trust within the community is highlighted by Koirala et al. (2018), who emphasise that higher levels of trust can enhance participation in energy communities. Moreover, Seyfang et al. (2013) identified five social objectives of energy communities in the UK: contributing to community well-being and health, improving education, enhancing social cohesion and inclusion, and creating volunteering opportunities. These objectives highlight the broad social benefits that energy communities aim to achieve. Social motives for participating in energy communities are strongly linked to the desire for a shared identity, trust, and community well-being. Community identity, social norms, and trust are essential factors that encourage participation. By fostering a sense of belonging and emphasising the broader social benefits, energy communities are believed to effectively engage and attract members, thereby achieving their social objectives.

Motives can be said to be heterogeneous (Bauwens, 2016). Whilst economic incentives, notably financial savings, are crucial motivators for joining energy communities, it is important to consider them in the broader context of environmental and social motives. Financial benefits attract participants, but the appeal of energy communities also lies in their potential to foster environmental sustainability and social cohesion. Recognising the multifaceted nature of these incentives can help design more effective strategies to engage and retain community members. Furthermore, it suggests that different individuals will be driven by different motives.

2.1.2.2 Individual capacity

Within individual capacity, both objective individual capacity and subjective individual capacity exist. The former refers to the tangible resources and skills that individuals possess that enable their participation in energy communities. This includes financial resources, technical knowledge, time availability, and access to relevant information. Subjective individual capacity concerns an individual's perception of their ability to influence change

and their beliefs that they can make a meaningful impact. Both objective individual capacity and subjective individual capacity affect willingness to engage (Mees, 2022).

The availability of financial resources is a critical factor affecting participation in energy communities. Individuals with higher income levels are more likely to engage in such initiatives because they can afford the initial investment required for renewable energy projects (Hanke & Lowitzsch, 2020; Devine-Wright, 2012). Having the technical knowledge and skills necessary to understand and manage renewable energy systems significantly enhances the likelihood of participation. A lack of technical expertise can be a barrier, making individuals feel ill-equipped to engage in these projects (Bomberg & McEwen, 2012; Thakur & Wilson, 2024). Individual resources such as time also impact participation. Being a member of energy communities often requires a considerable time commitment. Individuals with more free time are better able to engage in these activities, while those with limited time due to work or personal responsibilities may find participating challenging (Hanke & Lowitzsch, 2020). Lastly, access to information is seen as an important individual factor affecting participation. Access to accurate and comprehensive information about renewable energy options and the benefits of energy communities is essential. A lack of information can prevent individuals from making informed decisions and participating effectively (Koirala et al., 2018; Thakur & Wilson, 2024). The lack of knowledge concerns advantages to be gained through participation, such as financial benefits and environmental and societal benefits.

Another aspect of individual capacity concerns individual attributes such as education, age, occupation, lifestyle, and knowledge, which will affect the willingness to engage in energy communities (Hai, 2019; Koirala et al., 2018). For example, Kalkbrenner and Roosen (2016) found that a higher income and being male increased the willingness to participate in energy schemes.

Subjective capacity is very relevant and necessary for participation in energy communities (Mees, 2022). The belief that one's actions can have a positive and meaningful impact on environmental and community outcomes is crucial. When individuals feel that their participation will make a difference, they are more likely to engage (Mees, 2022). Participation is also hindered by beliefs that individual action is believed not to make a difference (Jackson, 2005; Burch, 2010). Individuals might feel that individual action within environmental issues is difficult since they are seen as too big to be dealt with, but where the aspect of collective participation in energy initiatives increases the subjective capacity and the willingness to participate (Mees, 2022). Positive attitudes towards renewable energy and community initiatives, shaped by environmental values and social norms, also contribute to subjective capacity. Individuals with strong pro-environmental attitudes are more inclined to participate in energy communities (Seyfang et al., 2013; Walker, 2008).

Both objective and subjective capacities are essential for fostering participation in energy communities. While objective capacity provides the necessary resources and skills, subjective capacity ensures that individuals feel capable and motivated to engage. Effective strategies to enhance participation should address both dimensions, ensuring that individuals have access to the resources they need and fostering a supportive environment that builds confidence and a sense of efficacy.

2.1.2.3 Contextual conditions

Beyond individual attributes, more contextual elements also influence willingness to participate, such as socio-political dynamics, community dynamics, and market conditions (Hai, 2019). Along the lines of contextual condition, social acceptance is an important condition that affects participation (Koirala et al., 2018).

Community dynamics have been seen to affect willingness to participate in community energy schemes (Kalkbrenner & Roosen, 2016; Koirala et al., 2018; Mees, 2022). It covers numerous aspects, from social cohesion (Mees, 2022) to the formation of community identity (Kalkbrenner & Roosen, 2016). Whilst this has been discussed under social motives, factors of social motives are influenced by community dynamics. It is seen that having a community identity, which is based on trust, social norms, and relation to one's community, increases willingness to participate in energy initiatives (Kalkbrenner & Roosen, 2016).

An unfavourable context can significantly hinder participation in energy communities. Market conditions, particularly the complexity of the energy market, make it difficult for individuals to understand and engage with available opportunities, negatively affecting participation (Hanke & Lowitzsch, 2020). Contextual factors, such as the activity level of municipal utility companies (MUCs) and their traditional roles in communities, also influence the prevalence of energy communities. For example, in Sweden, the institutional context acts as a barrier to the development of energy communities (Magnusson & Palm, 2019). The characteristics of Swedish society and the nature of its energy supply system have resulted in fewer energy community initiatives compared to the rest of Europe. In Sweden, local municipal authorities typically initiate environmental actions, which impact both the sense of urgency and the capabilities and interests of citizens. This traditional role of municipal authorities means that individual citizens are less likely to take the initiative for environmental actions, with local authorities often fulfilling that role (Magnusson & Palm, 2019). The active role of MUCs can be seen to counter the efforts of energy communities in contributing to energy citizenship, where citizens should pursue a more active and central role in the energy system (cf: Wahlund & Palm, 2023).

2.1.3 Summary

Literature on energy communities provides insight into the different perspectives of energy communities that exist with different preferences for ideal set-ups. Additionally, various factors influence participation. Understanding these conditions for participation and the different motives is crucial for designing effective community energy schemes since motives affect the perception of energy communities. Non-members of energy communities might be motivated by factors different from current members, affecting the ideal set-up. Both challenges to participation in solar energy communities and drivers to participation should be further studied, as well as their influence on ideal set-up. Whilst literature on energy communities sheds light on different motives to participate in energy communities and that individual and contextual factors affect participation, a more nuanced understanding of the adoption process and how different types of individuals view adoption is lacking. If engagement is seen as adoption, understanding how different individuals view engagement and how specific characteristics of collective participation that energy communities bring affect engagement is needed. Additionally, more understanding of what factors beyond the individual factors and contextual conditions affect engagement is lacking and, hence, needed.

2.2 Technology and innovation adoption

Literature on adoption will be used to further deepen the understanding of factors affecting the adoption of new technologies and ideas in general, and in this case, engagement in energy communities. Within adoption literature, factors influencing adoption are often divided into innovation characteristics, actor-level factors, and system-level factors.

Introducing innovation characteristics helps view energy communities from a different perspective. Different set-ups of solar communities can be seen as innovation characteristics, which will have implications for adoption. Actor-level factors are linked to both motives and individual capacity, offering a more comprehensive view of the individual aspects influencing adoption. Moreover, this approach will introduce system-level factors affecting adoption. System-level factors can provide insights into the contextual factors highlighted in the literature on energy communities. This broader perspective will enhance the understanding of how various factors at different levels influence engagement and participation in energy communities.

2.2.1 Innovation characteristics

Adoption is a mental process through which an individual goes from hearing about an innovation to becoming an adopter (Rogers, 2003). The characteristics of an innovation will affect the adoption and the implementation of the technology (Tornatzky & Klein, 1982). These characteristics include complexity, relative advantage, compatibility, cost, saving of time, social approval, reliability and newness. The level of *complexity* and how easy the innovation is to use explains why different innovations diffuse at different rates (Rogers, 2003). If an innovation is regarded to be easy to understand, it will be adopted more quickly (Sahin, 2006) compared to an innovation that is seen as complex (Rogers, 2003).

An innovation that is viewed to potentially provide benefits for the adopters in terms of economic, social, and environmental benefits affect the adoption of a technology (Rogers, 2003). This is commonly referred to as the *relative advantage* and denotes the potential value an adopter can gain from adopting (Tornatzky & Klein, 1982). For adoption to occur, the relative advantage of adoption must be higher than that of not adopting. The new technology must be better compared to the current one; hence, switching must be worth it. Additionally, changing might not only induce a financial cost but might also require behaviour changes. In the case of solar energy communities, the relative advantage can be seen to be twofold. It includes both adopting solar panels and doing it through a community, where adopting solar panels might yield environmental and economic gains and engaging in a community might provide social gains. Characteristics of a solar community in terms of how benefits are regulated or how social participation is organised will thus have an impact on adoption.

Adoption is also dependent on the *compatibility* of the innovation (Rogers, 2003). The compatibility of an innovation represents the extent to which an innovation fits into the life of the adopter in terms of socio-cultural beliefs, values, ideas and routines (Rogers, 2003). Additionally, it refers to how compatible the innovation is with the adopter's current infrastructure and other used technologies. Tornatzky and Klein (1982) add that an innovation's compatibility also has to do with how said innovation fits into the current practices of the adopter. A low compatibility will decrease adoption rates (Sahin, 2006). In

cases when a technology has a strong relation to physical infrastructure, the diffusion rate will be slow (Grübler, 1996). The concept of compatibility implies that solar communities may be suitable for different individuals in various ways.

The perceived *newness* of a technology will also affect its diffusion (Tornatzky & Klein, 1982). If it is considered new and advanced, it might scare people off and diffuse slower. Where solar panels themselves are not new, the concept of energy community might be new to many hence affecting the adoption to solar energy communities.

Numerous innovation characteristics will affect diffusion, yet what holds true for many of the characteristics is that they are subjective. Complexity, relative advantage, and newness are matters of perception and are thus highly subjective. What is seen as complex for one might not be the case for someone else. The perceptions will depend on the adopter, their previous experiences and knowledge among other things. As such, Rogers (2003) argues that to fully understand adoption, there is a need to understand the adopters themselves and their characteristics.

2.2.2 Actor-level factors

Individuals adopt in different ways, and Rogers (2003) outlines the following factors as affecting the adoption of individuals: innovativeness, networks, status, opinion leadership, education and personality. Innovativeness is a relative measure, where adopters will have more or less of it compared to other adopters in the system. It measures the degree to which an individual is relatively early to adopt new technologies and/or ideas compared to other individuals in the systems (Rogers, 2003). In turn, innovativeness is dependent on three factors: socio-economic status, personality, values and communication behaviour (ibid). The early adopters have high innovativeness, well networks, high status, high education and outgoing personalities. Meanwhile, the stereotypes of late adopters are labelled as sceptical and traditional. Sceptics adopt as the result of increasing peer pressure. Traditionals are often isolated in the social network of their system and tend to be suspicious of innovations. Their precarious economic position further forces them to be cautious in their adoption (ibid). All these characteristics lead people to adopt at different times.

While not focusing on personal characteristics, Grübler (1996) is in accordance that individuals do not adopt an innovation simultaneously; rather, some will adopt early and others later. Yet, there are critiques of this line of literature that consider it too simplistic. Seligman (2006) views adoption from the lens of mental processes and individual reasoning. This is a more iterative and cyclic approach to adoption processes compared to Rogers' (2003) more linear approach, allowing for a more complex understanding of adoption. An adopter's mental framework is affected by the adopter's identity construction, social influence, habits, impulses and other perceptions (Seligman, 2006). These aspects are present in the literature on energy communities, yet the emphasis on identity construction in energy communities has a more collective view rather than individual since there is a focus on forming a uniform collective identity (Bomberg & McEwen, 2012; Kalkbrenner & Roosen, 2016; Mees, 2022)

At the actor level, adoption can be viewed by looking at adopters through the lens of their resources and behaviours and investigating how they influence adoption (Mignon & Bergek, 2016). The adopter's resources encompass knowledge and experience, financial resources,

physical resources, and social capital. Knowledge and experience affect adoption in the sense that if an individual has previous knowledge and experience within a field, they are better equipped to make and fulfil adoption decisions. Knowledge and experience form the foundation of absorptive capacity, as emphasised by Cohen and Levinthal (1990), and whilst often used to describe a firm's innovation capability (Börjesson & Elmquist, 2011), it also influences the adoption of individuals (Viardot, 2013). The argument that adopter resources affect adoption, can also be seen in how individual capacity affects participation in energy communities.

Behavioural factors encompass a range of aspects crucial to adoption, including motives, norms, values, characteristics, and strategies. These factors play a significant role in influencing adopters' willingness to invest in new energy technologies. Motives, such as environmental concern or economic incentives, directly impact the level of investment in renewable energy and the way adoption occurs (Bergek & Mignon, 2012), and is in accordance with literature from energy communities.

In a study on adoption motives for renewable energy technologies, Bergek and Mignon (2017) categorised motives into instrumental motives, environmental motives, and symbolic motives. Instrumental motives refer to the practical advantages gained from owning and utilising the technology, environmental motives focus on the positive impact on the environment resulting from ownership and utilisation, and symbolic motives concern the effects on the adopter's identity and social standing resulting from ownership and use (Bergek & Mignon, 2017). These motives correspond to energy community literature, yet the perspective of adoption due to social standings and peer pressure is not to the same extent visible in energy community literature. When someone chooses to install solar panels on their roof, this might be due to peer pressure, and the adoption is visible. In contrast, when becoming a member of a solar community, the adoption is not as visible to others and, as such, less likely to be driven by peer pressure. Lastly, as has been described above, adopters' norms, values, and characteristics shape their attitude toward innovation, consequently affecting their likelihood of adoption (Rogers, 2003).

2.2.3 System-level factors

Lastly, there are systematic factors affecting adoption. Negro et al. (2012) and Mignon and Bergek (2016) describe different challenges encountered at the system-level such as market structure, infrastructure, finances, hard and soft institutions, technology supply, interaction and the technology. Infrastructure includes both physical infrastructure and knowledge infrastructures such as specialised knowledge and affect adoption. This is in line with arguments from energy communities, where it is described that knowledge infrastructure is acting as a barrier for people to join renewable energy communities (Hanke & Lowitzsch, 2020). Institutional challenges arise when both formal and informal rules including laws, regulations, norms, and values, influence the selection process, often to the detriment of new technologies (Mignon & Bergek, 2016). Traditionally for renewable energies, informal institutional challenges, such as lack of legitimacy or active opposition from various stakeholders, hamper the adoption of renewables (Negro et al., 2012; Smith, 2000). This agrees with argument that the institutional context impacts not only adoption of energy communities (Magnusson & Palm, 2019), but also capabilities and interest of citizens in terms of ability to engage in energy communities.

Interaction challenges can arise from either excessively strong or weak connectivity within the system (Mignon & Bergek, 2016). Having insufficient connectivity hampers learning and coordination among system actors (Negro et al., 2012). A weak interaction explains not knowing about the concept and thus affect opportunity to engage.

Lastly, whilst the different factors of innovation characteristics, adopter characteristics and system-level factors often are treated separately Mignon and Bergek (2016) highlight that the different aspects on adoption do not act in isolation but can potentially interplay.

2.2.4 Summary

Literature on adoption provides new perspectives on energy communities, where the set-up of an energy community can be considered as its characteristics, where different characteristics impact adoption differently. As such, it's important to understand the characteristics of solar communities that affect adoption. Similar views on actor-level factors are seen in energy community literature. Adoption provides initial insights on system-level factors affecting adoption, where interaction and institutional challenges are of importance. Yet there is a lack of understanding of institutional factors and how they affect individuals and thus impact views on energy communities. These factors are also pointed out as contextual factors in energy community literature. As such, literature on sustainable transitions needs to be explored to provide context to facilitate understanding of the adoption of energy communities and, specifically, the role of institutional context and its impact on adoption. Views on actors' roles and responsibilities in sustainable transitions are of special importance.

2.3 Sustainable transitions

Sustainable transitions are a complex phenomenon in the context of low-carbon transitions. Geels et al. (2017) point out that advancing low-carbon transitions relies on enhancements in both techno-economic aspects and the evolution of social, political, and cultural processes, encompassing the formation of positive or negative discourses. A socio-technical system provides societal functions and is comprised of technical systems, actors and institutional rules. As such, when a transition occurs from one socio-technical system to another, it does not only affect the technological context but also encompasses changes to actors, their composition, markets, user practices, norms and values (Geels, 2005)

Within the transitions literature, the multi-level perspective (MLP) is often used to understand system transitions. Geels (2005) states that system transitions do not arise from single drivers but rather from the complex alignment of processes within and between three levels: the socio-technical system, niche innovations and exogenous landscape developments. At these three analytical levels, numerous interactions are taking place and studying these aids in understanding system transitions. At the socio-technical level, the perceptions and actions of the different actors are guided by established rules. The established rules are called regimes and compromise institutions (Geels, 2004). The regime guides the actions of actors in the systems, and when regimes are stable, so is the socio-technical system. The exogenous level contains events taking place on a macro level, which can create pressure on the existing system. Such events can be slow-changing trends such as ideologies or shocks such as wars or economic crises, and they can allow for a destabilisation of the system and aid in the breakthrough of niche innovations (Geels et al., 2017). Geels (2005) especially emphasises

the significance of external events capable of influencing cognitive rules, a pattern observed in numerous empirical cases. Lastly, at the micro-level, niches are found, which are new technical innovations, business models or behaviours that deviate significantly from the dominant system (Geels et al., 2017). Within transition literature, an emphasis is placed on institutions. Geels (2004) underscores the role of institutions in shaping dynamics and facilitating change within socio-technical systems. Institutions are recognised as key components influencing the trajectories of innovation and societal transitions. Institutions comprise cognitive, normative and regulative rules and act as fundamental drivers in shaping the evolution of socio-technical systems (Geels, 2004). Institutions are central to the functioning and evolution of socio-technical systems. They guide perceptions and expectations, provide stability, and enable coordination. Understanding their role is crucial for managing transitions towards more sustainable systems, as they influence the behaviours and interactions of all actors involved.

When applying an MLP perspective to the case of solar energy communities, the dominant system is centralised energy production. This system is composed of incumbent actors (e.g., municipal energy producers), energy regulations, the energy market and electricity grids. At the macro level, the development of solar PV and other renewable technologies has been facilitated by increasing environmental concerns and societies rejecting fossil-based fuels (Geels et al., 2017). Concerning the micro-level, solar communities as a concept can be considered a niche where the innovation of solar PV constitutes the niche innovation (Smith & Raven, 2012). Concerning low-carbon transitions in electricity, Geels et al. (2017) point out that one cannot look at things in isolation since a transition depends on numerous factors and not only on the technology on its own, highlighting the importance of complementary innovation and new business models. Magnusson and Palm (2019) also state that citizen involvement through energy communities can be regarded as a niche phenomenon, which depends on a community's access to capital and technical knowledge and the institutional setting. Seeing energy communities as a niche implies that institutional conditions can both act as potential obstacles and drivers. Institutional rules affect views on who is considered legitimate actors in the energy system and contribute to established notions of how energy production should look. Institutional norms will impact perceptions of who is responsible for providing green energy. It influences views on the role of individual citizens and whether they should play an active and central role in the energy system. This provides nuance to the term energy citizenship, which examines new perspectives on the public's role in connection to energy matters (Wahlund & Palm, 2022). From this view, energy citizenship is a mean to challenge entrenched institutional rules (cf: Geels, 2004). Moreover, seeing solar communities as a niche phenomenon also links it to views from adoption literature and the aspect of newness, which affects engagement.

Literature from sustainable transitions helps shed light on viewing energy communities as a niche phenomenon. Doing so has implications where energy communities do not act in solitude but are part of a more extensive socio-technical system where institutional conditions can both act as potential obstacles and drivers. Institutional forces are essential and affect social acceptance and willingness to become a member. They also provide new insight into the perception of individuals' roles and responsibilities in energy production.

2.4 Research questions and analytical framework

Based on the abovementioned theoretical considerations, the purpose of this thesis can now be specified further. What was previously seen as reasons to engagement in solar communities is now understood as challenges and drivers, and under what conditions in understood as ideal set-up. As such, the purpose is therefore to identify the drivers and challenges to engage in solar communities and their effects on ideal set-up for underrepresented groups (see Figure 1). Consequently, the thesis will focus on answering the following research questions:

RQ1: What are the potential drivers to engage in solar communities for current non-members and how do they influence engagement?

RQ2: What are the perceived challenges to engage in solar communities for current non-members and how do they influence engagement?

RQ3: What does the ideal solar community model look like for people who are not currently members in any solar community?

Regarding drivers and challenges for energy community engagement, the study will explore three dimensions that cover both system- and actor-level factors: adopter behaviour, adopter resources and system. The study will investigate whether any specific driver or challenges within each dimension stand out. Additionally, it will be investigated if there any new factors previously not considered that are of importance.

When determining the effect on the ideal set-up, the six dimensions of process, outcome, place, interest, organisation and social interaction will be used. These have previously been used by research on members of energy communities in Sweden (Bergek & Palm, 2023), and will therefore allow for a comparison between non-members and members with regard to their view on the ideal solar community set-up.

In the following subsections, all the dimensions of the framework, and the reasons for including them, will be explained in more detail.

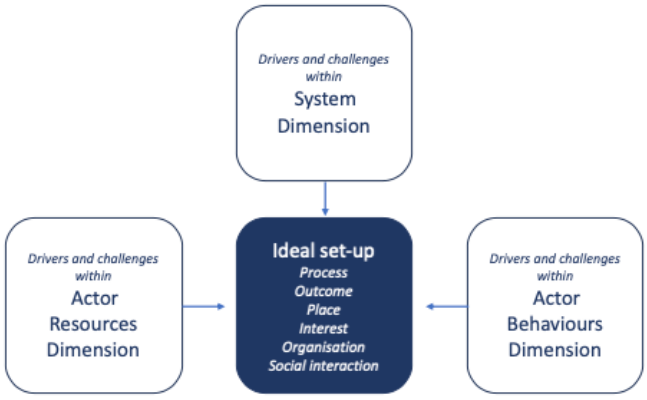

Figure 1 Analytical framework

2.4.1 Ideal set-up dimension

As has been seen, numerous perspectives on ideal set-up exist in literature. Views of what is considered ideal vary in the different perspective. For example, the importance of place is viewed differently by scholars, some stating that an ideal energy community has a strong local connection, where members both live close to each other and close to the solar installation site (Walker et al., 2022). Literature on adoption suggests that the different dimensions can be viewed as characteristics of energy communities, implying that various actors will have diverse perspectives on the set-ups of these communities (cf. Tornatzky & Klein, 1982)

This thesis will use the dimensions seen in previous research done by Bergek and Palm (2023), which used six dimensions to investigate the ideal set-up of solar communities as viewed by existing members of solar communities in Sweden. These dimensions have been chosen due to their prevalence in energy communities literature (cf: Hicks & Ison, 2018; Walker & Devine-Wright, 2008) and using them will provide an opportunity to compare ideals considered by current members and non-members. Below is a table with the dimensions and an explanation of them.

Table 1 Six dimensions of ideal energy community based on Bergek and Palm (2023)

Dimension	**Explanation**
Process	Refers to whom the initiative is developed and driven by. Incudes how active a member is in the planning, development and management of the community.
Outcome	Concerns who benefit from the economic and social benefits both in terms of spatial and social distribution. Three main economic models to distribute benefits exist: electricity model, investment model and re-investment model.
Place	Refers both to the geographical proximity of members themselves as well as members' proximity to the installation site.
Interest	Refers to the shared values and interests of members of the community.
Organisation	Refers to who owns the energy community and how decision making is operationalised.
Social Interaction	Concerns social relationships and interaction occurring within the energy community

It will be investigated how different challenges and drivers to engagement in solar communities affect these dimensions. For example, time availability might affect both views on the process dimension and social interaction dimension. In the former, active membership might be limited due to time constraints, and in the latter, little social interaction is preferred due to time constraints. Moreover, economically motivated individuals might prefer one organisational set-up with a certain type of decision-making compared to environmentally motivated individuals.

2.4.2 Adopter behaviours dimension

Both literature on adoption and on energy communities include the role of motives as factors affecting adoption, although they categorise these motives in slightly different ways. Whereas the adoption literature mentions instrumental motives, environmental motives and symbolic motives (Bergek & Mignon, 2017), the energy community literature discusses economic, environmental and social motives (Radkte & Bohn, 2023). Motives can have an effect on perceptions of the ideal set-up of solar communities. For example, socially motivated individuals could be more interested in participation and interaction than what is currently the case (cf: Bergek & Palm, 2023) and could, potentially put an increased emphasis on place (cf: Bojie Af Gennäs Erre et al., 2023). The ideal financial model could also change depending on the motives.

Adopter behaviours also encompass characteristics of individuals and values and are seen as important in both literature on transition literature, adoption and energy communities. Individual attributes are known to affect engagement (Hai, 2019). Education might affect willingness to engage and affect ideal set-up in certain ways, placing emphasis on dimension of interest. It is found that individual characteristics such as gender and age are recognised to affect willingness to engage in solar communities (Kalkbrenner & Roosen, 2016), hence exploring different genders' views on engagement is of interest. Lastly, norms and current behaviours, such as Swedish social norms, might act as a challenge to engagement and affect views on the ideal set-up favouring little social interaction.

2.4.3 Adopter resources dimension

As described in the literature review, many drivers and challenges to engagement in solar communities are tied to an individual's resources (Hanke & Lowitzsch, 2020). It is found that factors such as knowledge and experience, financial resources and time availability, have an influence in general adoption processes (Aguilar & Cai, 2010; Mignon & Bergek, 2016). These factors are applicable also to the specific case of solar communities, where education and awareness regarding local energy initiatives influence participation (Kalkbrenner & Roosen, 2016).

A lack of knowledge and experience with solar energy and the energy market makes it difficult for people to know whether engaging in solar communities will have the desired benefits and advantages. Additionally, a lack of knowledge might affect the ideal set-up of an energy community, for example, in terms of adopters' desiring more social participation with educational aims.

Financial constraints are pointed out as a challenge both in the general adoption literature (Mignon & Bergek, 2017) and in the specific energy community literature (Hanke & Lowitzsch, 2020). If financial factors are a challenge to engage in energy communities, a financial model that maximises the economic value might be favoured.

Additionally, time availability might act as a challenge to engagement in energy communities. Individuals might view becoming a member as equal to taking up a lot of time, which decreases willingness to become a member. Individuals could also have very little time

left to spend being engaged in energy communities. In both cases, an ideal where time-consuming activities are required might be avoided.

2.4.4 System dimension

The literature on energy communities recognises that contextual elements such as socio-political dynamics and market conditions affect participation in energy communities (Hai, 2019), but still focuses very little on system-level factors influencing participation and adoption. Complementary insights can, however, be found in both the general adoption literature and the literature on sustainability transitions, which stress the importance of considering the socio-technical system, including institutional rules, actor interactions and perceptions of market complexity (Geels, 2017; Negro et al., 2012). Institutional conditions such as perceptions of roles and responsibilities are particularly important. For example, seeing MUCs as legitimate energy providers might act as a barrier to energy community participation since individuals might have no desire to do a function that a legitimate actor already provides. The effect this could have on the ideal set-up of solar communities is that actors such as MUCs would be welcomed and encouraged in the process dimension. Additionally, it might affect views on actors beyond the local community being welcomed to participate in the management of the community. Other aspects to consider in the system dimension is that lack of knowledge at a systemic level creates a challenge for joining energy communities since little is known about them, or that weak connectivity contributes to few opportunities for citizens to become members (cf: Negro et al., 2012).

3 Method

The following chapter will outline the applied research method of the thesis with regard to the aim and the research questions. Firstly, the empirical context of the research is described and justified, followed by the research design, data collection and analysis methods, and lastly, a critical reflection about the methodology including its limitations.

3.1 Empirical context

This thesis is designed as a study on non-members' perceptions of solar communities in Sweden. This section explains why solar communities in Sweden were chosen as the empirical focus.

The reasonings to why Sweden as a country is chosen are numerous. Firstly, the role of energy communities has been described in a European context. Yet, it is widely known that the national context matters and that policy should be formulated with regard to regional preconditions for innovation, networking, and innovation barriers (Tödtling & Trippl, 2005). Looking at the EU level, renewable energy makes up 23 % of final energy consumption, where the highest share of renewable occurs in electricity generation, with a share of 40.7% (EEA, 2023). Sweden has one of the highest share of renewables in the EU (58.39 %) (ibid), and within electricity generation, its share of renewables is 67.8 % (IEA, n.d.). These numbers indicate that Sweden is far ahead compared with the EU average in these aspects. Energy communities at a European level are, among other things, a way to enable a green transition, where it could be argued that Sweden has already achieved a green, sustainable transition. However, energy communities still have a role to play in Sweden and are thus relevant. Not only can they help with the continued expansion of energy needs and industry growth, but the aspect of fairness and inclusion still holds true in Sweden. Moreover, the Net Zero Emissions (NZE) Scenario sees a continued increase in the share of renewable energy, where the adoption of electric vehicles (EVs) and heat pumps, both in residential and industrial settings, are driving factors (OECD, 2023).

Solar communities as a form of energy communities were chosen to study due to its potential and relevance to the Swedish context. In terms of solar PV production, solar PV only contributes to 1% of total electricity production in Sweden (Svensk Solenergi, nd). Additionally, public opinion about solar PV is that Sweden should invest more than today (Svensk Solenergi, nd). Moreover, solar PV is growing in Sweden, indicated by the increase of grid-connected PV systems in 2020 to 2021 by 46% (Energimyndigheten, 2023). Lastly, compared to other forms of energy communities, such as wind or biofuel, solar communities are considered more economical and thus being a more viable option for citizens.

3.2 Research design

Seeing as the study aimed to identify drivers and challenges to adoption of solar energy communities and the effect these have on the ideal set-up of such solar communities the overall research strategy used was a mixed-method approach. The research aimed to both identify and quantify barriers and drivers, but also to understand perceptions and behaviours, hence the need for a mixed-method approach of both quantitative and qualitative methods.

The research used two different data collection methods to answer the research questions, a survey method and focus group method.

The study employs a sequential mixed method design in which a quantitative method (an online survey) complemented by a qualitative method (a focus group study). The survey was used to identify drivers and challenges to engagement and effects on ideal set-up. It collected both qualitative and quantitative data. In cases where a quantitative method comes before a more dominant qualitative method, the function of the qualitative is to interpret the findings and results of the quantitative research, to understand better and explain behaviours as indicated by the quantitative method, to get to know the process behind behaviours, decisions, perceptions, and motivation and lastly to contextualise the behaviours under study (Hesse-Biber & Nagy, 2010). Consequently, the focus group was used to explore the identified drivers, challenges and effects on the ideal set-up, providing nuances and reasoning. When seeking to understand the perceptions and behaviours of individuals, it is more appropriate to use a qualitative approach (Bell et al., 2019).

By using these two methods as complements, the study was able to answer the research questions. The survey was used to answer the first part of RQ1 and RQ2 about the perceived challenges and potential drivers to engagement in solar communities, whereas the focus group was used to understand how said drivers and challenges influenced engagement. Results from both the survey and the focus group were used to answer RQ3 about the ideal set-up of solar communities.

The research was divided into different phases: a literature review, pre-interviews and pre-survey, data collection through survey, pre-analysis, focus group interview and a combined analysis. A literature review was conducted to understand what prevalent theories exist concerning energy communities, who are apart of them, why and how. Literature on adoption and sustainable transition was explored to cover any gaps identified from energy community literature. An analytical framework based on the literature review was then constructed. The analytical framework guided the construction of the survey and aided the focus group. Pre-interviews were carried out early to gauge how non-members resonated around solar and energy communities. It provided an opportunity to explore what types of answers are generated by different types of questions. It also helped to determine non-members' knowledge level of solar communities, difficulty in understanding the concept, and what explanations helped. The pre-survey helped in the survey formulation.

The type of questions asked in the survey aimed to measure the perception of challenges and drivers to engagement and view on ideal set-up; therefore, some of the questions are of quantitative nature. The survey had both quantitative analysis in addition to qualitative. The quantitative analysis was descriptive analysis, whereas the qualitative analysis used thematic analysis.

Concerning how drivers and challenges within the different dimensions were actualised in the study, both the survey and the focus group implemented these dimensions. The survey focused more on the drivers and challenges found within the adopter resource dimension and adopter behaviour. Questions directly linked to resources such as time and finance and behaviours and motives were asked to achieve this, in addition to investigating their effect on the ideal energy community. Beyond touching upon adopter resources and behaviour, the focus group focused more on system factors than the survey. It also focuses more on

understanding how ideal set-ups were affected by different motives and challenges and the reasoning behind this.

3.3 Data collection and analysis

The following section provides a detailed description of how data was collected using an online survey and through the use of an online focus group session, and how these data were analysed.

3.3.1 Survey

When using self-completion questionnaires, having no interviewer present means that the survey must be very easy to follow and the questions must be easy to answer (Bell et al., 2019). It is often used in quantitative research with the aim to measure a phenomenon.

Compared to structured interviews, self-completion questionnaires are cheaper and quicker to administer, interview effects are absent, there is no interview variability since questions are always asked in the same way, and lastly, it is very convenient for respondents (Bell et al., 2019). Yet, Bell et al. (2019) point out some disadvantages to be aware of, such as the inability to prompt and probe, the inability to ask questions that are not salient to respondents, the difficulty of asking a lot of questions and that it might lead to lower response rates.

Well-thought-out designs of self-completion questionnaires are important to ensure success. Bell et al. (2019) mention the importance of not cramping the presentation, having clear instructions about how to respond, and making sure that the layout is pleasing and facilitates answering the questions (Bell et al., 2019). In constructing the survey, the order of the questions was also reflected on. Fink (2009) states that to not diminish the questionnaire's value, the order must be considered since sometimes the answer to one question will affect another. Once the first draft of the survey was formulated, it was tested on three individuals. This was to ensure that the survey's overall design ensured a successful outcome. It also tested if the questions were understood as intended and that no misinterpretations were made. Based on the insights from the test panel, the survey was adjusted. These responses were not used in the final survey.

The survey had four sections: personal information, energy knowledge, solar communities, ideals, and an ending (see Appendix A for survey questions). Personal information included questions such as age, the highest level of education, and living situation, and the aim was to gather the personal characteristics of the respondents. The section on energy knowledge included questions about how well the respondents were aware of their own energy consumption and whether they were interested in energy questions or not. The section aimed to determine previous knowledge of energy and values. The section on solar communities started with a brief introduction text to the concept of solar communities. It was followed by a number of statements on solar communities concerning both drivers and challenges, as well as some open questions. Lastly, the survey ended with an open question in addition to asking for email for future participation in a focus group.

The responses to three main questions were used to implement the analytical framework (see Appendix Table B for a complete description):

a) To what extent do you agree with the following reasons to become a member in a solar community? (Several sub-questions covering different motives)

b) To what extent do you agree that the following acts as a barrier for you to become a member in a solar community? (Several sub-questions covering numerous aspects)

c) What do you consider important for a solar community to function well? (Several sub-questions covering numerous aspects of ideal set-up)

d) In what ways would you consider being involved? (Several sub-questions covering different types of engagement)

For more specific questions in the ideal set-up dimension, questions specific to different economic models (outcome), investment preference and decision-making models (organisation) were also asked. Additionally, open question were asked concerning motives, barriers and views on engagement.

The types of questions used in the survey were both questions that provided quantitative descriptive analysis but also open questions which provided more qualitative data. Likert scales were used to quantify both perceptions of solar communities and attitudes towards different models of solar communities. Likert scale is an ordinal scale in which respondents are asked to answer to what extent they agree or disagree with a statement (Fink, 2009).

The survey was active from 15-03-2024 to 25-04-2024 and collected a total of 53 responses. Moreover, the study was interested in underrepresented groups and current non-members of solar communities. Men over 50 years of age were seen as the typical members of solar communities in Sweden (Bergek & Palm, 2013); as such, anyone not fitting that description was of interest. After the survey closed it was seen that most respondents were female and considered young adults. 53 % of the respondents were female, and a majority, 36% of the respondents, were between 26-35 years of age. Concerning level of education, the majority of the respondents were well educated with a university degree (62%). The rest had either a higher education diploma (14%) or a high school diploma (24 %). The housing situation for the respondents differed, yet most respondents, 45 %, lived in houses, 34 % lived in communally owned apartments, and 18 % in rented apartments.

The study implemented convenience sampling. Convenience sampling is a type of non-probability sampling method where the sample is selected due to it being accessible to the researcher (Bell et al., 2019). Accessibility can be due to geographical proximity, time, and or willingness to participate in the study (ibid). In this study, the survey was sent out to different Facebook groups, posted on library information walls, and sent to the researcher's personal network. Additionally, attempts were made to find participants to fill out the survey in public places such as libraries and central stations. Concerning the selection of Facebook groups, a variety of types of groups were selected, partly based on geographical areas but also on interest. In total, the survey was posted in ten Facebook groups (see Appendix C for a list of groups). Since the study implemented convenience sampling, the response rate is impossible to calculate but knowing the response rate is less of an issue when a sample is not based on probability sampling (Bell et al., 2019). However, a concern with convenience sampling is the question of representation, which will be discussed further in the methodology discussion.

Concerning the analysis of the survey, descriptive and thematic analysis was implemented. The descriptive analysis was done by looking at the averages of idenentified barriers and drivers. For Likert-scale questions, the results were quantified and portray in a table to show spread and frequency of answers. The open questions in the survey were analysed through thematic analysis. This was done though first familiarising oneself with the data, then searching for themes, reviewing them and lastly defining them. These findings from both the descriptive analysis and the thematic analysis were used as the foundation for the focus group session.

3.3.2 Focus group

The survey was followed up by a focus group interview. The focus group method is a type of group interview featuring multiple participants, including a moderator/facilitator. It centres around a specific, well-defined topic, emphasising group interaction and collaborative meaning construction. Combining aspects of both group interviews and focused interviews, it involves individuals with known involvement in a particular situation, adding the dimension of group interaction to create a more focused approach than traditional group interviews. (Bell et al., 2019).

Bell et al. (2019) state that the focus group method is a technique that allows the researcher to develop an understanding of why people feel the way they do. As such, using it in the study made it possible to get a deeper understanding of why the participants had certain perceptions of solar communities and how these influenced engagement. Additionally, focus groups allow people to probe each other's reasons for holding a certain view. Therefore, focus groups can be valuable in gathering diverse perspectives on a specific issue, such as solar communities. Additionally, using a focus group compensated for some of the disadvantages of using an online survey, such as the inability to prompt and probe (Bell et al., 2019). Using a focus group was an opportunity to answer more in depth and gain a more nuanced understanding of the responses. It was also e an opportunity to discuss ideal set-ups of solar communities.

The focus groups operationalised the analytical framework in two ways. Firstly, it aimed to gain a deeper understanding of identified drivers and challenges from the different dimensions, and secondly and more importantly, it provided an understanding of how identified drivers and challenges influenced and affected the engagement in solar communities. Before the focus group was conducted, the data from the survey was analysed. As such, the findings from the survey were used to guide the focus group.

The size of focus groups is typically suggested to be six to ten members; a smaller group is recommended when the topic is complex, yet a larger group is suitable when involvement in a topic is likely to be low. Nevertheless, when dealing with topics that participants have limited involvement with, larger groups may not be more effective, as it can be challenging to stimulate discussion in such contexts (Bell et al., 2019). A smaller group was used because solar communities are most likely a topic participants had little experience with. The aim of the study was therefore to use a focus group interview of at least four participants and to do this at least once.

Finding participants for the focus groups was done through the survey, where the last question was if they would consider taking part in a focus group. Seven said yes and were

contacted, and four were able to participate. All participants were females aged 26-35 for all four participants. Moreover, the participants in the focus group were all educated beyond high school, with only one of them having a five-year university degree. Areas of education included engineering to textile management. Two participants lived in communally owned housing, one in a smaller house and the last in a rented apartment. The majority of the survey respondents and focus group participants were females and young people, which matched the target group. However, it should be noted that limitations to focus groups include the issue of generalisability, where results are regarded as not always being reliable indicators of the whole population (Bell et al., 2019).

The focus group took place online using Zoom and lasted 60 minutes. The session was recorded. The focus group started with an overview of the topic of solar communities; this was followed up by a discussion around pre-identified themes within drivers and barriers to becoming a member and their influence on ideal set-up. Having it recorded also allowed the researcher to be fully present in the interview and not be stressed about taking notes on everything. Notes were still taken during the session to aid in the analysis. Concerning limitations to focus groups, Bell et al. (2019) state that analysing the data poses challenges since there is a rapid generation of a substantial amount of information. Devising an analysis strategy that integrates both thematic content and interaction patterns is a complex task.

The data from focus groups was analysed using thematic analysis. To aid the analysis, numerous pre-identified themes generated from the survey aided both the execution of the focus group but also the analysis. After the focus group session, the data recorded was reviewed and notes were taken. The notes taken during the focus groups were also reviewed. This was followed by searching for themes and collecting relevant data to each theme. Having done this, a broader view was taken to see whether the themes were coherent and worked with each other. Lastly, the themes were defined and then related to the research questions and literature.

3.4 Research quality and limitations

In order to ensure the quality of the study, certain quality criteria must be considered. Two frequent terms used for quality criteria are reliability and validity. The following chapter provides a discussion of the research quality and its limitations and ends with an overall assessment of the methodology.

3.4.1 Reliability

Reliability refers to whether the study's findings are repeatable (Bell et al., 2019). Different aspects of reliability were considered during the study. In the survey, reliability was ensured by making sure that the questions asked about and the concepts used could not be misinterpreted. If such had been the case, different respondents would have given different types of answers whilst not referring to the same thing. To ensure reliability in the survey, the survey was discussed thoroughly with the researcher's supervisor, and more importantly, it was pre-tested by two individuals. During the pre-tests, the respondents answered the survey while the researcher was present. Any misunderstanding or feedback could be brought up directly, giving the test person a chance to explain why it could be misunderstood. This was done on three occasions.

During the focus group, the researcher herself made sure not to misunderstand or misinterpret any situation nor that the participants did. To limit misunderstanding of the researcher, the researcher repeated what was said and asked if it was correctly understood to avoid misunderstandings. To limit misunderstandings among participants, questions that were not properly understood were formulated differently a second time to eliminate misunderstandings of the participant.

3.4.2 Validity

The criterion of validity is often considered to be the most important. Validity refers to the integrity of the conclusions drawn from the research findings (Bell et al., 2019). There exist different types of validity: measurement validity, internal validity, external validity and ecological validity. Overall, to ensure validity, the questions used in the survey were based on the specific dimensions identified in the theoretical framework and related to the analytical framework. The focus group centred its discussions on findings from the survey and the analytical framework. This approach ensured that the study answered what it was intended to do.

Measure validity refers to the degree to which a used measurement measures what it is supposed to measure (Bell et al., 2019). The types of measurements used in the survey were concerned with measuring attitudes and opinions as well as the level of interest or familiarity with concepts. The survey used Likert scales to measure attitude and opinion in different questions. For questions concerned with evaluating respondents' values or interest in topics such as energy questions, a scale of 1-5. Clear descriptions were provided to avoid misunderstandings of concepts and what the different numbers meant, such as 1 being very little and 5 being expert.

Internal validity is concerned with determining whether a conclusion that implies a causal relationship between two or more variables is sound and reliable (Bell et al., 2019). An example of this is whether, in this study, we can suggest that a certain motive is responsible for variation in social participation and not due to some other factor. Using focus groups was an opportunity to gain deeper insight than what the survey could provide, where causal relationships could be discussed. External validity tackles the question of whether the results from a study can be generalised in another context than the one studied (Bell et al., 2019). This study used mixed methods to ensure validity. Using mixed methods is the process in which one uses more than one method whilst studying the same dimension of a research problem. It is used to determine whether any similarities of the data from the different methods can be seen (Hesse-Biber & Nagy, 2010). As such, it increases credibility and can secure validity. Additionally, it provides complementarity, which opens a deeper understanding of the study's research problem. Hesse-Biber and Nagy (2010) also point out that using a mixed method aids the research in improving total understanding when data and results from one method aid in developing or informing the other method, which was the case for this study. More focus groups could have been conducted to increase external validity. However, this was not possible due to the limited interest of survey respondents in volunteering in a focus group session.

A concern in the study was the sampling strategy, where using convenience sampling raises the question of representation. To ensure that the sample was representative numerous sampling strategies were implemented. The survey was posted in numerous Facebook groups

and put on posters, and volunteers were sought in different public spaces. Concerning Facebook groups, they were chosen based on either geographical considerations or interest. Geographical Facebook groups in the vicinity of Gothenburg were chosen due to Chalmers's local presence, as it was reasoned that seeing Chalmers as a legitimate local education institution would aid in willingness to respond. Groups were also chosen based on interest, to reach a more diverse sample. Reaching a more diverse population was also tried by contacting different official organisations, such as Gothenburg Energy, Hyresgästföreningen and HSB, where it was asked if the survey could be shared through them with a select number of their customers or members. However, none of the contacted organisations were willing to do this. As such, both time and access acted as a constraint in the sampling strategy.

Ecological validity refers to whether social findings can be applied in everyday settings that occur naturally (Bell et al., 2019). Bell et al. (2019) elaborate and state that the findings of a study utilising questionnaires may exhibit measurement validity and a satisfactory level of internal validity, allowing for the accurate assessment of relationships between variables. Additionally, these findings may demonstrate external validity, suggesting that they can be generalised to other populations employing similar questionnaires. However, the unnatural context of responding to a survey may restrict the ecological validity of the findings, limiting their applicability to real-world contexts since what respondents answered in the survey might not translate into reality. To overcome this, the focus group was used, where results from the survey could be discussed and gauged to see if they were applicable to everyday settings.

3.4.3 Delimitations and limitations

The thesis investigated the perception of solar communities according to underrepresented groups. However, who is considered to belong to underrepresented groups can be discussed. Previous studies by Bergek and Palm (2023) found that current solar community members are a homogenous group comprising white men in their 50s and many being house owners. As such, any individual not conforming to the above characteristics could be included in an underrepresented group. This is a very broad understanding of underrepresented groups.

Moreover, the study was restricted to focusing on non-members' of solar energy communities and not any other type of energy communities, as such the findings might not be applicable to other types of energy communities. Additionally, the study restricted what was considered a solar community. The study considered the solar energy community to be a form of collectively owned solar energy where energy is produced by other than traditional energy companies. However, communally owned housing associations with installed solar panels were not considered a solar community. Lastly, the study did not investigate regulative aspects or policies of solar communities.

Concerning limitations of the research, the major ones were sample size, methodology constrains, time. For sample size, the research had a rather small sample size that can be seen as a potential weakness where the sample size is not indicative of the larger population. There were constraints with survey respondents and focus groups participants such as potential biases. Yet using mixed methods was a way to combat this. Lastly, the limited time during which this research took place was a limitation. Having had more time, the breadth and depth of the research could have been improved.

3.4.4 Overall methodology assessment

The study has some limitations. It uses a relatively small sample size, where respondents to survey and focus group participants are chosen based on availability. Although most respondents were young females, which corresponds well with the intended target group, the limited reach may affect the depth and breadth of insights and impact the generalisability of the study. Despite this, the study offers valuable preliminary insights into the factors affecting engagement in energy communities and views on ideal set-up.

4 Drivers and challenges and their effect on ideal set-up

The following section combines the results from the survey and the focus group and presents the findings using the analytical framework. As such, drives and challenges to solar community adoption will be brought up across the adopter behaviour dimension, the adopter resource dimension, and the system dimension. In the subsection on ideal set-up, views of an ideal solar community across the various ideal set-up dimensions are synthesised and presented. Lastly, the influence these drives and challenges have on the ideal set-up is presented. Two figures concerning motives and barriers are shown below to aid in the presentation of the results. The information in these two figures is referenced in all sub-sections. Additionally, supplementary figures are provided in certain sub-sections. Figure 2 illustrates the importance of different reasons for becoming a member of a solar community. Figure 3 shows the perceived barriers for respondents not being members of a solar community.

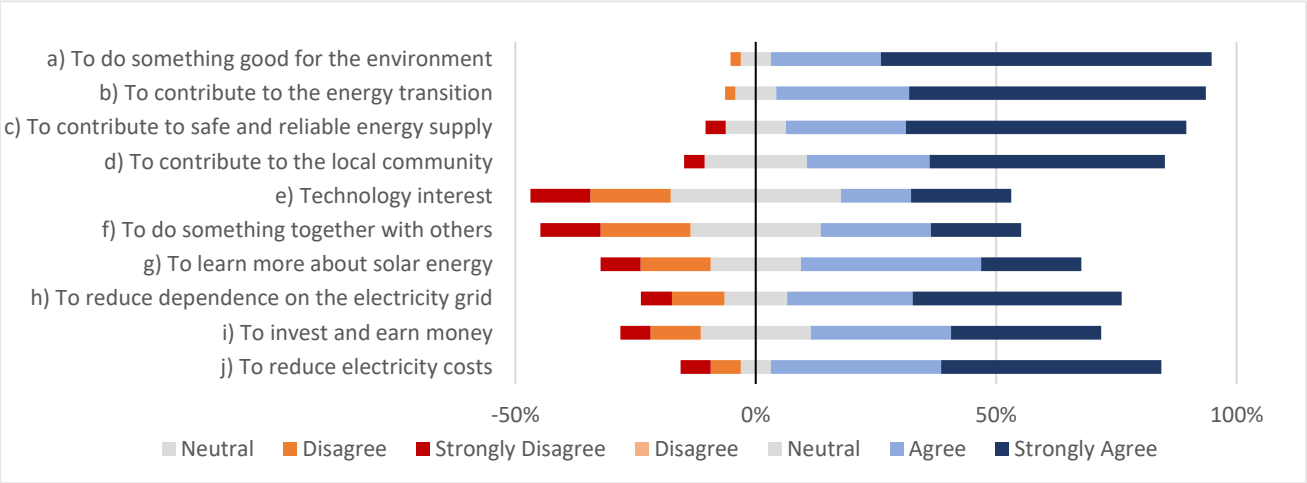

Figure 2 Reasons to become a member of a solar community for non-members

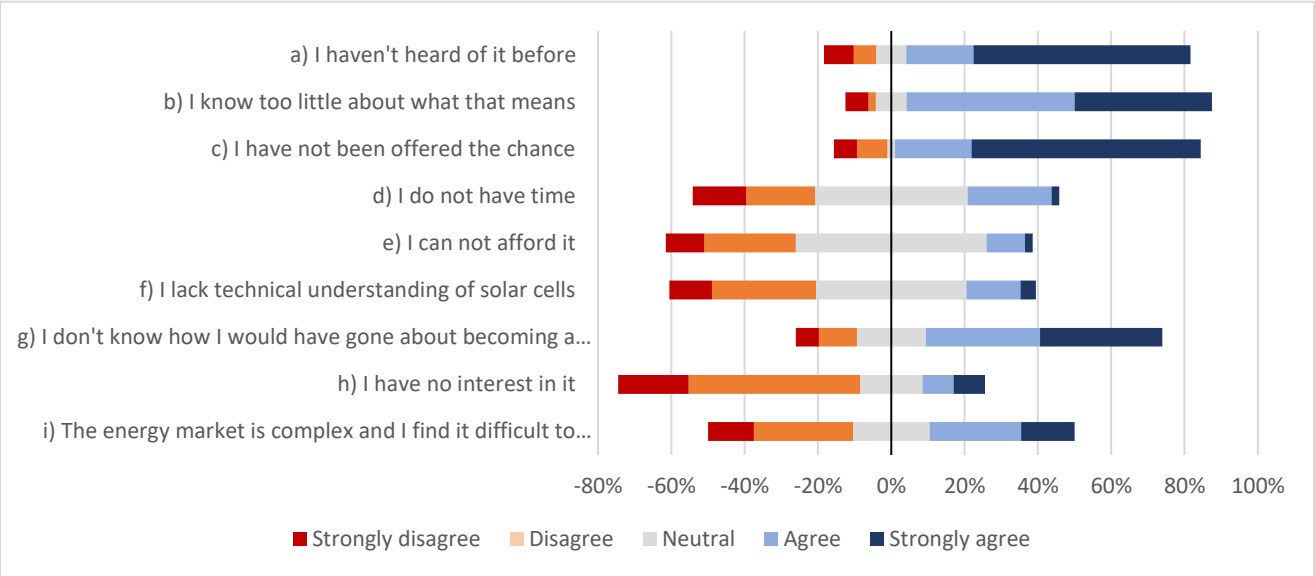

Figure 3 Perceived barriers to becoming a member in a solar community for non-members

4.1 Adopter behaviour dimension

This section presents the drivers and challenges to solar community adoption in the actor behaviour dimension. It starts by introducing drivers and challenges within individual characteristics. Secondly, respondents' motives for potentially becoming a member of a solar community are presented. This is followed by presenting the norms and values of the respondents and how they act as drivers and/or challenges to solar community engagement.

4.1.1 Individual characteristics

It was seen that females were, to a greater extent, not responsible for energy questions in their household. When asked whether respondents were responsible for energy questions, 43% of the respondents who said yes were females, and for no, 72 % were females. It was seen that a higher degree of education led to a higher interest in environmental and sustainability questions. Moreover, it was seen that respondents living in a house had a higher interest in energy questions compared to people in communally owned apartments. On a scale of 1-5, where 5 denotes a very high interest and 1 a very low, house owners had an average of 3.7, whereas respondents living in communally owned apartments recorded an interest of 2.8.

During the focus group interview, the difference in participants' housing situation was pointed out as affecting one's interest in energy questions, where it was reasoned that house owners' interest in energy questions is born out of necessity. *"I'm a house owner; this forces me to be more conscious about all things related to energy. Heating up a house means a completely different cost compared to living in an apartment".*

43 % of respondent responded that they were active in some form of association during their free time. Among these, communally owned housing associations (Bostandsrättsförening) were the most frequent, followed by different sports associations.

4.1.2 Motives

Overall, it was seen that motives were heterogeneous, with economic motives in combination with environmental motives being dominant. Few respondents possessed social motives. Many respondents recognise the multifaceted nature of motives and how numerous different types of motives act as reasons to join and engage in a solar community. This is seen by the strong agreement for numerous types of motives, from environmental to economic and instrumental. However, different views on motives emerge when comparing motives from the survey and the focus group.

In the survey, respondents viewed environmental reasons as the strongest motive for joining a solar community. The two statements to do something good for the environment and contributing to the energy transition are strongly agreed and agreed by 92 % and 89 % respectively (Figure 3, a, b). Societal reasons to engage are overall agreed by respondents to be important reasons to engage, where being a part of a bigger picture of the energy transition acts as motivation. Respondents are motivated by contributing to societal change, where 83 % of respondents strongly agree and agree that contributing to a safe and secure energy supply acts as a reason to join a solar community. Other societal motives, such as contributing to the local community, are also reasons for joining a solar community and are

seen as somewhat strong reasons to join, with 49 % of respondents strongly agreeing and 25% agreeing that it acts as a motive (Figure 3, d). Respondents also possess instrumental motives to join a solar community, where 70 % strongly agree or agree that lessening the dependence on the electricity grid acts as a motivation to join (Figure 3, h).

Economic motives are considered very important by many. Reducing electricity costs is more important as a motive than investing and earning money when joining a solar community. Overall, 81 % of the respondents strongly agree or agree with reducing electricity costs (Figure 2, j), whereas 60 % strongly agree or agree with investing and earning money as a motive (Figure 2, i).

When asked in free text what would have motivated the respondents to become a member of a solar community, it is shown that motives are heterogeneous, and respondents possess numerous motives at the same time. Many are economically motivated; economic motives are often mentioned in combination with other motives, such as environmental motives or societal ones.

> *"Clear financial gain, simplicity."*
>
> *"Good financial return combined with little effort and insignificant fuss in the association."*
>
> *"Environmental awareness and economic benefits."*
>
> *"If it looks like a good deal and also really contributes to societal gain, then I'm interested."*

The focus group provided a somewhat different perspective on the motives for joining a solar community. Where environmental motives in the survey were dominant, from the focus group, economic motives stood out alone as the main motive to become a member. All participants in the focus group highlighted the economic motive as the most important one:

> *"There would have to be strong and visible economic gains for me to consider becoming a member."*

Environmental motives were recognised by the participants in the focus group. However, its importance was shown to be not very strong. It was reasoned that there existed easier ways of doing something for the environment. One participant highlighted that if she would consider becoming a member, it would, in addition to economic gain, be due to feeling like she contributed to a positive impact on the environment and to something greater than herself and thus felt good about herself. However, she recognised easier ways to contribute to both environmental and societal benefits than becoming a member of a solar community:

> *"If I would consider joining, then it would be due to egoistic reasons where I would feel good about doing something with a positive environmental impact, but even then, I would prefer to continue recycling and get the same feel-good feelings from that instead".*

Two reasons that showed to be weak were social motives and technical motives. Social motives to join a solar community are not very strong. Almost as many people who agree with doing something together with others as a motive to join a solar community (40%) is countered by the percentage of respondents who disagree (30%) (Figure 2, f). The percentage of respondents who disagree with doing something together is the highest among all motives. This indicates that not only is it a weak reason to join, but rather it can act as an obstacle to becoming a member. This is shown in the focus group, where it was emphasised that engagement must not include any form of social participation.

> *"If it would be any form of social engagement with other members, I would not be interested."*

Lastly, technical motives such as having an interest in technology or learning more about solar energy are also weak. A majority are neutral in the statement that having technology as an interest act as a motive to become a member.

4.1.3 Norms and values

The respondents were asked about their interest in energy, environmental and sustainability issues. The scale used to indicate interest was 1-5, with 1 being not interested at all and 5 being very interested.

The respondents were interested in energy questions overall, averaging 3.4. More noticeable was the value placed on being environmentally conscious. Many of the respondents were environmentally conscious and interested in environmental and sustainability questions. When asked about their interest, the average was 4.06, with 5 being the most answered number, and 46 % responded with 5. The focus group participants were all environmentally conscious and interested in sustainability.

Being very interested in environmental and sustainability questions was also reflected when asked about what they believed to be barriers to them not being a member of a solar community. Most respondents disagreed or strongly disagreed with the statement of not having an interest in becoming a member (47% and 19% respectively) (Figure 3, h).

Additionally, a societal norm for the respondents seems to be to be engaged in some form of association in their spare time. A majority of respondents were today active in some form of association. When asked about reasons for not wanting to be an active member and to socially engage in a solar community, participants agreed that the social norm of Swedes not seeking out new relationships was a strong reason.

> *“We are happy with the relationships we have and don’t want to go through the effort of creating new ones”.*

4.2 Actor resources dimension

The following section introduces drivers and challenges within actor resources that are found to influence solar community engagement. Firstly, findings within knowledge and experience

are presented, followed by time availability. The section ends with presenting results within financial resources.

4.2.1 Knowledge and experience

Knowledge and experience concern many areas. It covers both knowledge about electricity in general terms, familiarity with solar energy, experience of being in associations and previous knowledge of solar communities. The most visible challenge is not knowing about the concept of solar communities.

The respondents were asked numerous questions about their knowledge and familiarity with electricity consumption and solar energy, with values ranging from 1-5, where 1 indicated very little knowledge and 5 was expert. When asked about electricity consumption in general terms, such as when they use the most electricity and what energy source, the average response was 3.08, with answers being normally distributed between 1-5. This was followed up by asking about their actual monthly electricity consumption in kWh/month. 58 % of the respondent did know their monthly electricity consumption when provided options of different ranges, such as < 150 kWh, 150-450 kWh, and the rest answered that they did not know. A clear majority of respondents (66%) are responsible for energy-related questions in their household, whereas the rest, 34 %, are not. Out of the 66 % who were responsible, 57 % were males and 43% were females.

Overall, respondents were neither very familiar with solar energy in general terms nor did they possess any technical knowledge and understanding of solar energy. When asked about how familiar the respondents were with solar energy in general terms, the average answer was 2.83, where the most frequently answered level was 3. The respondents who were not responsible for energy questions in their household tended to answer low on being familiar with solar energy in general terms. When asked what their technical understanding of solar energy was, the average was 2.66, with 2 being the most frequent answer.

At the same time, increasing one's knowledge of solar energy was not seen as a very strong reason to join a solar community. On one hand, many agreed that learning more about solar energy was a reason to join (Figure 2, g), but compared to other reasons, it was a rather weak reason. Many respondents stated that never having heard about the concept of solar communities before acts as a barrier to becoming a member, with 78 % of respondents strongly agreeing or agreeing with this statement. (Figure 3, 1). As such, it can be stated that a major challenge to becoming a member is not knowing about solar communities in the first place. The low overall knowledge of energy and solar energy can be seen to act as a challenge.

Lastly, concerning experience is the fact that a majority of members have experience of being in an association. Experience of being a board member in, for example, a communally owned houses association might give either a positive or negative experience of what it means to be part of a board in a solar community. One participant elaborated on this and explained that her engagement in her housing association is one she does not enjoy and that being a board member has taken up more time than planned. This negative experience of being a member of a board in a housing association has a negative effect on willingness to engage in a board of a solar community and thus acts as a challenge.

4.2.2 Time availability

Concerning time availability and its impact on solar community engagement, the findings from the survey and focus group reveal nuanced insights. A significant share of respondents (41.7%) expressed a neutral stance on whether time acts as a barrier to joining (Figure 3,d). This neutrality likely reflects uncertainty about the time commitment required for membership in a solar community. However, this does not imply that time is an unimportant factor. Both survey responses, including free-text answers, and focus group discussions highlighted the critical role of time availability.

Many respondents indicated that time availability would be a decisive factor in their decision to join a solar community. They expressed concerns about existing commitments to work, family, and friends, which already occupy much of their time. These views were expressed in their responses to questions about social participation, such as involvement in board activities or social meetings:

> *"Lack of time."*
>
> *"Don't want to tie myself up too much."*
>
> *"I don't think I would have wanted to set aside time for this. Work, family, friends, and house, etc., take up time."*

In the focus groups, all four participants consistently identified time availability as a limiting factor in two ways. First, they felt they did not have sufficient time to engage actively. Second, even if they had available time, they preferred to spend it on other activities. Time availability constitutes a significant challenge for potential members of solar communities, impacting their willingness and ability to engage.

4.2.3 Financial resources

Regarding financial resources, the findings are mixed. On one hand, financial constraints are not seen as a major barrier to becoming a member of a solar community. On the other hand, financial benefits are a significant driver for membership. For respondents, the financial gains must be clear, as highlighted in the motives section.

While financial resources are seen as a minor barrier to solar community engagement, there is a possibility that respondents lack sufficient information to make a well-informed decision. When asked about the statement, *“I don’t have the financial resources”* as a barrier to joining, 52% of respondents remained neutral. This neutrality suggests that either they do not see financial resources as a significant issue, or they lack enough information about the financial implications of being a member.

The importance of financial resources is further emphasised in the survey responses. Hesitant respondents frequently mentioned money and reasonable costs as critical conditions for considering membership in a solar community. This indicates that clear information about financial benefits and costs is crucial for potential members.

4.3 System dimension

The following section presents drivers and barriers within the system dimension. It starts by describing challenges to become engaged in solar communities found in the market structure which is followed by presenting challenges concerned with interaction within the system.

4.3.1 Market structure and institutions

Respondents were asked about their views on the energy market and the role of solar communities in it. The statement *"The energy market is complex, and I have a hard time understanding the role of solar communities in it"* achieved an equal share of views; approximately the same percentage of respondents disagreed strongly to agreeing strongly, as was it for agreeing and disagreeing (Figure 3,9). The focus group provided complementary views on the market complexity, where participants recognised the complexity of the energy market but stated that it was neither a challenge nor a driver:

> *"I honestly don't feel like I understand the whole energy market that much, but neither do I want to learn about it by being a member in a solar community."*

The role of the solar community in the energy market and the Swedish context was questioned by participants during focus group interviews. Partly, it was felt that engaging in a solar community would have little societal effect or contribute to the green transition. Secondly, it was seen that the advancement of green energy in Sweden made solar communities feel less urgent. This was highlighted by a participant stating:

> *"Me becoming a member of a solar community would contribute as much to the green transition as a drop in the ocean."*

The influence of the Swedish setting was further pointed out:

> *"Pretty much everyone in Sweden already has access to green electricity."*

There was a positive attitude towards utility companies, especially smaller municipal utility companies with already strong local connections. Participants saw these as legitimate actors in the energy market that already provided renewable energy and positively impacted the community.

During the focus group interview, the role of individual citizens in the energy transition was brought up. It was discussed who's responsible for ensuring a fair and just transition. It was reasoned that placing responsibility on individuals to contribute to green electricity and pursuing a more active role in energy questions is unreasonable and unfair.

> *"Why should the responsibility be placed on the individual citizens? The same is true with recycling; we as citizens shouldn't have to recycle, it is the companies creating the packaging that should. I think the same is applicable in this case".*

4.3.2 Interaction

A challenge that is perceived to affect participation is not having been offered the opportunity to become a member and not knowing what steps to take to join. This wide lack of opportunities indicates a weak interaction of solar communities at a system level and a widespread lack of awareness.

Many view the lack of opportunity as a major challenge to being a member. 82 % of respondents strongly agree or agree that not having been offered the chance of becoming a member constitutes a barrier (Figure 3, c). Moreover, many respondents stated that not knowing what steps to take to become a member acts as a barrier to becoming a member, with 64 % of respondents strongly agreeing or agreeing with this statement (Figure 3, g).

The lack of information about what solar communities mean is seen when asked if respondents would consider joining a solar community: 42 % said yes, 12 % said no and 46 % maybe. A follow-up question was asked to respondents who answered no or maybe what conditions must be fulfilled for them to consider joining. A strong emphasis was placed on more information and knowing more about what it would mean to be a member.

> *"Increased knowledge and clear advantages"*
>
> *"More knowledge about it - how it would work practically."*
>
> *"More information to see if more people in the village are interested."*
>
> *"More information!"*

Provided that these conditions were met, 81 % of previous no and maybe respondents changed to yes. This shows that lack of information and understanding is a big obstacle, yet it also has a big positive potential, indicated by how many went from no to yes.

4.4 Views on ideal set-up

The following subsection presents the views on the six dimensions used to describe an ideal set-up of a solar community. The dimensions are process, outcome, place, interest, organisation, and social interaction.

The figures below are used to present findings across all dimensions. Moreover, dimension-specific figures will be used when they are relevant in some subsections.

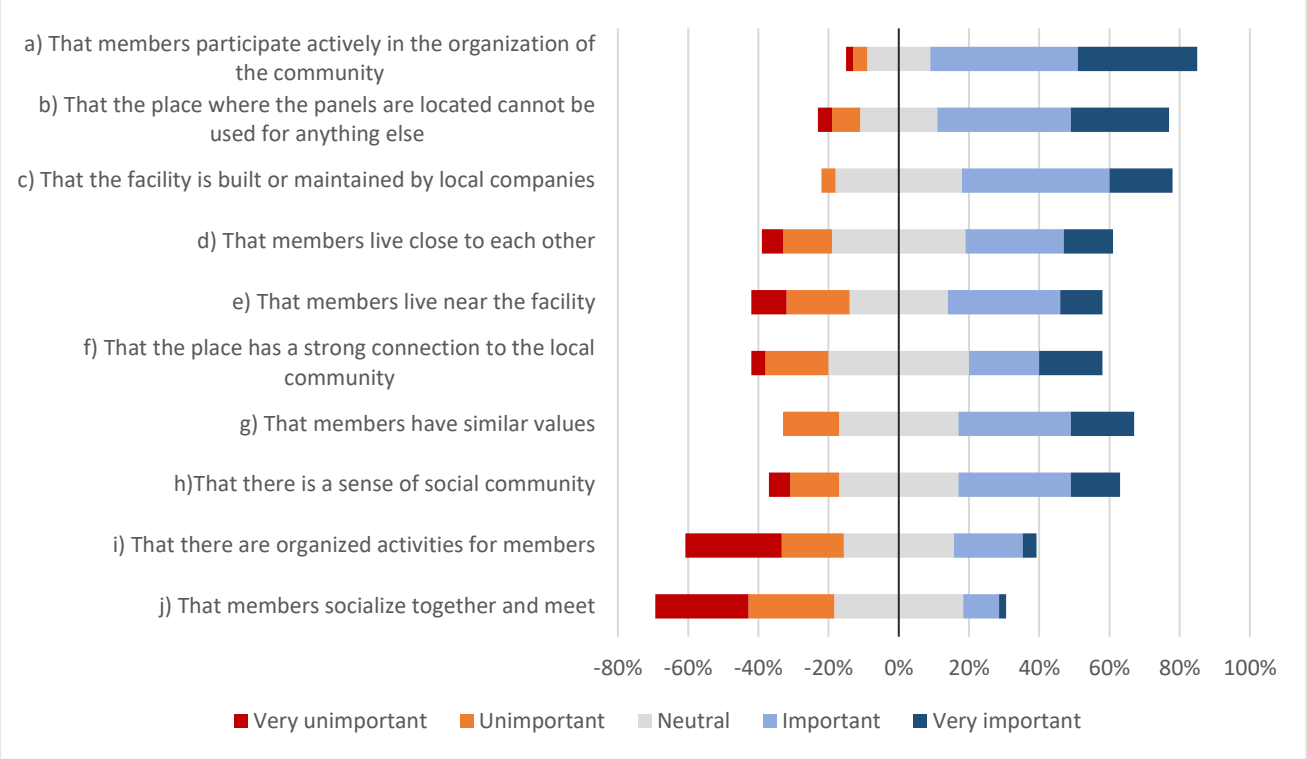

Figure 4 Importance of different factors in an ideal solar community

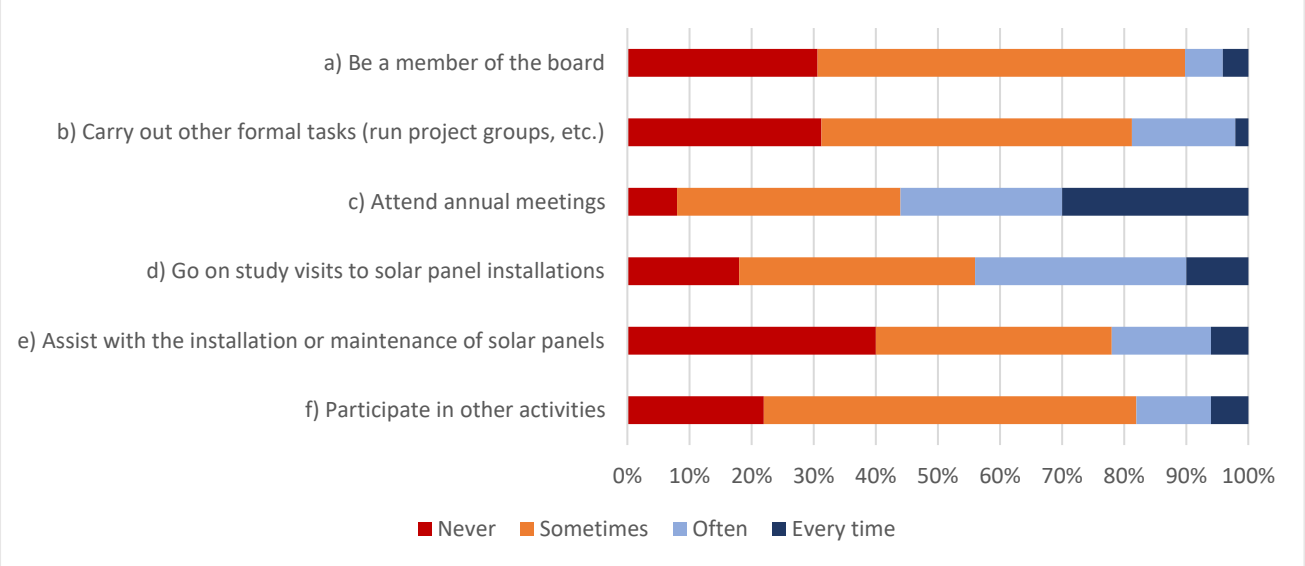

Figure 5 How often different activities would be undertaken

4.4.1 Process

There is a strong consensus among respondents that active membership is considered important for a solar community to work well. This is seen by 34 % of respondents considering it to be very important and 42 % important (Figure 4, a). Relative to other factors, active participation by members of the community is the most important factor. However, despite respondents viewing active participation as very important for a solar

community to function well, the majority do not want to be involved in running the solar community. When asked if they would consider being a member of the board, 30 % responded never and 59% sometimes (Figure 5, a). Even stronger was the reluctance to undertake other formal tasks, where 31% answered never (Figure 5, b).

Reluctance to be an active member is also seen in the view of participating in yearly board meetings. Half of the respondents would be present every time or often, whereas the other half would participate sometimes or never (Figure 5, c). That such a large portion of respondents are hesitant to participate in one event that occurs once a year indicates the overall mindset of active membership where respondents want to do the bare minimum, and for some, that is also too much.

Participants in the focus group also highlighted the importance of having active members in solar communities as long as they themselves are not required to be active members.

4.4.2 Outcome

Respondents are both environmentally driven, where doing something good for the environment, contributing to the energy transition, and to a safe and reliable energy supply are all reasons for becoming a member that a clear majority agree with (Figure 2, a,c).

Additionally, giving back to the local community is strongly agreed to be a reason for becoming a member, with a strong majority of 49 % agreeing strongly and 25 % agreeing (Figure 2, d). Yet when asked about their views on the economic model, the option of having parts of the profits to be used externally, such as in local projects, views were not as strongly positive as local motives. Equal parts viewed it as a very good and poor alternative with most people viewing it as a neutral alternative (Figure 6, f). This was supported by focus group participants stating that using profits for any external purpose was not desirable. Moreover, the effect of giving back to society was debated. It was argued that other actors would have a greater and more positive effect on society than what benefits from a solar community would contribute to.

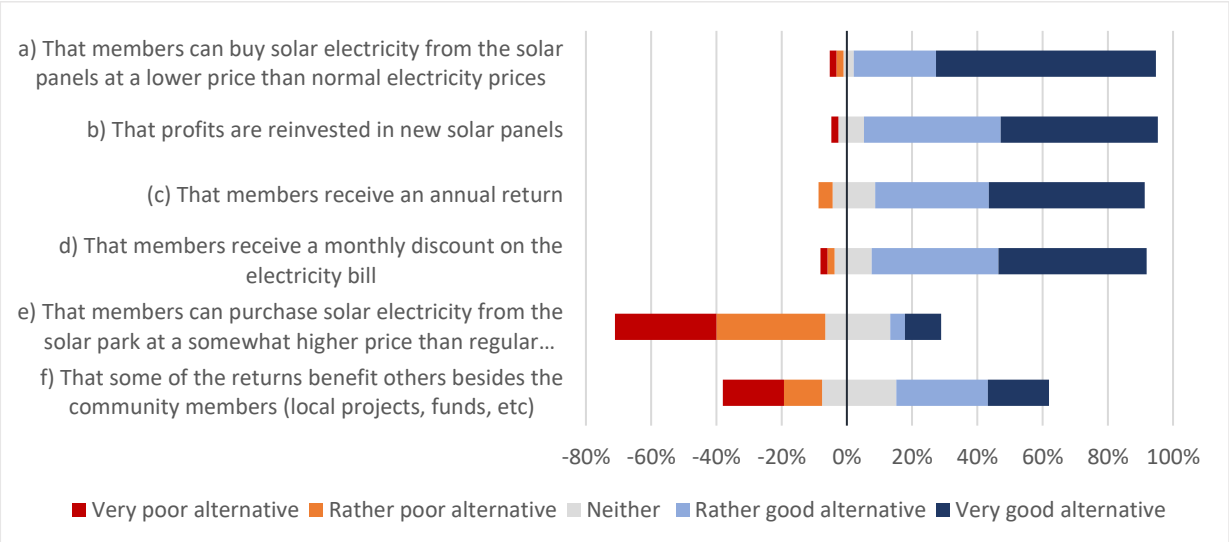

Figure 6 Views on different economic models

Concerning views on the economic model, the overall view of respondents was that a model with a clear economic gain was preferred. This was seen in that a majority viewed the alternatives of buying solar electricity from the solar panels at a lower price, getting a yearly divided and getting a monthly reduction on the electricity bill as very good and pretty good alternatives (Figure 6, a,c,d). However, respondents were also open to alternatives where personal economic gains were not as evident, such as the alternative of using profits to re-invest in new solar panels (Figure 6, b). Lastly, there was consensus in viewing the alternative of buying electricity from the solar installation at a higher price than normal electricity prices to be a poor option (Figure 6, e).

When asked in free text about how respondents would want to be financially compensated, a strong majority stated that they want lower electricity prices. Yet some state that type of financial compensation is not as important as long as there is some financial compensation.

> *"Lower price of electricity."*

> *"Doesn't really matter, as long as there is financial compensation."*

Focus group participants further reinforced these views. The main priority was ensuring maximum economic profit, but they were open to different forms of economic models. Discussions around receiving the profits monthly or annually took place, where it was stated that having it monthly has a greater effect on personal finance, especially in hard financial times where making ends meet is a monthly question.

4.4.3 Place

The respondents do not consider the notion of place as a decisive factor for a solar community to function well. This holds true for members living close to each other and members living near the facility. Respondents possess similar views on the importance of proximity between members and proximity to the facility. 42 % of respondents believe it to be very important/important for members to live close to each other, and 44% of respondents believe it to be very important or important for members to live close to the facility (Figure 4, d,e). Yet, it is seen to be more unimportant for members to live close to the facility compared to each other (28 %, 20%). In both cases, a large portion has neutral views on the statements.

Participants in the focus group were not too concerned about whether members lived close to each other or to the facility. One participant made it obvious by stating:

> *"Since I wouldn't plan on seeing any members either way, I wouldn't care if they were close to me or not."*

Overall, the respondents hold more practical than symbolic views on place's importance. A clear majority of the respondents believe it is unimportant that the installation site has a strong connection to the local community, as 40 % do not have an opinion on the matter (Figure 4, f). Yet, there is more importance placed on the fact that the location of the facility should be in a place that cannot be used for anything else, where 66 % believe it to be either very important or important (Figure 4, b). Concerning whether the facility is built or maintained by local companies, 60% of respondents believe it to be important and/or very important, yet many believe it to be neither important nor unimportant (36%) (Figure 4, c).

4.4.4 Interest

When it comes to having shared values and interests among the members, it is not considered very important. When asked about the importance of members having similar values for a solar community to function well, 50 % of respondents either believed it to be very important or important, whilst 34 % remained neutral in the question (Figure 4, g). As such, it is not a very important factor to consider. Participants in the focus group stated that when it came to values and interests, it was important that everyone agreed on the interests, objectives and goals of the solar community, but that individual interests were not important. If interests, values and goals of the community would be regulated in the formal description of the solar community, individual values would not matter:

> *"If it would be written down what our goals would be and the values of the community as a whole then I would not care about the individual values and interests since I would never meet with them either way."*

Having a sense of social community also follows the same pattern as having similar values, where the respondents do not consider it very important (Figure 4, h).

4.4.5 Organisation

When asked how respondents would have preferred to pay for solar panels in a solar community, a majority preferred the option of paying for a share in a solar installation (1000 SEK/share) over subscribing to solar panels (700 SEK/panel, over five years). Paying a one-time fee is preferred despite being more expensive since the aspect of flexibility is highly valued, as pointed out by focus group participants.

When asked about the views on decision-making and governance types, there is an overall positive view on both two forms of decision-making and governance types asked about. The differences in opinion can be seen in the details. More respondents thought that one vote per share was seen as a rather good alternative; however, more also saw it as a rather poor alternative in comparison to one vote per member. Moreover, the alternative of one vote per member also had more neutral views, where respondents saw it as neither a good nor a bad alternative.

When asked to choose one over the other, the preferred alternative was that of one vote per member, with 52 % preferring this alternative (Figure 7).

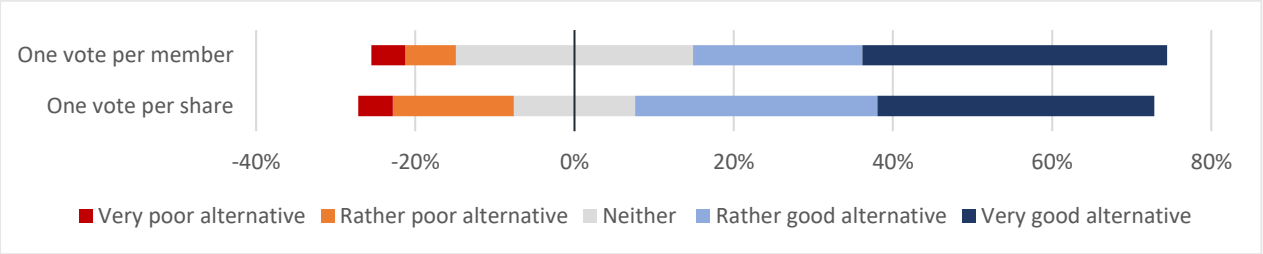

Figure 7 Views on decision-making

From the discussion during the focus group, it was reasoned that if someone had made a larger investment in the solar community by owning more shares, then that should be reflected in their influence in voting and decision-making, and thus, one vote per share should be implemented.

During the focus group, discussions on alternative forms of organising and structuring solar communities appeared. Whilst not considered a solar community in this study, participants brought up communally owned housing associations with solar panels on their property as a preferred organisational form. It was reasoned that an alternative to solar communities in this form would occur in an organisational form that they would be familiar with and comfortable with. It was stated that organisational aspects would follow the current ones used in the housing association.

4.4.6 Social participation

There is an overall strong agreement that being an active member of the organisation is considered very important, yet no one actually wants to be engaged. This holds true for all kinds of participation. There is most opposition to being a member of the board and undertaking other formal tasks (Figure 5, a, b).

A sense of social community in a solar community is considered somewhat important for a community to function well, where 46 % believed it to be either very important or important (Figure 4, h). Yet having organised activities for members that might help foster this sense of social community is not considered important at all, nor are members socialising together and meeting each other seen as important. These two views on social participation, organised activities and members socialising together are the two most unimportant views on what is required for a solar community to function well. In total, 45 % of the respondents believe organised activities to be unimportant and very unimportant, whereas the corresponding percentage for socialising together is 51 % of the respondents (Figure 4, i, j). Additionally, for both these statements, 32% and 37 % of respondents are neutral in the question about organised activities and socialising together, respectively. This further emphasises that it is not considered to be very important. The low willingness to participate is also seen by 82% of respondents stating that they are not inclined to participate in other activities (Figure 5, f)

When asked about participation in social activities, many state that a requirement for them to be a member is that it must be easy and have very little social interaction.

> *"I'm not that interested in social activities. I could have imagined getting involved in the organization, but in a limited way. Any compensation could increase motivation*."

> *"I could do a task that needs to be done in order for it to work. But if it meant a lot of social interaction and commitment, I probably wouldn't want to be a member."*

Participants in the focus group also emphasised that they do not want to socially engage in a solar community. If being a member would mean any form of social engagement, they would not want to become a member.

4.5 Drivers and challenges' effect on ideal set-up dimensions

This section synthesises the drivers and challenges brought up in subsections 4.1, 4.2, and 4.3 and ties them together with the views on the ideal set-up discussed in subsection 4.4. The findings are the result of both responses from the survey, but mostly from the discussion in the focus group session, which aimed to discover how different drivers and barriers influenced engagement. Whilst numerous different drivers and challenges have been identified, not all influence the ideal set-up. Some drivers and challenges influence the willingness to become a member in the first place, not the actual engagement as a member.

Table 2 Summary of identified drivers and barriers that influence solar community set-up.

Driver / Challenge	**Ideal set-up dimension**	**Influence**
Time constraints	Process	Low participation in running the solar community.
Economic motive	Outcome	Profits and benefits are to be kept in the community and not shared to the local community.
Low social motives Economic motives	Place	Openness to place with external actors being welcome.
Low social motives Time constraints Individual characteristics	Interest	No efforts to create a common unified collective identity. No desire nor time to invest in creating social identity. Higher interest in energy questions and solar community due to owning a house.
Economic motive	Organisation	An individual should have more influence if they have made a larger economic investment.
Low social motives Time constraints Social norms	Social Participation	Social participation within the solar community is undesirable.

Participants in the focus group highlighted the importance of having active members in solar communities, provided it is not themselves who are active. Overall, respondents are very hesitant to engage in the solar community, with a majority responding "never" when asked how often they would consider being a part of the board, undertaking other formal tasks such as projects, etc. The focus group participants gave reasoning to this, stating time as a limited resource. Time availability is seen as a major challenge that influences the process, resulting in low active participation.

Regarding outcome, economic motives play a significant role. Profits and benefits are to be kept within the community and not shared externally. This was supported by focus group participants, who stated that their economic motivation made using profits for any external purpose undesirable. Environmental motives as a driver have not a strong effect on the outcome. Whilst some societal motives are recognised to act as reasons to join a solar

community, such as contributing to the local community, these are not reflected in ideal set-up.

In terms of place, the community is open to external actors, and locality is not emphasised. The lack of social motives to engage in solar communities contributes to a very open approach to the notion of place. Economic motives contribute to the welcoming of external actors since they might increase potential benefits.

Low social motivation influences interest in the community. The respondents do not consider having a sense of social community very important. This lack of social motivation affects the importance placed on interest, leading to no efforts to create a common unified collective identity or to invest time in creating a social identity. Yet individual characteristics influence the interest of becoming a member.

Having an economic motive influenced the preferred governance type of decision-making. It was reasoned that if someone was economically motivated to become a member and had made a larger investment in the solar community by owning more shares, this should be reflected in their influence in voting and decision-making. Thus, one vote per share should be implemented.

Concerning social participation in social activities, many highlight time availability and lack of interest in hanging out together as a group as limiting factors. Many state that a requirement for them to be a member is that it must be easy and have very little social interaction.

It is important to note that while environmental motives are present and act as drivers to become a member of a solar community, they do not significantly impact the ideal set-up of the community. Additionally, a lack of knowledge and experience acts as a challenge to solar community engagement. Not knowing enough about solar communities creates an openness to different solar community set-ups. However, the extent of this influence cannot be clearly determined.

It can be concluded that drivers such as economic motives, individual characteristics, and house owners influence engagement. Individuals would consider becoming a member but want to have a passive membership with no social participation. Economic motives create a preference for keeping benefits internally and not sharing them with the local community. Additionally, economic motive influences decision-making models. Social norms are strong challenges to both willingness to become a member in the first place, and its influence is also seen in social participation, contributing to individuals favouring low social participation.

5 Discussion

The purpose of this thesis was to identify the drivers and challenges to engaging in solar communities and what the ideal set-up of solar communities is for underrepresented groups. The study has investigated drivers and challenges across three dimensions: actor behaviours, actor resources and system, and identified the ideal set-up of a solar community. The following chapter will present a discussion of the findings. It starts by discussing the drivers and challenges found in solar community engagement adoption, this is followed by discussions on the ideal solar community set-up and how the different drivers and challenges influence this. The findings are discussed with reference to the literature presented in Chapter 2.

5.1 Drivers and challenges

Challenges and drivers found across adopter behaviours dimension, actor resource dimension and system dimension are discussed below.

5.1.1 Interest

Individual characteristics have been pointed out to influence participation in energy communities (Hai, 2019), mentioning factors such as education, age, income, occupation and lifestyle. However, the emphasis on the housing situation has not been as present as a factor determining willingness to participate. This is despite the majority of members of solar communities in Sweden being house owners (Bergek & Palm, 2023). However, during discussions in the focus group, light was shed on the fact that being a house owner necessitates an interest in energy questions and thereby affects willingness to join a solar community. The difference in the cost of electricity in apartments to houses is substantial and thus was found to act as a driver to join solar communities. The difference in the interest in energy questions depending on housing situation indicated that house owners have an interest tied to their housing situation. This study suggests that for house owners, the compatibility of solar community is higher, as is the relative economic advantage. Becoming a member of a solar community has a potentially greater impact on house owners' finances and their electricity savings compared to people living in apartments.

Beyond housing status, gender was also seen to influence engagement. When asked outright if they would consider joining a solar community, males were more willing to engage in solar communities. This supports other research where men are the majority of members in solar communities (Bergek & Palm, 2023) or are more willing to engage in energy initiatives (Kalkbrenner & Roosen, 2016). This might be due to males being more responsible for energy questions in their households and, as such, seeing solar communities as an extension of their responsibility.

5.1.2 Economic motive

The dominant driver in joining a solar community was found to be economic motives. The role of economic motive is recognised in literature, with many recognising that financial gains act as a key motive for individuals to become members of energy communities (Bauwens, 2016; Seyfang et al., 2013). The findings of this study not only showed economic

motives to be present and affect willingness to become a member but also found them to be the most important ones. Economic motives were a significant driver and alone acted as a reason to join. Whilst Sloot et al. (2019) argue that economic motives have been exaggerated, the findings of this study thus indicate the opposite.

Yet, the study found that numerous motives are present and that individuals can possess more than one, confirming previous literature (Bauwens, 2016; Bergek & Mignon, 2017). From the survey, it was clear that environmental and societal motives were also drivers of solar community participation. At first glance, environmental motives seemed to be strong, yet they were found to not be strong enough on their own to make individuals willing to become a member. Moreover, they had limited influence on the ideal set-up.

5.1.3 National context

Societal motives are recognised as strong drivers to engagement in solar communities by current members of solar communities (Bergek & Palm, 2023). While the study finds that societal motives are agreed to be potential reasons for becoming a member, there are contextual forces that counter their weight. Contributing to a sustainable transition is agreed upon, yet when digging deeper, it is argued that solar communities' actual impact on the transition as a whole is considered marginal. It was reasoned that the national context of Sweden, having made advancements within green electricity and being far ahead in the sustainable transition, counters the need for individual contribution. Individuals believe that their potential contribution in terms of membership in a solar community would not really have an effect on the transition as a whole, seeing as Sweden has already come a long way. This points to the importance of considering the national context (cf: Tödtling & Trippl, 2006).

From this lens, the advancements in renewable energy and the green transition, rather than encouraging further engagement and contribution, negatively affect individual citizens' subjective capacity. Subjective capacity is argued to be a determining factor in affecting willingness (Mees, 2022). The positive developments already witnessed in Sweden offset subjective capacity, where the positive aspects of national and local authorities having already achieved a lot contribute to the perception that personal efforts are unnecessary. This point of view is not as described in literature; instead, it is more emphasised that not enough action taken by authorities makes citizens themselves take matters into their own hands (Mees, 2022). As such, this study sheds light and provides a new perspective on societal motives, subjective capacity, and the role of national context.

5.1.4 Social norms

The findings of the study indicate that social motives to join a solar community did not exist. This goes against the widespread importance placed on social motives and their role in energy community participation (Kalkbrenner & Roosen, 2016). Fostering a community identity and contributing to social cohesion are seen as reasons why citizens engage in solar communities (Seyfang et al., 2013). However, this study points to social motives being absent. However, this is in line with previous research on motives to join solar communities in Sweden, which indicates that social motives are very weak for current members of solar communities (Bergek & Palm, 2023).

It is reasoned that the national context with a strong social norm of limited social interactions affects the willingness to become a member of a solar community. Not only are social interactions and engagement viewed as undesirable, but they are also directly seen as a challenge. Respondents unanimously agree that any form of social interaction is unwanted and negatively affects willingness to engage.

The majority of respondents were environmentally conscious and had an interest in sustainability, and thus the concept of solar community and its environmental cause fits into respondents' beliefs and values, indicating compatibility. However, the added behaviour changes of engagement, which solar communities denote, counters the willingness to become a member. Whilst respondents recognised the environmental benefits and potential economic gains that solar communities bring, the aspect of social engagement counters the relative environmental and economic advantage of becoming a solar community member. This suggests that the characteristics of social collective engagement act as a challenge rather than a driver in Sweden, opposing previous literature (Seyfang et al., 2013). Further, it can be argued that the concept of solar communities is not compatible with the social norm in Sweden. Solar communities can be seen as having low compatibility with social norms in Sweden, negatively affecting engagement (cf: Sahin, 2006).

It is also seen that there is no desire to foster a uniform collective identity through solar communities. The concept of community with a shared identity, shared values, and interests was, to a large extent, absent in the study. These findings are in direct opposition to the wide literature stating that community identity and shared values and interest are vital factors encouraging participation (Bomberg & McEwen, 2012; Kalkbrenner & Roosen, 2016; Mees, 2022). While it was recognised that having a sense of community is somewhat important, no one actively wants to be a part of forming a collective identity. This is evident by how little respondents want to socially interact with other members. Simultaneously, numerous members were active in other forms of associations in their spare time. This indicates that the source of social cohesion is found through other means.

Overall, the norms and values of respondents were that they possess strong environmental values and interests, yet it did not automatically translate into wanting to become a member of a solar community.

5.1.5 Institutional conditions

The European Commission emphasises making the energy system more democratic through solar communities. It is assumed that individuals want to increase their voice in energy questions. These arguments are also viewed in literature promoting increased individual agency in energy questions such as energy citizenship, where the individual acts as the agent of change (Wahlund & Palm, 2022). However, views are brought up where it is seen that individuals do not believe that taking ownership of energy questions and being the agent of change is their responsibility. This affects the sense of responsibility of the respondents and, hence, their willingness to engage in solar communities, which is important to have if one wants to be engaged in solar communities (Mees, 2020). This study shows that individuals, to some extent, did not possess this sense of responsibility and that individuals felt that contributing to green transition should not be placed on them. A possible explanation of this is the positive view of MUCs. MUCs are regarded as legitimate actors, possessing citizens' trust and acting with citizens' intentions in mind. Viewing MUCs as legitimate actors creates

a stable energy system and thus contributes to respondents not seeking alternative energy system solutions. This supports views on institutional conditions affecting the perception of roles and responsibilities (Geels, 2004).

This study suggests that a strong presence of MUCs and seeing them as legitimate affects perceptions of roles, responsibilities, and energy citizenship, acting as a challenge to solar community engagement.

5.1.6 Lack of knowledge

A main challenge to engagement is the systemic lack of knowledge and awareness of solar communities. These findings are in agreement with Thakur and Wilson (2024) in that a lack of awareness of energy communities is a barrier to participation. This covers both awareness of solar communities as a concept and knowledge about what it means to engage. It is also the fact that individuals do not know what steps to take, given that they want to become a member. The lack of knowledge and awareness acts as a challenge by failing to create the proper conditions for citizens to engage. Gaining awareness and knowledge will provide citizens with information to make well-informed decisions regarding engagement.

The lack of awareness and knowledge of solar communities by citizens indicates the presence of interaction challenges arising from strong connectivity within the energy system. This is in agreement with Negro et al. (2012), stating that strong connectivity by few dominant actors in the energy system limits market access for newcomers, where solar communities can be understood as newcomers.

5.1.7 Interaction across dimensions

The findings from the results showed that drivers and challenges to becoming a member of a solar community do not act in isolation. Instead, numerous factors interact to reinforce each other as drivers and challenges affecting the ideal set-up. For example, social norms and time constraints create passive members.

Time constraints as a barrier have previously been recognised as constituting an obstacle to becoming a member (Hanke & Lowitzsch, 2020), and this study further reinforces time availability to act as a major challenge to becoming a member. Additionally, time availability interacts with the emphasis on low social motives influencing engagement where no social interaction is preferred.

5.2 Ideal set-up

Many of the drivers and challenges to becoming a member of a solar community have an influence on the desired engagement. Below are discussions on these influences, and the most critical views on the ideal set-up are presented.

5.2.1 Openness

Firstly, the systemic lack of knowledge about what solar communities mean influences views on the ideal set-up. Most notably, many respondents are neutral in how they view an ideal

solar community because they do not know enough about solar communities. They feel they do not have all the information or experience to form a decision (See discussion on lack of knowledge). This leads to many non-members being open to numerous ideals and set-ups across the dimension. However, there is a clear preference in some dimensions despite a lack of previous experience with solar communities, such as social participation.

5.2.2 Participation

Regardless of the driver to engage in solar communities, there was consensus around views of active participation in the organisation and social interaction. It was recognised that active participation in a solar community is a necessary condition for it to function well, yet no one wanted to be an active member themselves. This was seen in how no one wanted to engage in the board of a solar community nor participate in any social activities. This confirms previous findings on the view of active participation in Sweden, where it is regarded as important, but no one actually wants to be an active member and participate in social settings (Bergek & Palm, 2023). These views on participation can be explained by a strong social norm in Sweden, together with time constraints affecting the ideal set-up of a solar community through low participation and no desire for social activities.

5.2.3 Strong economic motives

The economic motive was stated as a strong driver to engagement in solar communities and it affects the ideal set-up of solar communities in numerous ways.

In outcome perspectives, economic motives limit the benefits generated by the community to stay within the community itself and not be shared with the local community. Sharing benefits with the local society is not only considered to be important (Bomberg & McEwen, 2012; C. Walker et al., 2022; G. Walker & Devine-Wright, 2008) but doing so is also seen to represent a strong solar community (Hicks & Ison, 2018). This study showed that a strong economic motive cancelled out the societal benefits, such as using part of the benefits generated by the solar community for the local community, and thus goes against views stating that citizens aim for not only personal gains but also social contributions (Mees, 2020).

In organisational aspects and decision-making, a strong economic motive created a preference for giving influence according to economic investment. Economic motives influenced decision-making to take the form of one vote per share, as opposed to one vote per member, which is considered to be more democratic (Hicks & Ison, 2018; Stauch & Gamma, 2020).

5.2.4 Comparison to current member views

Whilst not all dimensions were investigated in detail due to non-members having difficulty forming opinions on certain aspects, some similarities could still be recognised between non-members' and current members' views on the ideal set-up of solar communities. The most notable similarity is the perspective on engagement. As seen in this study, active membership is considered very important for a community to function well, but no one actually wants to be an active member, which is a view shared by current members of solar communities

(Bergek & Palm, 2023). Additionally, it concerns the aspect of social participation, where both non-members and current members want social activity to be kept at a minimum.

5.2.5 Alternative views on solar communities

Compared to the literature on ideals of energy communities, which mention organising communities according to place or interest, COP and COI (Walker et al. 2022), there are indications that neither perspective is applicable to non-members in Sweden. Overall, respondents were open to the notion of place, where living close to other members was not considered important, nor was living close to the facility. Moreover, actors beyond the local community were welcome to participate. At the same time, there was little evidence that supports the notion of interest being an important pillar. Citizens were environmentally conscious and interested in sustainability, but this did not translate into an interest and willingness to join. In addition, it can be seen how the arguments for social cohesion of solar communities were not applicable in the Swedish context; this raises the question of whether solar communities can be organised differently in Sweden.

Can solar communities be an extension of already established communities, such as communally owned housing associations? These are already existing organisational forms that many are familiar with and comfortable with. Additionally, it would not require new social engagements, which has been identified as a major challenge. As such, the appeal of low social engagement, familiarity, and simplicity are drivers that support this alternative view of the solar community.

Arguments can be made on whether a communally owned housing association with solar panels on its property should be considered a solar community. It should not be overlooked that solar communities can be organised completely differently from what has been seen so far, to the extent that they might not be considered a solar community anymore. If it is shown that this is a preferred way for individuals living in communally owned housing apartments, it would still increase the representation of citizens involved in solar energy production despite it not being open to everyone. Yet, arguments that engagement in solar communities creates legitimacy for solar panels facilities, aiding the transition as a whole, would not be in the same way be applicable to this type of engagement.

6 Conclusions and implications

The purpose of this thesis was to identify underlying reasons underrepresented group have yet not become members in solar communities and under what conditions they could be encouraged to become member. This was achieved by constructing three research questions.

The first research question concerned potential drivers to engagement in solar communities and their influence on engagement. The findings indicate that drivers to engagement are economic motives supported by environmental motives and that individual characteristics such as house owners and gender influence willingness to engage. The second research question was about perceived barriers to engagement and how they influence engagement. Key barriers identified include a widespread lack of awareness and understanding of solar communities, and time and social constraints. It is shown that the national context of Sweden, with strong advancements in renewable energy sources and social norms, also affects the perception of solar communities and constitutes challenges, negatively impacting engagement. As such, the study provides noteworthy views on individuals' roles and responsibilities in the energy transition. Lastly, the third research question was what the ideal solar set-up looked like for current non-members of solar communities. Here the research show that many non-members are open to different ideal set-ups of solar communities and would consider becoming a member. The most important factor to consider in the ideal set-up of solar communities is the need for low social engagements which is emphasised by many, a perspective shared by existing solar communities.

Based on the answers to each research question, an overall conclusion is that numerous barriers exist with lack of knowledge and awareness being the most prominent one. Economic drivers are the strongest reasons to become a member and affect the ideal set-up greatly. Non-members want to be passive member in a solar community that requires little social interaction and time investment.

These results have implication for solar communities, policy makers, and for MUCs. That many non-members are open to different ideal set-ups of solar communities and would consider becoming a member should be leveraged by current solar communities, local authorities, and decision-makers to make targeted efforts to counter the lack of awareness and knowledge and provide the opportunity to join solar communities. For current solar communities, the combability of the ideals of non-members with those of current members should be exploited and where the aspects such as little social interaction and time invested should be communicated. MUCs that are active in starting solar communities should keep in mind to design energy communities that require little social interaction, that are not time-consuming, as this will create conditions for attracting more members. Yet, clear communication about costs, benefits, and opportunities to become a member must be improved. The study also brings new perspectives on how solar communities may be developed in the future to be more compatible with the national context of Sweden something policy makers are impacted by.

This study has focused on the drivers and challenges for underrepresented individuals to become members of solar communities and their views on the ideal set-up. Future research could focus on drivers and challenges for socio-economic vulnerable groups and their perceptions of solar communities and different set-ups. Additionally, the research found

indications that house owners are more naturally interested in energy questions and thus more likely to become a member in a solar community due to compatibility. This aspect in not explained by current literature and as such would be interesting to further explore and study. Moreover, it could also include the role of gender in being responsible for energy questions and its impact on solar community membership. Lastly, there is an absence in literature that explores how positive national advancement can offset subjective capacity and influence individual responsibility and involvement in the green transition. Seeing as this was very present in the findings, providing new perspectives on literature, it would be an interesting area for further research.

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Appendix A - Survey questions

Solenergigemenskaper

Hej!

Denna enkät syftar till att utforska din relation och syn på solenergigemenskaper.
Tack för att du tar dig tid att besvara denna enkät som består av ca 30 frågor.

Personlig Information

Denna information delas ej externt utan är endast till för intern forskning.

1. Vad är ditt kön?

- ◯ Kvinna
- ◯ Man
- ◯ Vill ej säga

2. Hur gammal är du?

- ◯ < 18
- ◯ 18 - 25
- ◯ 26 - 35
- ◯ 36 - 45
- ◯ 46 - 55
- ◯ 56-65
- ◯ >65

3. Vad är ditt postnummer?

4. Vilken är den högsta utbildningsnivå du har avslutat?

- ◯ Gymnasieutbildning
- ◯ Högskoleutbildning
- ◯ Universitesutbildning
- ◯

5. Hur bor du?

- ◯ Hyreslägenhet
- ◯ Bostadsrätt - lägenhet
- ◯ Hus
- ◯ Studentlägenhet
- ◯ Annat

6. Är du engagerad i någon form av förening i idag? (tex barns fotbollsförening, bostadsrättsförening)

- ◯ Ja
- ◯ Nej

7. Vad för någon förening är du engagerad i idag? (tex barns fotbollsförening, bostadsrättsförening)

Energikunskap

8. Hur pass insatt är du i din elförbrukning i generella termer (t.ex. när du använder som mest el och vad för energikälla)? (1 inte alls, 5 väldigt)

1	2	3	4	5

inte alls väldigt

9. Vad är din elförbrukning per månad?

- ◯ <150 kWh
- ◯ 150 - 450 kWh
- ◯ 450 - 800 kWh
- ◯ 800 - 1600 kWh
- ◯ > 1600 kWh
- ◯ Vet ej

10. Är du ansvarig för energifrågor i ditt hushåll?

- ◯ Ja
- ◯ Nej

11. Tycker du att du är insatt i solenergi på ett generellt och övergripande sätt? (1 inte alls, 5 väldigt)

1	2	3	4	5

inte alls väldigt

12. Tycker du att du har en tekniska förståelse av solenergi? (1 inte alls, 5 väldigt)

1	2	3	4	5

inte alls väldigt

13. Hur pass interesserad är du av energifrågor? (1 inte alls, 5 väldigt)

1	2	3	4	5

14. Hur pass interesserad är du av miljö och hållbarhet? (1 inte alls, 5 väldigt)

1	2	3	4	5

15. Har du/äger du solpaneler idag?

- ◯ Ja
- ◯ Nej

16. Var har du installerade solpaneler idag?

- ◯ Jag äger enga solpaneler
- ◯ Jag har andel i solpaneler

Solenergigemenskaper

Solenergigemenskap är en form av kollektivt ägd solenergi där energi produceras av andra än traditionella energibolag. Kan även benämnas som solenergi-kooperativ. Det är en ekonomisk förening där medlemmar engagerar sig på grund av ekonomiska, miljömässiga eller social skäl. Det är ett sätt för privatpersoner som ej fysiskt kan installera egna solceller eller vill dela på kostnaderna att investera i solenergi.

Gemenskapen kan se ut på många olika sätt, i vissa köper du en andel för en summa och får avdrag på månadsfaktura, andra gemenskaper har valt årlig utdelning per andel, vissa väljer att återinvestera i nya solceller för att expandera produktion. Platsen för produktion varierar, i vissa fall hyrs plats av kommunen i andra fall på sker det på medlemmars tomt.

Denna enkät riktar sig mot solenergigemenskaper / solenergi-kooperativ, bostadsrätter som har solpaneler installerade är inte en solenergigemenskap.

17. Har du hört talas om solenergigemenskaper tidigare?

- ◯ Ja
- ◯ Nej

18. Är du medlem i en solenergigemenskap idag?

- ◯ Ja
- ◯ Nej

19. Har du fått erbjudanden om att gå med i en solenergigemenskap?

- ◯ Ja
- ◯ Nej

20. Till vilken grad håller du med om att följande är hinder till att du inte är medlem i en solenergigemenskap?

	håller starkt med	håller med	varken eller	håller inte med	håller starkt inte med
Jag har inte hört talas om det tidigare	◯	◯	◯	◯	◯
Jag vet för lite om vad det innebär	◯	◯	◯	◯	◯
Jag har inte blivit erbjuden chansen	◯	◯	◯	◯	◯
Jag har inte tid	◯	◯	◯	◯	◯
Jag har inte råd	◯	◯	◯	◯	◯
Jag saknar teknisk förståelse av solceller	◯	◯	◯	◯	◯
Jag vet ej hur jag hade gått tillväga för att bli medlem	◯	◯	◯	◯	◯
Jag har inget intresse av det	◯	◯	◯	◯	◯
Energimarknaden är komplex och jag har svårt att förstå solenergigemenskapers roll i den	◯	◯	◯	◯	◯

21. Hade du kunnat tänka dig att vara medlem i en solenergigemenskap?

◯ Ja

◯ Nej

◯ Kanske

22. Vad för förutsättningar hade du behövt för att kunna tänka dig att vara medlem i en solenergigemenskap?

23. Givet att dessa förutsättningar hade funnits, hade du då kunnat överväga att gå med i en solenergigemenskap?

◯ Ja

◯ Nej

24. Till vilken grad håller du med om följande anledningar till att vara medlem i en solenergi gemenskap?

	håller starkt med	håller med	varken eller	håller inte med	håller starkt inte med
att göra något bra för miljön	○	○	○	○	○
att bidra till energiomställningen	○	○	○	○	○
att bidra till säker och pålitlig energitillförsel	○	○	○	○	○
att bidra till det lokala samhället	○	○	○	○	○
teknikintresse	○	○	○	○	○
att göra något tillsammans med andra	○	○	○	○	○
att lära mig mer om solenergi	○	○	○	○	○
att minska beroendet av elnätet	○	○	○	○	○
att investera och tjäna pengar	○	○	○	○	○
att minska elkostnaderna	○	○	○	○	○

25. Vad hade motiverat dig till att bli medlem i en solenergigemenskap?

Ideal

Om du hade varit engagerad/velat engagerad dig i en solenergigemenskap, hur hade du velat att den skulle se ut då?

26. Vad tror du är viktigt för att en solenergigemenskap ska fungera väl?

	väldigt viktigt	ganska viktigt	varken viktigt eller oviktigt	ganska oviktigt	väldigt oviktigt
att medlemmar deltar aktivt i gemenskapens organisation	◯	◯	◯	◯	◯
att platsen där panelerna finns inte kan användas till något annat	◯	◯	◯	◯	◯
att anläggningen byggs eller underhålls av lokala företag	◯	◯	◯	◯	◯
att medlemmar bor nära varandra	◯	◯	◯	◯	◯
att medlemmar bor nära anläggningen	◯	◯	◯	◯	◯
att platsen har stark koppling till det lokala samhället	◯	◯	◯	◯	◯
att medlemar har liknande värderingar	◯	◯	◯	◯	◯
att det finns en känsla av social gemenskap	◯	◯	◯	◯	◯
att det finns anordnande aktiviteter för medlemmar	◯	◯	◯	◯	◯
att medlemmar umgås tillsammans och träffas	◯	◯	◯	◯	◯

27. På vilket sätt hade du kunnat tänka dig att engagera dig?

	Vid varje tillfälle	Ofta	Ibland	Aldrig
vara med i styrelse	◯	◯	◯	◯
genomföra andra formella uppgifter (driva projektgrupper etc)	◯	◯	◯	◯
närvara vid årsmöten	◯	◯	◯	◯
gå på studiebesök på solpanelsanläggningar	◯	◯	◯	◯
hjälpa till med installation eller underhåll av solpaneler	◯	◯	◯	◯
delta vid andra aktiviteter	◯	◯	◯	◯

28. Hur hade du resonerat kring ditt sociala deltagande? Vad hade begränsat eller motiverat det? (vara med i styrelse, sociala träffar etc)

29. Hur hade du velat bli ekonomiskt kompenserad för ditt medlemskap? (lägre pris på el, årligt avkastning etc)

30. Vilken ekonomisk modell hade du önskat av en solenergigemenskap?

	väldigt bra alternativ	ganska bra alternativ	varken bra eller dåligt	ganska dåligt alternativ	väldigt dåligt alternativ
att medlemmar kan köpa solel från solpanelerna för ett lägre pris än normala elpriser	◯	◯	◯	◯	◯
att vinster återinvesteras i nya solpaneler	◯	◯	◯	◯	◯
att medlemmar får en årlig avkastning	◯	◯	◯	◯	◯
att medlemmar får rabatt månadsvis på elfakturan	◯	◯	◯	◯	◯
att medlemmar kan köpa solel från solparken för ett någorlunda högre pris än normala elpriser	◯	◯	◯	◯	◯
att delar av avkastningen kommer till nytta för andra än gemenskapens medlemmar (lokala projekt, fond etc)	◯	◯	◯	◯	◯

31. Vilket sätt hade du föredragit att betala för solpaneler i en solenergigemenskap?

◯ betala en engångsavgift för en andel i anläggning, ca 1000 kr/andel

◯ abonnera på solpaneler för fast pris à 700 kr/panel med 5 års bindingstid

32. Hur hade du resonerat kring beslut och rösträtt i solenergigemenskapen?

	väldigt bra alternativ	ganska bra alternativ	varken dåligt eller bra	ganska dåligt alternativ	väldigt dåligt alternativ
en röst per medlem	◯	◯	◯	◯	◯
en röst per andel	◯	◯	◯	◯	◯

33. Vad hade du föredragit kring beslut och rösträtt i gemenskapen?

◯ en röst per medlem

◯ en röst per andel

Tack!

Stort tack för att du tog din tid och svarade på denna enkät!

34. Är det något du vill tillägga angående solenergigemenskaper?

35. Tycker du att solenergigemenskaper låter intressant och kan tänka dig att vara med på en intervju? Skriv din mail.

Appendix B - Operationalisation of the dimensions in the analytical framework for survey questions and focus group.

Table 3 Operationalisation of analytical framework

Focus		Focus session questions	Survey Questions	Response scale
Adopter behaviour				
		Open questions on adopter behaviour.		
Individual characteristics			Gender, Age, Education Housing, Free time engagement	
Motives			To what extent do you agree with the following reasons to become a member in a solar community? - to do something good for the environment - to contribute to the energy transition - to contribute to safe and reliable energy supply - to contribute to the local community technology interest - to do something together with others - to learn more about solar energy - to reduce dependence on the electricity grid - to invest and earn money - to reduce electricity costs	Strongly agree, agree, neutral, disagree, strongly disagree
			What would have motivated you to become a member in a solar community?	Free text
Norms and values			To what extent do you agree that the following acts as barrier for you to become a member in a solar community? - I have no interest	
			How interested you in the following? - Energy questions	1 (not at all) – 5 (very)

			- The environmental and sustainability	
			Would you consider becoming a member of solar community?	Yes - No
Adopter resources				
		Open questions on adopter resources.		
Knowledge & experience			To what extent do you agree that the following acts as barrier for you to become a member in a solar community? - I haven't heard of it before - I know too little about what that means - I lack technical understanding of solar cells	Strongly agree, agree, neutral, disagree, strongly disagree
			What preconditions would you need to consider becoming a member in a solar community?	Free text
			How familiar are you with the following aspects? -Your electricity consumption in general terms? -Solar energy in general terms? -Technical understanding of solar energy?	1 (not at all) – 5 (very)
			Are you responsible for energy question in your household?	Yes - No
			Do you own solar panels today?	Yes - No
			Have you heard about solar communities before?	Yes - No
Time availability			To what extent do you agree that the following acts as barrier for you to become a member in a solar community? - I do not have time	Strongly agree, agree, neutral, disagree, strongly disagree

Financial resources			To what extent do you agree that the following acts as barrier for you becoming a member in a solar community? - I cannot afford it	Strongly agree, agree, neutral, disagree, strongly disagree
System dimension				
		Open questions on system dimension.		
Market structure and institutions			To what extent do you agree that the following acts as barrier for you to become a member in a solar community? - The energy market is complex and I find it difficult to understand the role of solar communities in it	Strongly agree, agree, neutral, disagree, strongly disagree
Interaction			To what extent do you agree that the following acts as barrier for you to become a member in a solar community? - I have not been offered the chance -I don't know how I would have gone about becoming a member	Strongly agree, agree, neutral, disagree, strongly disagree
			Have your heard about solar communities before? (Also knowledge & experience)	Yes - No
			Have you been offered the chance to join a solar community?	Yes - No
Ideal set-up				
		Open questions concerning ideal set-up dimension and **how** these were affected by different drivers and challenges.		

Process			What do you consider important for a solar community to function well? - That members participate actively in the organization of the community	Very important, important, neither, unimportant, very unimportant
			In what ways would you consider being involved? - Be a member of the board - Carry out other formal tasks (run project groups, etc.) - Attend annual meetings	Every time, sometimes, often ,never
Outcome				
	Motives		See motives	
	Economic model		What economic model would you want in a solar community? - That members can buy solar electricity from the solar panels at a lower price than normal electricity prices - That profits are reinvested in new solar panels - That members receive an annual return - That members receive a monthly discount on the electricity bill - That members can purchase solar electricity from the solar park at a somewhat higher price than regular electricity prices - That some of the returns benefit others besides the community members (local projects, funds, etc	Very good alterative, good alternative, neither, bad alternative, very bad alternative

			How would you want to be economically compensated for your membership?	Free text
Place			What do you consider important for a solar community to function well? -that members live close to each other -that members live near the facility -that the place has a strong connection to the local community -that the place where the panels are located cannot be used for anything else - that the facility is built or maintained by local companies	Very important, important, neither, unimportant, very unimportant
Interest			What do you consider important for a solar community to function well? -that members have similar values	Very important, important, neither, unimportant, very unimportant
Organisation				
	Investment		What way would you prefer to pay for solar panels in a solar community?	Per share, subscription
	Decision-making		How would you reason about voting rights and decision-making in a solar community? - One vote per member - One vote per share	Very good alterative, good alternative, neither, bad alternative, very bad alternative
			What would you prefer concerning voting rights and decision-making?	One vote per member, one vote per share.
Social participation			What do you consider important for a solar community to function well?	Very important, important, neither,

			- that there is a sense of social community - that there are organized activities for members - that members socialize together and meet	unimportant, very unimportant
			How would you reason about your social participation?	Free text
			In what ways would you consider being involved? - Go on study visits to solar panel installations - Assist with the installation or maintenance of solar panels - Participate in other activities	Every time, sometimes, often ,never

Appendix C - List of Facebook groups

- Vad händer i Frölunda
- Vi som bor I Hisings-Kärra
- Jonsered
- Fearless women – Ekonomi för barnfamiljen
- Privatekonomi
- Vardagsekonomi
- Grön omstart
- Kollaborativ Ekonomi Sverige (KES)
- Ekobyar – hållbara byar och communities

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