How Much is Enough?:
Redistributive *Power* for a Just Energy Transition

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Abstract

One vision for the energy transition emphasises the importance of the wider democratisation and distribution of energy provisioning, grounded in large-scale energy demand reduction and greater engagement of civil society in the organisation, operation, and ownership of the energy system. In such a vision, energy communities hold potentional to intervene in the nature, dynamics, and distribution of power. Relating both to the discursive, political and social power of citizens within a society, as well as the energetic, electrical power contextualised by a global supply chain of biophysical resources to meet energy needs. An energy transition grounded in such local initaitives represents a redistribution of both these aspects of power. Nested within this potential for redistribution emphasises the potential for a bottom-up energy transition, characterised by a flourishing network of energy communities, to contribute towards energy justice and a just energy transition. Indeed, there are many seeming ovelaps between the conceptual basis of just transitions and local energy communities, however identifying strategies that can be adopted by local initiatives to support energy justice is a persisting challenge. Steered by the overarching question: how can community energy initiatives understand, actively reflect on, and engage with their contributions towards distributive energy justice? The research aims to support practitioners working within the energy community ecosystem to engage with contributions to energy justice. Guided a conceptual framework of distributive energy justice grounded in an attention towards capabilities, intesectionality, and spatiality. The framework is applied within three empirical case studies of energy commnunities located in the Netherlands, Sweden and the United Kingodm. Based on extensive and in-depth interviews with stakeholders within the energy community ecosystem, the research arrives at a question matrix designed to support local intiaitives in their active reflection and engagement with distributive energy justice. In doing so, the research arrives at an approach that builds on current scientific and academic understandings of needs, power, and multiple geographies within the energy system. Moreover, the dashboard tool seeks to facilitate practioners to ask critical questions of the various impacts that energy communities can have across environmental, economic, social, and technical impact categories.

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Preface

Over the past several years the question 'how much is enough' has become a dearly held question. It has embedded itself into the lens with which I see, interpret, and engage with the world. Serving as an invitation to consider limits across a multitude of contexts: personal and professional, intimate and intellectual, macro and micro. I see it as a deeply ontological question, grounded in an experiential and existential exploration of boundaries of being, and in this way the concept of enough can take systemic effects.

Applying the concept of enough in the present context has been invariably tested. From personal challenges, establishing a work-life balance with appropriate boundaries; academic reflexivity, when intellectual wanderings can be encouraged, and when it is time to say 'enough is enough' recognising the need to focus and 'kill ones darlings'; as well as the scaffolding the understanding of justice, how much and what kind of empowerment of is needed. At the heart of it, the concept of enough is entangled with the notion of sufficiency. While the idea of sufficiency, for many, represents calls for a repressive or regressive regime of some autocracy imposing limits to freedom. Personally, asking how much is enough becomes an invitation to test the imagination. To be creative with how we establish thriving and flourishing lives, while respecting ecological limits. This requires a critical re-evaluation of what humans, collectively, perceive as successful lives, what level of dignity, for all living life, is truly sufficient. The question of how much is enough forces us to consider difficult questions: What set of rights of nature are enough? How much collective energy consumption is too much? What level of socio-economic inequality is too much?

The dynamic nature of the question has both intrinsic and instrumental value. The moment taken to 'simply' consider what enough is, in whichever context being applied, provides an opportunity to (re-)imagine the needs that are trying to be met, and what the thresholds of necessity and sufficiency are. Taking such a moment need not arrive at a specific answer, hence the intrinsic value. It is, simultaneously, a question with instrumental value. For instance, the relationship between energy consumption, greenhouse gas emissions, and climate system functioning means that there emerge very real limits for how much energy demand is too much. This is deeply context dependent, based on the particular energy system in place. But nonetheless leads to more concrete questions regarding the provisioning of affordable low-carbon energy.

Two themes that have emerged within the course of the research, of particular pertinence to the question how much is enough, relate to the role of power and responsibility, and the interaction between the two. Who has power, what does this currently look like, and what could it look like. How does responsibility manifest from the perception of power that an actor holds, what does taking responsibility look like? Indeed, how are we to establish societal structures in which power (both in terms of physical energy and discursive, political, social) are equitably distributed? What is enough power to hold, and how can power be shared? These questions have become nested within the understanding of justice here, and while the question of enough is often implicit, it is remains a valuable seed to sow for future conversations and reflections about a justice and transitions.

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Chapter 1 Introduction

1.1 Energy Transition and the role of Community Energy

The transition to decarbonise global energy supply away from fossil fuels towards electrification and renewable energy has gained increasing momentum, and is argued to only continue (IEA 2023; Meldrum 2023). However, there are multiple visions for what an energy transition can actually look like (Barton et al. 2018; IEA 2022). Concerns with a particular discourse in which a transition towards a decarbonised energy system is vulnerable to tunnel visioning whereby climate change, and broader ecological breakdown, is framed as a technical problem that can be tackled with technical solutions (Stein 2023; Stokes 2021). The risk of this is that underlying societal structures, hierarchies and histories, contributing to inequalities and injustices, are ignored amidst urgent calls of 'crisis' (Hitchcock Auicello 2019; Powys Whyte 2021). This involves the large-scale energy production and distribution, owned and controlled by publically traded companies motivated by delivering greater investor returns. A consequence of which is that the economic benefits emerging from the provision of energy are concentrated to a small proportion of wealthy individuals (Stahel 2020). The wealth extraction that this represents from the local communities that these systems directly serve create imbalances of power between those who benefit financially through ownership and control, and those who depend on the particular systems to deliver their basic needs. In practice, this affects the lived experience of households, especially those who are detrimentally impacted by socio-economic inequalities, through unequal access and affordability to low-carbon technologies and energy sources, vulnerability to price shocks, and experiences of energy burden and poverty (Carley & Konisky 2020; Guan et al. 2023; Lamb et al. 2020).

An alternative vision to this, such as the 'Thousand Flowers pathway', represents the wider democratisation and distribution of energy provisioning, grounded in large-scale energy demand reduction and greater engagement of civil society in the organisation and operation of the energy system (Barton et al. 2018; Johnson & Hall 2014). Supporters for a localised energy transition highlight the power of crowding in the real, community economy, ensuring that benefits are delivered locally, to stakeholders and residents, rather than extracted through processes of financialisation and rentiership (Bentley et al. 2021; CLES 2020; Sayer 2020). With a thriving garden depending on healthy, nutrient-rich, and biodiverse soils, the Thousand Flowers pathway highlights the role of an engaged citizenary, actively participating in initiatives whereby local energy production serves the needs of local demand (Barton et al. 2015). Within this vision, local energy communities and initiatives, owned and controlled by citizens and public insitutions particularly prevalent.

Increasing attention has been given to the role that energy communities could play within a civil society led energy tranisiton. This has extended across a range of issues, including the various technical, economic, and social barriers, and what can be done to overcome them (Bauwens et al 2016, Gui & MacGill 2017; Kooij et al. 2018); attitudes and impacts of participatory processes (Chilvers & Longhurst 2016; Velasco-Herrejon & Bauwens 2020); their sources of finance and institutional logics (Bauwens et al. 2022; Casalicchio et al 2022; Hall et al 2016); as well as a systems engineering perspective and the effects of distributed or decentralised energy resources (Hansen & Barnes 2021). Attention has also been given to evaluating the impacts of energy communities across the stakeholders involved (Berka & Creamer 2018; Bianco et al 2021; Tarhan 2015). This finds specific overlap with research on multiple-value retention within communities, as well as the contribution energy communities can have towards a just energy transition.

A core theme for both energy communities and energy justice relates to the nature, dynamics, and distributions of power within transitions. In the present context, this relates both to the discursive, political

and social power of citizens within a society: the power held by individuals to exert their will and as well as the power imbued within social systems, structures and hierarchies (Avelino & Rotmans 2009). As well as the energetic, electrical power contextualised by a global supply chain of biophysical resources to meet energy needs (Barton et al. 2015). An energy transition grounded in local initaitives represents a redistribution of both these aspects of power (Fuchs et al. 2021; Hansen & Barnes 2021). Following such redistribution of power, there is emphasis that this can contribute to achieving energy justice, charaterised by processes in which benefits and burdens distributed equitably; active participation engages a range of stakeholders; and the autonomy, rights and dignity of those stakeholders is upheld (Carley & Konisky 2020; McCallum et al. 2022; McCauley & Heffron 2018).

1.2 Problem definition and knowledge gap

Existing research has sought to examine equity implications of an energy transition driven from the bottom up by civil society and decentralised community energy groups (Johnson & Hall 2016). This has included work applying energy justice frameworks to energy communities to assess how impacts contribute to just processes and outcomes (Hanke et al. 2021; Lacey-Barnacle et al. 2023). This research points towards a positive contribution that a grassroots energy transition can have for establishing just processes and outcomes. One issue has been that evidencing the nature of the impacts of energy communities and how they are distributed remains challenging. Further, there are significant gaps translating the conceptual work relating to energy justice into useable knowledge for the benefit of local communities themselves. The present research will focus on the latter issue, highlighting that amidst the wide range of growing literature of energy justice, intergrating theoretical insights for direct use for practictioners within community energy intiatives has been limited.

The problem here is that while local community initiatives may be doing important work contributing to a bottom-up energy transition, there are not currently the practical tools to actively engage with the ways in which they contribute to just transitions. Indeed, while there may be ovelaps between the conceptual basis of just transitions and local energy communities, identifying strategies that can be adopted by local initiatives to support energy justice is a persisting challenge. For instnace, while there may be some tools for policy makers to assess the equity implications of energy policy, these are often not applicable or practical for use in local initaitives and energy communities (EEP 2022; Sovacool & Dworkin 2015). As such, knowledge gaps exists within communities to understand how their organisation and operations contributes to redistributing power, both for citizens as well as energy resources. With the subsequent risk that structural inequalities will be inherited and reproduced at the local level.

1.3 Research aim, questions, and framework

In light of this, the aim of this research is to arrive at a conceptual and analytical toolbox that can support practitioners working within the energy community ecosystem to engage with distributive energy justice. Practically, this means working towards a dashboard of critical and reflexive questions regarding the contribution of energy communities to a just energy transition. In so doing, this research will enrich existing literature regarding distributive energy justice by undertaking an exploratory research project into the nature of benefit distribution within energy communities.

To do this, the research will be guided by the following, overarching question: **how can community energy initiatives understand, actively reflect on and engage with their contributions towards distributive energy justice?** To answer this question, several sub-questions have been formulated, providing guidance to the multiple stages of the research process:

1. What are community energy initiatives and what are the main impacts associated with them?
    a. What are the core activities engaged with by energy communities?
    b. What are the different kinds of benefits and burdens associated with initiatives?
    c. What mechanisms are associated with the distribution of these benefits?
2. How can the concept of distributive energy justice be applied to the context of energy communities?
    a. How can distributive energy justice be conceptualised?
    b. How can this conceptualisation be applied to the context of community?
3. How can expressions of benefit and burden distribution and justice concepts support reflection and discussion regarding energy justice within energy communities?
    a. How do stakeholders within energy communities perceive benefits?
    b. What are the experiences of how these benefits and burdens are distributed?
    c. What do experiences of benefit and burden distributions reveal about energy justice within energy communities?

The structure of the report will be as follows, the first substanative section will present a literature review, laying the theoretical and conceptual foundations for the subsequent empirical research. Answering the first research question will include an overview of energy communities as they are currently understood; elaborating on the form of organisation and operational functions they are involved in. Having done so, the literature of their impacts will be reviewed presenting the associated benefits and burdens, in order to outline the various mechanisms which enable distribution of those impacts. This will serve as the first conceptual pillar upon which the analysis of case studies based. The second research question will introduce the concept of energy justice, the second pillar. Outlining a relevant landscape for the reader to engage with core issues of distributive justice broadly, as well as specific issues of distributive energy injustice specifically. Further nuance will be established by a conceptual and analytic framework grounded in three concepts of pertinent to distributive energy justice: capability, intersectionality, and spatiality. The output here, a table of questions associated with each of the core concepts, will serve as the analytic foundation for the empirical research. The subsequent empirical analysis, along with answering the final sub-question, will culminate in a dashboard of questions serving as a tool for discussion and active reflection within community energy groups. The research strategy and framework is illustrated in Figure 1.

1.4 Scientific and social relevance

Energy communities are examples of systemic interventions to meet basic needs through alternative constellations of energy resources. They are embedded within a scientific field examining the socio-technical transitions required to meet human needs within planetary boundaries (O'Neill et al. 2018). Moreover, they represent socio-cultural interventions of bottom-up processes to support the the empowerment, resilience and regneration of local communities to support a just energy transition (Acosta et al. 2018; Eder 2021). Within these fields, this exploratory research will arrive at a meaningful tool, in the form of a question dashboard, that can both be built on in future research as well as implemented in practice within energy communities. The theoretical contributions of the research relate to bringing together core concepts within the field of energy justice, and testing their application within empirical research. Engaging with stakeholders to map, specify and detail the multiple impacts of energy communities and their distributions will support understanding of self-percieved roles and responsibilities. This creates a usable tool for future researchers that can test causality between the

impacts of energy communities and the outcomes in terms of distributive energy justice that is sensitive to needs, power, and geography. Additionally, theoretical steps are taken to apply an expanded understanding of the capabilities approach that emphaises relevance of individual and collective needs for the processes and outcomes of disitributive energy justice.

Social relevance and value is generated in both the research process itself and the outcome, as well as situated within larger, strucutral social changes and local level affects for community initatives. By holding interviews with stakeholders within the energy community ecosystem engaging with themes of impacts, distributions, and justice concepts, the process will begin to sow the seeds of reflexive reflection of contributions towards a just energy transition. More substantially, the delivery of a usable dashboard to support active reflection and engagement of justice within energy communities. Translating scientific research into practical knowledge which aims to facilitate processes within local civil society initatives. Additiaonlly, the social relevance of the research is related to the choice of title for the report. The concept of enough, tacitly understood to relate to limits, sufficiency and needs, and exists as an underlying theme of the research (Jackson 2017; Skidelsky & Skidelsky 2013). Navigating the structural transformation of the energy system that meets energy needs while respecting environmental limits and boundaries requires a reconfiguration of what it means to have enough or particular resource or service to meet those needs (Fuchs et al. 2021). While this is not a question possible to be answered presently, what can be done, and would provide value to do, is bring questions of sufficiency and limits into the realm of energy communities. This relates to considering the implicit boundaries of responsibility of citizen initiatives and their members, perceptions of necessary or optimal scale of community owned RES, or the extent of empowerment of groups and citizens that would mark significant improvement to distribution of discursive power. The question *how much is enough,* then, aims to signal and embed the question of sufficiency, limits and needs within the framing of power distribution. The social relevance includes the extent and expectations of responsibility to do so.

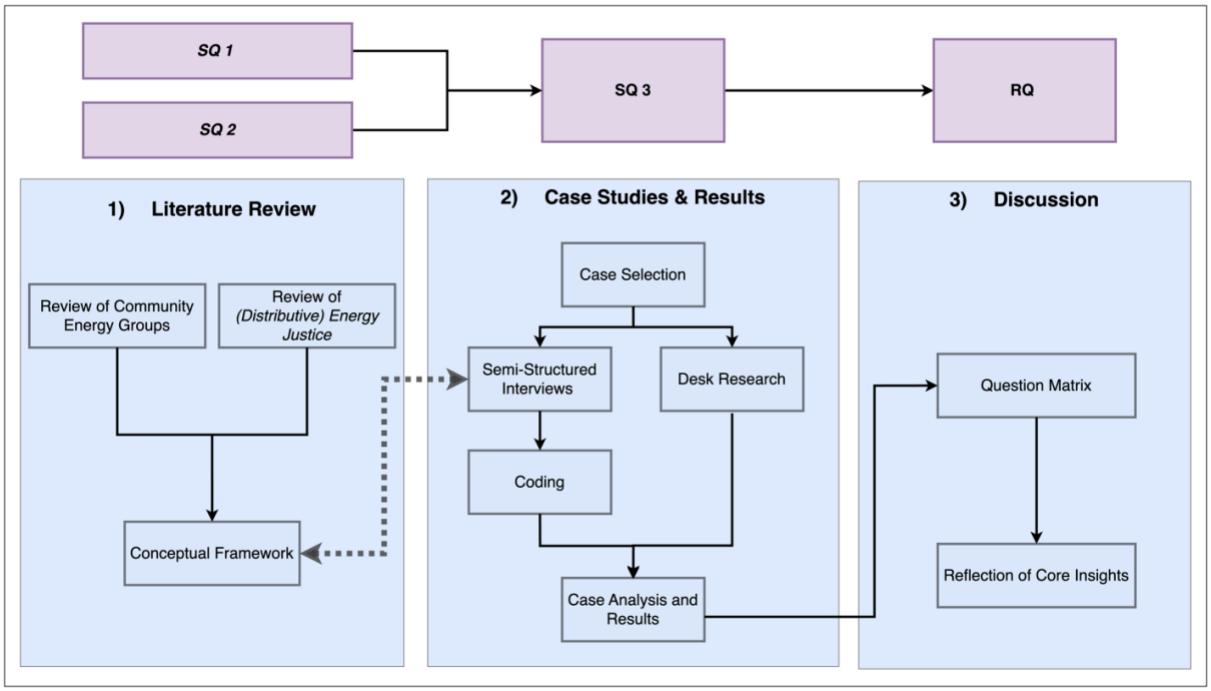

Figure 1 Research Framework

1.5 Positionality and Blind Spots

A short note here is needed to recognise the inherent positionality of the research(er) as well as identify the subsequent blind spots that will limit the research. A significant theme that runs through this research relates to the role of power within transitions. Within the academic institutional context, I am situated at an intersection of multiple privileges as an English native speaker, male, white, highly-educated, amongst other power holding attributes (Bell et al. 2020; Kajser & Kronsell 2014). The relevance of this in the present research is that these aspects of identity shape how I see and engage with the world around me; it becomes crucial to name what these are, to subsequently understand how they function, in order to begin glimpsing the world from a more reflexive place. While it is possible to draw on literature, read and listen deeply to more marginalised perspectives, the position of power that I occupy makes it possible to ignore, consciously or subconsciously, the sets of values, opinions, and worldviews that confront or disrupt my own set of power and privilege. In essence, this is both an epistemic and ontological problem, how we be in the world is affected by the power we occupy within a particular context, which in turn impacts what sources of knowledge are drawn on. The subsequent methodological implication is that the way in which research is conducted is intricately inter-related to the existing power structures that weave together social life. One challenge of this is the understanding of discursive power in its current formulation, such that individuals are imbued with some power, political, social, economic, or otherwise, and that asymmetries are problems of distribution. This framing of power as an issue of allocation misses the role of power as socially constructed and exerted onto individuals.

Chapter 2 Literature Review, Theories and Concepts

This chapter will first provide an overview of community energy groups, outlining core organisational forms as well as common operational functions that initiatives engage in. Introducing these initially will provide the reader with a baseline understanding of the community energy ecosystem, and in so doing answer research question 1a, *what are the core activies engaged with by energy communities?* Subsequently, the literature of core benefits and burdens that emerge as well as the nature of their distribution will be reviewed. This will lay the conceptual foundations for analysising the case studies later, highlighting core kinds of impact categories, the potential mechanisms for distribution, and the business models associated. Finally, the conceptual foundations of distributive energy justice will be established. Working towards a framework that will be applied in practice within energy communities.

2.1 Energy Communities Background

Community energy initiatives come in multiple kinds of constellations, broadly emphasising empowerment of local citizens through active engagement in local energy production (Caramizaru & Uihlein 2020; Chilvers & Longhurst 2016). The operational functioning of energy communities are varied, ranging from community scale energy, virtual power plants, peer-to-peer trading, and microgrids (Klaassen & van der Laan 2019; van Summeren 2022; Warneryd & Håkansson 2020). Alongside this variation, what distinguishes energy communities as innovative energy system interventions are the kinds of organisational forms adopted, such as co-operatives, trusts, foundations, and limited companies (Caramizaru & Uihlein 2020; Tarpani et al. 2022). Indeed, Roberts et al. (2019, 11) emphasise that, "energy communities are a specific way to organise an activity - nor the activity itself." What becomes noticeable, then, is that such local initiatives involve intervening on technical features of the energy system, as well as innovation of social and economic organisation.

There is a rich literature of socio-technical systems and their respective transitions detailing the relationships between the "technical components of the energy system, the individual actors and organisations, legal frameworks and institutional and political structures" (van der Grijp et al. 2019). The aim of this research, examining how energy communities contribute towards distributive justice, does not require an in depth examination of the socio-technical systems literature itself, however, it is worth highlighting that much of the literature on energy community draws on these conceptual and analytical frameworks to understand and characterise energy communities. For instance, the strategies of scaling up energy communities (Bauwens et al. 2020), the process of establishing generation technologies (Gjorgievski et al. 2021); the flexibility services that could be offered by energy communities (Klaassen & der Laan 2019); or establishing local micro-grids and peer-to-peer services (van Summeren 2022; Tushar et al. 2021). The relevance of this for the present project is to appreciate the energy system, and its subsequent transition, as an assemblage of intersecting social, political, economic systems situated within a broader set of planetary and ecological systems (Fanning et al. 2020; O'Neill et al. 2018). The implication being that local energy initiatives will operate within and acros multiple kinds systems and societal structures, requiring attention for analysis of the subsequent impacts and distribtuions thereof.

Organisational Form

Multiple research projects and synthesis reports have emerged in recent years providing systematic overviews of energy communities within Europe (Bauwens et al. 2022; Compile 2019; European Commission, 2023). These have ranged from establishing common understanding of how to define energy communities (Caramizaru & Uihlein 2020; van der Grijp et al. 2019; Roberts et al. 2019), barriers and facilitating conditions for scaling up (Bauwens et al. 2020, 2022; Palm et al. 2022), as well as overviews of

business models adopted (Neumann & Tuerk 2022; Kubli & Puranik 2023; Reis et al. 2021). Two European frameworks define the legal forms of 'Renewable Energy Communities' (REC)s and 'Citizen Energy Communities' (CECs) (Directive 2019/944; Renewable Energy Directive 2018/2001). Characterised by principles around governance, ownership and control, and purpose. In terms of governance and ownership, both emphasise the importance of collective, community ownership of the organisations' activities, such that open and voluntary participation gives members or shareholders effective control. This can be thought of as an appeal towards democratisation of the energy system, whereby citizens have an active role within decision making. Moreover, the purpose of both RECs and CECs are to be operated for broadly non-commercial aims, namely, "to provide environmental, economic, or social community benefits for its shareholders or members or the local areas where it operates, rather than financial profits" (Directive II 2018/2001, Article 2(16)c).

RECs can be considered a subset of CECs in that the former have several more stringent requirements relating to geography, activities, and participants (Caramizaru & Uihlen 2020; Roberts et al 2019). For instance, the condition that members should be "located in the proximity [emphasis added] of the renewable energy projects that are owned and operated by that legal entity [the REC]" (Directive 2018/2001, Article 2(16)a). CECs, on the other hand, do not have a defined boundary, with activies operating across a range of scales at neighbourhood, village, town, or city level. This has led to a differentiation between a 'community of place' and a 'communtiy of interest'. The former is understood as a community in which a defined geography demarcates its operations, while the latter may operate across multiple geographies and is unified, instead, by a strong degree of common purpose (Bauwens et al. 2022). Additionally, CECs have stricter conditions for the kind participants with effective control. Such that RECs allow both small and medium sized entities (SMEs), companies and organisations, to participate and take partial effective control in decision making, CECs exclude Medium-sized entities (Caramizaru & Uihlen 2020). While the directives offer definitions for RECs and CECs, there are multiple forms these can take, with various legal structures that depending on national context.

In a systematic meta-analysis of energy communities across Europe, Wierling et al. (2023) identify over 1000 citizen-led local initiatives across 29 countries. They emphasise the high degree of participation of members within decision making processes, for instance, the common adoption of the 'one member - one vote principle' (OMOV principle), characteristic of cooperatives. In the review, they identify a diverse landscape of legal forms that energy communities adopt across countries. For instance, in Sweden, these could be 'Ekonomisk förening' ('Economic Association') or 'Samfällighetsförening' (joint-ownership association); in the UK 'cooperatives, 'community benefit society' or 'community interest company'; and in the Netherlands a 'Coöperatie' ('cooperative'), 'verenigning' ('association'), or 'Stichting' ('foundation/trust'), amongst others. While the OMOV principle might often be adopted, symbolising a high degree of participation, in practice the actual level of involvement of members can vary greatly, depending on size, scale, and proximity members have to the outcome of the decision. The range of legal forms that energy communities may adopt have varying voting principles. For instance, limited partnerships enable alternative distributions of both responsibilities and profits, giving larger shareholders more weighting within decision making. Community trust and foundations, meanwhile, have a greater mandate to generate wider societal benefits for the community, beyond individual members. Housing associations can deliver benefits to residents even if they are not directly involved in decision making, tackling fuel poverty or energy burden directly since, by nature of the association, they are often serving in low-income or vulnerable social groups (Caramizaru & Uihlein 2020; Roberts et al. 2019; Tarpani et al. 2022). Along with various legal forms, energy communities have multiple options regarding the business models adopted, these will be returned to in subsequent sections examining the ways in which communities can distribute their benefits and costs.

Operational Function

The literature regarding energy communities highlights several different activities that are currently undertaken by citizens to participate more directly in the energy system. Often these relate to the collective co-ownership of generation technologies, ie wind turbines or solar panels, the sharing of this locally produced electricity facilitated through Peer-to-Peer (P2P) electricity trading, energy services and advice, or system operation, such as flexibility services (Kubli & Puranik 2023; Neumann & Tuerk 2022; Reis et al. 2021). Indeed, the Renewable Energy Directive, aims to "ensure that renewable energy communities are entitled to: a) produce, consume, store and sell renewable energy… b) share, within the renewable energy community…that is produced by the production units owned by that renewable energy community… c) access all suitable energy markets…" (Directive 2018/2001, Article 22(2)). Other less common activities relate to collective energy storage and mobility services (CEE et al. 2022; Compile 2021). Caramizaru & Uihlein (2020, 13) highlight that across a set of 24 European case studies of energy communities, the most common activity engage is energy generation, followed by supply, energy efficiency, distribution, then mobility services; With less common activities including consumption & sharing, flexibility and storage, and financial services. They differentiate between generation in which the energy is produced and sold to an energy supplier, supply activities in which the community is responsible for the (re)sale of the electricity, and consumption and sharing whereby the energy produced is self-consumed within the community itself (Caramizaru & Uihelin 2020, 12).

Energy Services and Advice

The easiest activities that energy communities can engage with is advice. These can include energy efficiency advice and home interventions that can also be targeted towards more vulnerable households, unable to invest in generation technologies, who are more likely to live in less energy efficient houses (End Fuel Poverty Coalition 2022; Jones et al. 2022). For example, South East London Community Energy (SELCE) offers a whole range of energy advice sessions and workshops supporting social groups most at risk from energy burden (SELCE 2023). Alongside support for individual households, there are also larger scale services targeting higher level interventions for communities themselves. For instance, the Dutch network organisation, Energie Samen, provides a range financial support for projects of various sizes, from €30,000 up to €10Mn, through a Realisation Loan or the Large Projects Credit. Members can also gain support regarding funding for feasibility studies or technical expertise regarding grid connections, through a bank of resources, the Energie Samen Academie, where insight and knowledge is shared relevant to multiple phases of establishing an energy community project (Energy Samen, 2023).

Generation aggregation and collective ownership

The REScoop compile project (2019-2023) aimed 'to show the opportunities of energy islands for decarbonisation of energy supply, community building and creating environmental and socioeconomic benefits' (Compile, 2020). When reporting on various best practices from across Europe, they emphasise the popularity of energy communities focused on energy production, ranging from wind, hydro, solar, biomass and geothermal energy production (Compile, 2021). Broadly, this relates to investments from citizen members to establish collective ownership of renewable generation technology. Due to the current legislation, it becomes most convenient for the produced energy to be sold to the central grid, generating a revenue stream that is then paid back to investing members. A limitation here is the control the community has to distribute the physical energy generated by their infrastructures. Depending on national contexts, it becomes markedly expensive and legally challenging to become an energy supplier.

Shared supply and Peer-2-Peer

Once the system of renewable generation is well established, some communities can take steps to become energy suppliers. Doing so creates greater autonomy within the system, retaining value within the energy

community through direct energy cost savings, with payments to private energy companies avoided and instead a cost price can be paid by members. Klaassen & van der Laan (2019, 8) highlight that "Cutting out the role of the traditional Supplier as middleman would likely reduce the costs for energy supply but would also require the community to take on the role of the Supplier. The community would then need to manage its expected surplus or deficit in energy production / consumption e.g. via a bilateral contract with a third market party (Supplier / BRP) or through wholesale market participation." In other words, becoming the supplier or sharer of energy increases the burden for the energy community: the legal and technical expertise required to navigate existing electricity markets is not simple. Nonetheless, there is appetite for this to be made more accessible, for instance, the recent campaigns in the UK introduced the 'Local Electricity Bill' aiming to enable local initiatives to share electricity locally (Power for People 2023).

Aggregation and System Operation

Recently, there has been attention given to more complex roles that energy communities can adopt, such as facilitating demand side flexibility (Klaassen & van der Laan 2019; Neumann & Tuerk 2022). This relates to various functions in which the energy community functions as the energy service company or aggregator of member production (Klaassen & van der Laan 2019). This can include activities such as self-balancing by the community, aggregating prosumption in order to sell to the grid when electricity is more expensive making use of variable supply costs.

2.2 Benefits and their Distributions

2.2.1 Benefit Categories

Within the landscape of energy communities there exists a multiplicity of benefits emerging from their activities. These range from the economic and energy oriented benefits, such as energy price stability, cost savings, or return on investment, to environmental benefits such most notably emissions reductions from the transition away from fossil fuel to renewable energy sources (Reis et al. 2021). Moreover, preliminary research indicates that emissions reductions may be compounded by the energy demand reductions that has been observed when individuals become prosumers (REScoop 2018). Alongside these, are multiple social benefits emerging from the participation of citizens in decision making processes, these relate to trust building, social capital effects whereby local networks are strengthened (Berka & Creamer 2018; Kubli & Puranik 2023). The increasing attention being given to energy communities has included attempts to name, illustrate and evidence their various impacts. Tarhan (2015) provides an overview of four core categories of affects found from energy communities, economic impacts associated with coop ownership; social impacts and community empowerment; environmental and behavioural impacts; and contextual factors affecting co-ops' impacts. Gorgievski et al. (2021) include an additional focus on the technical impacts on the energy system. Berka & Cremer (2018) when taking stock of local impacts give attention to the knowledge sharing and skills development effects as separate from broader social impacts. This chapter will provide the conceptual understanding of the different kinds of benefits that have been found within community energy initiatives, and indicate the nature of their distributions, answering research questions 1b and 1c. This will culminate in an analytical understanding that will be operationalised in empirical cases.

Economic

Tarhan (2015) identifies two sets of economic impacts, those for the shareholding members who invested in the energy projects, and the broader local economic impacts. Revenue is most commonly generated from selling the produced energy to the grid. Interest is then paid back to investors, varying depending on the project and the priority of the community business model, with returns between 2% to 6% (Big Solar Coop 2023; Zeeuwind 2023b). The economic benefits of community energy groups primarily go to the initial

investing members, which, while logical, raises concerns about perpetuating wealth inequalities. Despite coops being open for participation, wealth distribution patterns in Europe suggest that only the wealthy can invest in financial assets (Balestra & Tonkin 2018; OECD 2021). This highlights the broader socio-economic context in which energy communities operate, shaped by historical wealth structures. While local initiatives promote inclusive finance, there's a need for reflexivity regarding existing wealth concentrations. Investors still need to be paid, but doing so at slightly slower rates could enable finance to flow into social benefit funds or projects. This does bnot deny the value retention within communities, afterall research into the small scale community wind farms in Iowa and Scotland found that five to thirty four times more economic value was retained locally compared to larger, commercially owned projects owned by more distant companies (Aquatera 2021; Galluzzo 2005; Tarhan 2015). In these projects, it is indicated that when ownership is collective, economic benefits are retained in multiple ways, from local employment as well as revenues and broader economic value retained in the local community.

Social

The second set of benefits relate to social impacts on the community, the various effects for trust, cohesion, and broader social capital. Emphasised here is the importance that "RE [renewable energy] co-ops, despite their democratic ownership and governance structure, do not automatically entail the generation of positive social outcomes. The nature of the *process* and *outcomes* of community-owned energy projects seem to be a significant determinant of their social impact" (Tarhan 2015, 111). This resonates with findings from Berka & Cremer (2018), highlighting that social capital functions both as an outcome as well as a precondition to local projects. Participation in decision making contributes to greater trust in the local community, simultaneously the successful realisation of these projects relies on existing levels of trust and cohesion. One issue is that the social benefits are deeply challenging to actually quantify (Gjorgievski et al. 2021; Wealth Economy 2019). Berka & Creamer (2018, 3413) note that 'literature is largely limited to anecdotal evidence on (intended) allocation of project revenues based on one-time interviews with local residents and project participants and cannot demonstrate links between CRE [*community-owned renewable energy*] and the character of local and regional development pathways in terms of employment, income and productivity, social inequality and living standards.' A core issue here is the validity that different methods have, and the kinds of evidence required to systematically show the benefits being delivered, along with their distributions. While various proxies for social impacts exist, like reducing energy or fuel poverty, these often struggle to capture more relational effects, such as network effects of trust building or knowledge flows. This seems to highlight the work required to recognise the plurality of social impacts emerging from energy communities, the limits of existing methods, and alternative sources of validation to recognise social experience, value and impact (Mihaiova et al. 2022; Sovacool et al. 2023). For instance, establishing consistent, reliable, and accurate quantitative methods for measuring the changing perceptions and behaviours of individual members. Alternatively there could also be space to recognise and represent the building of trust through contact with opinions and perspectives different from one's own (Bernstein et al. 2020; Meleady et al. 2020). When these aren't known, or possible to know quantitatively, Proka (2021, 4) emphasises that when considering the various social impacts it becomes important to ask two core questions: 'even when social impacts do manifest, we need to ask ourselves: who in the community benefits and who is left out?' as well as 'how can impacts be efficiently and equitably spread across the whole community?'

Environmental

There are a range of environmental benefits emerging when citizens organise collectively for the co-ownership of the energy system. Most obvious are the contributions towards decarbonisation, with the deployment of renewables contributing to the reduction of carbon dioxide, amongst other greenhouse gases, emitted in the process of energy generation, distribution, and consumption. Yet, while renewable

energy sources are often since as more sustainable by default, large differences in environmental impacts can be found within supply chains. For instance the role of embodied carbon within the production of energy generation technology varies significantly depending on the manufacturing countries' energy mix (Liu & van den Bergh 2020; Sovacool et al. 2019), as well as the type of materials used for the technologies (Morini et al. 2021; Müller et al 2021). With cheaper solar panels produced in countries, such as China or India, that have higher mixes of fossil fuel energy in their electricity mix, sourcing from these countries can support in establishing viable business models (IRENA 2020; Ritchie et al. 2022). Moreover, the challenge of opaque supply chains and limited reporting of systemic impacts across wider ecological and social impacts means that it becomes difficult to know the true extent of impacts, or provide legitimate alternatives. For instance, 45% of global polysilicon, a crucial material within solar panels, comes from the Uyghur Region in which forced labour camps underlie the supply chain (Murphy & Elimä 2021). As such, even for community energy initatives that aim to prioritise environmental and social impacts, with more limited resources the challenges of establishing a viable business case means that cheaper parts, componenets and materials are often preferred. An additional impact emerges from the changing proximity between electricity production and consumption. While the impacts of energy communities on consumption levels is currently understudied, initial results highlight that decreasing the physical distance between production and consumption, has a pyschological effect leading to greater consideration for energy demand, and subsequent reduced consumption (REScoop 2018; Sifakis 2019). With more research needed to assess the extent and robustness of impacts, it is a promising result in regards to the feedback between local energy supply and prosumption. Moreover, it provides policymakers additional diversity to energy strategy, beyond stalling efficiency gains, that could reduce projected doubling of global electricity demand (IRENA 2019; Pinto et al. 2023)

Technical

The technical benefits and barriers that emerge for energy communities can be understood in two forms, the physical and infrastructure challenges within energy system management, as well as institutional and legislative issues requiring technical expertise. For the former, this includes navigating self-consumption and self-sufficiency, load matching and electricity exports, while the latter relates to navigating the regulatory technicalities, such as taxation, legality of ownership of infrastructure, commodities, and services. At a system level, grid operators and distributors can benefit when communities are able to share their self-generated electricity balancing supply and demand locally. This presents an opportunity to avoid investing into large scale upgrades of existing national grid networks, both materially and capitally intense, and instead opting for localised energy networks (Rozite 2023). However, a transition towards a more decentralised energy system poses challenges such that with more stakeholders involved in local energy production, there is increased complexity to navigating surplus and scarcity in the grid (Hansen & Barnes 2021; SmartEN 2023). An additional set of techno-economic impacts are distinguished by Gjorgievski et al. (2021) as consumer-centric effects, such as energy bill savings and payback period, and investor-centric effects such as operation and cost savings, life cycle costs and net present values. To be sure, these effects overlap between the technical and the economic, however, since they are dependent upon the technical performance of the energy technologies, they have been placed in the more technically focused category. Additionally, energy communities are required to navigate multiple kinds of expertise and technical knowledge sets relating to the legislative, judicial, and administrative tasks. These are likely to manifest in the form of burdens upon local energy communities, struggling to navigate specialised knowledge.

Table 1. Benefits and Burdens within community energy initiatives

	Environmental	**Economic**	**Social**	**Technical**
Benefits	Greenhouse gas emission reduction Material footprint (+/-)	Revenue to community (payments to investors) Bill reduction Local employment Pay-back-period Social Benefit Fund	Skills building + Knowledge sharing Network and capacity Social capital and trust Energy security/independence	Local grid balancing/ stability National grid upgrades avoided Energy demand reduction Energy Efficiency gains
Burdens	Land-use change effects Embodied carbon effect Mining and extraction processes	Capital investment Subsidies Loans O&M	Social capital pre-required Stretched for time and energy	Costly capital infrastructure Legal barriers for collective ownership (Un)favourable tax rules

2.2.1 Distributions

The focus of the present research is to examine the nature of the distributions of benefits and burdens that emerge within energy communities, and explore the contributions towards energy justice. As such, it is important to have an understanding of the dynamics of distribution, identifying core actors involved, and how the roles and responsibilities of these actors may affect distributions. To be sure, while this does not mean establishing explanatory causality, there is an implication that particular kinds of distribution of benefits and burdens contributes to more or less just processes and outcomes. The intention here is to provide an overview of some dynamics affecting distribution between actors, which can be used in practice for practioners to reflect on how decisions made have impacts on who is impacted by the activities of the energy community. This section will provide an overview of the way that the business model have been innovated and adopted by local initiatives that in turn shape distributional effects before highlighting various core actors within the community energy ecosystem.

Business models

As mentioned, energy communities are not characterised by particularly profit driven motives, however, they nonetheless need to establish viable business cases. This means delivering some kind of economic return whereby investors benefit 'from cheaper energy supply, selling surplus generation or participation shares, or be self-consuming and thereby reducing their power grid dependency' (Reis et al. 2021, 6). Kubli and Puranik (2023) offer a typology of five key dimensions relevant for business models of energy communities: community value propositions; energy community members; key functions; energy value capture; network effects. In this framework, they identify multiple design options for each of the dimensions. For instance, in terms of community value proposition, they note options including, increasing self-consumption and grid reliability, reducing energy costs as well as reducing energy consumption. The value propositions proposed relate to tackling core needs within the energy system, while the network effects relate to the broader societal values, such as learning effects, peer effects and trust building. The energy value capture relates to the revenue stream, such as income from energy services, energy cost savings or community service fees (Kubli & Puranik 2023). These design options, especially the value proposition, offer insight into how benefits are to be distributed amongst community members. For instance, deciding to offer particular levels of return on investment can become a trade off to re-investing in new renewables

projects or offering alternative advice programs. What separates the business models of energy communities, compared to other commercial energy companies, is the level of involvement and participation of community members, "the whole business model must be created by, for and with them" (Reis et al. 2021, 5). Along with the value proposition and revenue streams for the communities in question, the Reis et al. (2015) note a competitive advantage that energy community business models have. Relating to, for instance, the energy autonomy and resilience of local energy supply, in terms of demand flexibility and price stability. They highlight that impacts on behaviour change, for instance the observed reduction in energy consumption for members of energy communities (Akadiadis et al. 2017; REScoop 2018), environmental awareness (Berka & Creamer 2018), and community building, cohesiveness and trust (CEE et al. 2022).

The various design options that local initaitves have for establishing business models for the longer term prosperity of groups allow a variety of environmental, economic, social, and technical impacts. Yet, the various design options for communities do not inherently lead to more equitable distribution of impacts. For instance, as highlighted within economic benefits, depending on the demographic of membership it is possible that those who are involved within energy communities are individuals belonging to power holding social groups, high income/wealth. The impact of this is that historic socio-economic inequalities are re-produced at the local level, whether for the economic benefits, with interest paid only to already members. Alternatively, this may be experienced in unequal distributions of social impacts, with the benefits of building trust and community cohesion, concentrated within only those who can afford to spend their leisure time involved in community groups, rather than working. Meanwhile, environmental inequalities within the supply chain may be reproduced, in part due to lack of transparency of the supply chain as well as the limited resources of the communities themselves. With cheaper solar panels and solar themal able to be sourced from China, for instance, there is a larger likelihood that fossil fuels have been used to manufacture the panels, or that environmental standards for mining are lower, or even that forced labour is involved (Liu & van den Bergh 2020; Murphy & Elimä 2021; Stamford & Azapagic 2018; Tschopp et al. 2020). That energy communities are nonetheless vulnerable to unequal distirbutions of impacts and subsequent injustices that may emerge, motivates understanding for which distributions are given attention. Additionally, there is relevance for understanding the relationships that are involved within the energy community ecosystem. This relates to the interactions between stakeholders, the power that is held, and how the nature of these relationships reveals possibilities alternative distributions to emerge by giving attention to need and vulnerability.

Stakeholders involved

A report examining the impacts of community energy initiatives for those most vulnerable to climate change within the UK gave particular attention to the process of deep listening to the needs of households from low-income areas for their energy needs (Samson 2018). Actively engaging with deep listening processes can build greater trust and understanding across categories of difference (Gram-Hanssen et al. 2021). Examining the impacts of community energy initiatives for those most vulnerable to the impacts of climate change within the UK, the report aimed to give space to the needs of households from low-income areas for their energy needs in order to build capacity, or pathways towards it. Identifying the critical stakeholders involved within the energy community, giving space for experiences to be voiced, and mapping out policy opportunities. Four critical stakeholders were identified: the community organisations themselves, local authorities, businesses and energy agencies. For the community organisations themselves several recommendations emerged regarding the ability to develop stories that speak into the lived experiences of the citizens in vulnerable or disadvantaged areas to recognise their needs and the issue that residents 'have bigger things to worry about', such as health, deprivation, housing standards. This also meant engaging with organisations with greater capacity as well as those more embedded within the local communities

themselves. Moreover, and crucial in terms of collective co-ownership are methods to support procurement of community energy assets. The implication for present purposes is to highlight the importance of building relationships within local residents in order to understand the particular needs and resources that ought to be better distributed.

The significance of working with local authorities was highlighted via the importance of institutional power and legitimacy that accompanies the local authorities; specifically, being able to bring multiple stakeholders together. Yet, local authorities, in the UK at least, are stretched already, showing a lack of interest and enthusiasm in community energy projects. As such, imbalances of power exist between the local initiatives and those in decision making positions. The effects of this uneven distributions means that local communities are often functioning within a governing or legislative system that does not adequately meet or respond to their needs. This can mean a lack of support in administrative tasks as well as identifying where community level finance is available. Poorly distributed resources for energy communities, makes it subsequently more difficult for initaitives to achieve the impacts that they could be capable of.

Finally, energy agencies were emphasised as critical stakeholders for supporting community energy initiatives and facilitating their professionalisation. Whether the support regards knowledge, advice and expertise, connection with and mediation between other stakeholders, or establishing further legitimacy and institutional power for the projects (Samson 2018, 10-11). For communities in low-income areas, partnerships with energy agencies are particularly powerful for access to finance. The report frames key needs within low-income energy communities in terms of capacity building. Whether this relates to funds to buy-in, community capacity, or knowledge, models and ideas, these are effectively the benefits that stakeholders - in particular the energy communities themselves - need to receive more of. These are the aspects of community energy that can support their activities, in turn enabling them to deliver their other benefits.

This sub-chapter has outlined the various kinds of benefits and burdens found within community energy initiatives, along with pointing towards the ways in which these are distributed, and who is actually impacted. To a large extent, local initatives can take solace in retaining any value created within their communities, to a greater degree than large-scale, commercial, and privately-owned and operated energy projects. Yet, supporting internal processes to actively reflection on contributions towards a just energy transition, it become pertinent for scholars and practioners to have a useable framework of distributive energy justice. The following chapter will outline the core conceptual foundation through which distributive energy justice is presently understood, culminating in a conceptual framework that will be applied in subsequent empirical analysis.

2.3 Distributive Energy Justice

The field of energy justice has emerged from work across a number of justice disciplines, from civil rights, labour, and gender equality movements, as well as the environmental justice movement (Heffron & McCauley 2018). Each of which brought attention to particular social dynamics, processes and functioning, questioning what should be considered acceptable within societies. Common amongst these has been a subversion of societal patterns, often relating to the exploitation and extraction of people and the planet, rooted in political-economic structures that systematically disadvantage particular social groups. For instance, the expectation that unpaid care work is to be fulfilled by women is nested within a broader mal-recognition of autonomy, rights and highly differentiated energy needs (Bell et al. 2020; Chen et al. 2022; Gonzalez 2021). The intention of this chapter is to provide the reader with an understanding of key energy

justice issues, how these relate to the energy transition, in turn presenting a conceptual framework (Figure 2) that will guide the analysis of the distribution of benefits within energy communities. Together, this will answer the second sub-question: *how can the concept of distributive energy justice be applied to the context of energy communities?* To do so, there will be a brief contextualisation of the tripartiate understanding of justice, along with a justification for the focus on distributive justice. Following this, three core concepts will be presented as core aspects of distributive energy justice undersood presently.

It is worth noting that the present purpose is not to offer a comprehensive account of the histories of justice theories, their emergence, nor contestations. Rather, the aim is to provide the reader with a foundation to support thinking critically about applying justice in practice. The subsequent chapters, work towards a conceptual framework of distributive energy justice, and consist of a limited set of three core concepts, capability, intersectionality, and spatiality. Respecting the boundaries of time and scope of the current research requires placing limits that lead to unfortunate exclusions and omissions which, while interesting and have textured the author's own understanding of justice, lie 'just' beyond the scope of feasibility. For the sake of space, two ought to be mentioned, first, the temporal dimension highlighting elements of inter- and intragenerational justice are key in discussions of justice; accounting for longer-term thinking that is required when engaging with issues of sustainability (Krznaric 2020). Second, and more substantially, the scholarship on epistemic justice that seeks to establish plurality within transitions (Martin & Wood 2022). Expanding the scope of justice to include marginalised world views, such as those from indigenous peoples, as well as the recognition of the rights and dignity of the more-than-human living world (Harraway 2007; Wall Kimmerer 2013). The lamentable and bitter irony of the 'in passing' nature of noting these epistemic histories ought not be understated. Too often is it the case that these peripheral strands of thought, justice and paradigm shifting ways of relating with people and the natural world, are brushed aside when decision making becomes occupied by a 'tyranny of urgency' to tackle a crisis (Partridge et al. 2018; Whyte 2021). Yet, when it comes to mobilising theoretical insights for application in more practical settings, in which time and energy become scarce resources, there is a regrettable justification that simply pointing towards these histories must be enough.

2.3.1 Conceptualising Energy Justice

Justice movements illuminate features of both process and outcome, with the tripartite framework commonly deployed, focusing on three core tenets: distribution, participation, and recognition (Heffron 2022; Jenkins et al. 2021; McCauley et al. 2013; Ramasar 2022; Wijsman & Berbés-Blázquez 2022). These ask of the what, how and who of transitions (Jenkins et al. 2016). The distributive tenet is the *what* of justice, generally asking what are the benefits and burdens, who benefits and who is burdened, and by how much. This is often given focus in policy debates since it becomes the most tangible to measure and quantify, however, climate and energy justice scholars emphasise that participation is crucial for just transitions. This relates to the inclusivity and active engagement of governance procedures, processes of decision making, and the extent to which relevant stakeholders are included (Becker & Neumann 2017; Jenkins et al. 2021; Lelieveldt & Schram 2023). Meanwhile, the recognition tenet emphasises that all individuals are worthy of dignity, respect and rights, and that social relations are never power neutral, and that there always exists dynamics marginalising and disadvantaging particular groups (Dahl et al. 2004). Equitable distribution of goods, services, or broader outcomes requires appropriately recognising the needs of particular stakeholders, this cannot happen when impacted social groups are dis-empowered (Ducre 2018; Kaźmierczak 2018). As such, processes of transitions, and those in decision making positions, require a reflexivity to their power. Listening to marginalised positions requires stepping back from one's own positionality, and in turn stepping forward, or aside, to allow alternative those quietened voices to be heard (Gesturing Towards Decolonial Futures 2023). Recognising who is experiencing energy injustices is a step

towards being able to re-distribute to their favour. While the three tenets are often treated as independent of each other, a more nuanced understanding seeks to appreciate their co-dependent, interrelated and embedded nature, that, for convenience becomes simplified in application and analysis (Velasco-Herrejon & Bauwens 2020). What is to be emphasised is that the distributional outcomes of any transition are deeply dependent upon the nature of the processes undertaken, characterised by particular forms of participation and recognition. While each tenet is worthy of attention, the present focus on distribution is due to an interest in the outcomes of alternative ownership and grassroots organisation, along with the fact that it is often the distributive features that hold more tangible as well as material impacts for energy commuities. Energy related injustices are more clearly identified by the mal-distributions emerge, often relating to pre-exisitng or underlying inequalities (Stewart 2021).

The manifestations of unqual distributions of income, wealth, or access to low carbon energy, are often symptoms of deeper structural issues, and can quickly become sites of injustices; those who benefit the least being those who are burdened the most (Bayliss et al. 2020; Guan et al. 2023). In the context of the energy transition, many distributional questions emerge, such as the equitable access and affordability of low-carbon technologies (Coote 2023), be this inclusive mobility (Nieuwenhuis et al. 2020), renewable energy sources (Bartiaux et al. 2019), or household energy efficiency interventions (Brugger et al. 2021). Additionally, distribution of various social, environmental and economic impacts across supply chains, such as for the communities located in close proximity to mining and resource extraction (Jenkins et al. 2019). Taking a distributive approach encourages, although does not necessitate, an inquiry into existing socio-economic structures to understand who, how and why particular inequalities interact within the energy transition. For instance, energy burden, which refers to the share of household income that is allocated towards the energy bill, for electricity and space heating (Oswald et al. 2020); a higher energy burden means that a larger proportion of household income is spent on energy. The problem is multifaceted, lower-income households are more likely to live in poorly insulated buildings and unable to afford to renovate and retrofit, which becomes compounded for renters since landlords who are not regulated to perform retrofits or renovations are less financially incentivised since it is not their bills affected (Grossmann 2019; Krishnamurth & Kroström 2015; Palm et al. 2020). Moreover, low income households, who are more likely to experience higher energy burden, become increasingly vulnerable to energy price shocks because of this large proportion of spending on energy (Guan et al. 2023). What this highlights is that the experience of energy inequalities, and subsequent injustices, intersect across social, economic and technical systems. This in turn requires asking who is experiencing energy burden across society, as well as understanding which social groups experience greater barriers to access affordable low-carbon technologies or energy (Cabrita & Quefelec 2022; Energy Equity Project 2022).

The question of distribution is often a quantitative one, 'by how much' is pertinent when considering the allocation of benefits and costs across the stakeholders and social groups involved. Yet, McCauley & Heffron (2018) note a resistance to an entirely quantitative understanding of distributive justice, identifying alternative approaches that examine capabilities and wellbeing, risk and responsibility, vulnerability, and recognition, as more qualitative and subjective experiences of justice. The question of risk and vulnerability to damages of climate change becomes a core issue for creating energy policy. Recognising who is burdened by particular energy policies, enables policy design to allocate support more appropriately so that specific policies as well as entire policy programmes and bundles protect those most in need (Lamb et al. 2020). This can include access and affordability of low-carbon technologies (Büchs et al. 2021) as well as tackling labour displacement and providing job opportunities where they are needed (Carley & Konisky 2020; Deutz 2014).

In the context of energy communities, identifying what is actually being distributed by the community group is a first important step. This may relate to the particular benefits and burdens that are at stake, the revenues for instance, or flow of energy that is generated. In turn, establishing which stakeholders are involved, both in terms of decision making as well as those impacted by particular outcomes, who are the earners or owners. Additionally, understanding the power dynamics that shape the nature of benefit/ burden distribution, and assessing their equitability. In part, this means taking a critical approach to ownership structures, who are the co-owners and what is risked by these people or groups, who invests their time and what kind of reciprocity is established. This final step, relating to power dynamics, is particularly explorative and requires a flexible approach to understanding the contexts in which energy communities operate in order to assess the existing socio-economic structures that may affect distributional impacts. As such, three concepts will be drawn on presently to refine the understanding of distributive energy justice.

2.3.2 The Core Concepts

Three concepts will be focused on to refine the understanding of distributive justice, namely, capabilities, spatiality, and intersectionality. These have been chosen for their relevance and importance when considering the justice implications of energy communities within the energy transition. Whereby, capabilities ground the nature of distribution in terms of needs, freedom, and functioning; intersectionality emphasises the role of power, marginalisation, and forms of vulnerability; while spatiality highlights the multiple geographies of the energy transition in which supply chains operate across local, regional, and national boundaries (Avelino et al. 2023). Figure 2 presents the conceptual framework that this chapter works towards, with the interactions of the concepts providing insight and nuance to one another, and their nesting within the distributive dimension specifically.

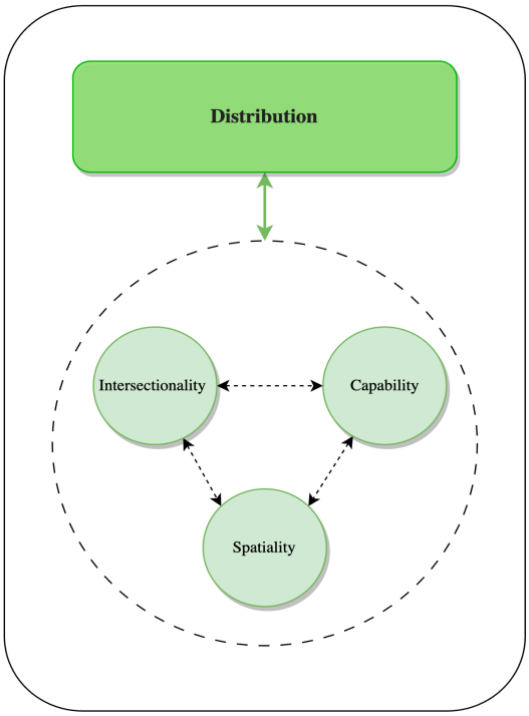

Figure 2 Conceptual framework of distirbutive energy justice

2.3.2.1 Capabilities

Definition

The Capabilities Approach (CA) pioneered by Amartyra Sen and Martha Nussbaum was established as a method of evaluating development; framing wellbeing through a lens of real freedoms rather than 'simply' economic growth (Nussbaum 2000; Sen 2001). Two core components of the approach are capability sets and real functionings. Capabilities refer to the enabling conditions for individuals to achieve particular real freedoms, actually functioning in a given way. The approach was developed as an alternative way to assess, evaluate and compare levels of welfare, giving attention to the needs of the individual, as well as the dynamics that support those needs to be met. Additionally, the notion of conversion factors highlights the contextual features, access to particular financial, educational, or healthcare resources which make achieving a particular real functioning more or less difficult (Sen 1995). In its initial formulation, the CA takes the individual as the unit of analysis for the means and ends of development, with the intrinsic value of human freedom as the purpose of development (Osmani 2016).

Relation to Distributive Energy Justice

The CA has been used within the context of energy justice to highlight what individual energy needs are present, how these support wellbeing, and how to ensure their provision. In particular, examining the impact for bottom-up processes in local community initatiatives (Velasco-Herrejon & Bauwens 2020). The CA helps frame decision making in terms of the specific, contextual needs of a given energy project, as well as considering the causalities between achieving a particular functioning, the material enablers to achieve them, and the wider systems of provisioning. For instance, Day et al. (2016) used the CA to conceptualise the relationships between the energy/fuel sources used, the domestic power supply and energy services. The authors outline the chain of relationships that convert the initial fuel sources into real freedoms and functionings, and in the process identify various positions that interventions can be made when tackling energy poverty (Day et al. 2016). While it is outside the present scope to evidence and quantify the causal chains between the initial extraction and satisfaction of a particular individual need, thinking in terms of capabilities draws attention to what energy needs are and how they are met. This includes the specific technical systems currently in place to provide services, as well as the socioeconomic and institutional contexts responsible for this. This provides a lens to assess what costs and benefits are emerging at different points in the energy supply system that are connected to the specific needs of individuals and households.

Subsequent CA developments have broaden the approach from its methodological individualism which cannot capture the emergent features of communities (Schlosberg & Carruthers 2010). This opens up a view of communities themselves as units of analysis, with particular needs, functionings and freedoms necessary to thrive and prosper. Widening the CA to include communities as units can provide space to recognise how different communities are embedded within a socio-ecological context. With varying intensities of embeddedness, there is an ontological shift in which the relationship in and with the world around extends beyond the individual and anthropological. The point to carry forward here is that (in)justice can be understood as entangled with the various ways that communities may "experience themselves in the world as having responsibilities to other humans, nonhumans and the environment. Injustice involves one society robbing another society of its capacities to experience the world as a place of collective life that its members feel responsible for maintaining into the future" (Whyte 2016, 12).

Role in present research

The role of the capabilities approach in the present research manifests from the framing of needs and functioning, for whom and in what way particular needs are satisfied, and how responsibility for meeting those needs are distributed. The implication of adopting a Capabilities Approach means that konlweldge of

individual and community needs is to be derived from the people directly involved in the local initaitves. Identifying the range of needs at the individual and organisational level that energy communities are able to play a role in delivering. Since the aim of this research is to lay an exploratory foundation for understanding how justice within energy communities can be understood, this means drawing on the insights of those directly involved.

Additionally, taking an expanded view of capabilities that includes the deterioration and damages of socio-ecological context of a community to be undermining for meeting needs, and thus a site of injustice, requires asking of wider impacts across a supply chain. Since the extraction of material resources within one community are depended upon for provisioning the needs in another, a capabilities approach which tracks how those needs are met implicates, to some minimal extent, an analysis which includes wider supply chain impacts. Within the context of an analysis of energy communities, this will mean gauging the extent to which effort is, or can be made, to include wider ecological impacts within decision making.

2.3.2.2 Intersectionality

Definition

The concept of intersectionality relates to the multidimensional exertion of power within societies. Initially formulated to reveal the compounding discrimination experienced by individuals who are part of multiple social groups, each of which experiencing some level of marginalisation (Crenshaw 1989). Since then, the intersectional lens has been developed in a range of contexts, analysing experiences and dynamics of power, marginalisation, and vulnerability by social groups, ie class, race, gender, nationality, ability (Bell 2020; Ducre 2018; Sovacool et al. 2023). In the context of environmental justice, Ducre (2018, 33) sought to 'acknowledge multiple oppressions' and to 'contextualise the histories of oppression born within European imperialism and colonialism'. The work within intersectional analysis has increasingly been brought into the context of energy justice and the energy transition, proving especially useful to subvert existing hierarchies.

Relation to Distributive Energy Justice

Intersectionality is a useful lens for analysising and addressing energy injustices due to the attention to the manifestations and exertions of power across the multiple societal systems and strucutres involved within socio-technical transformation (Bell et al. 2020; Sovacool et al. 2023). Identifying how particular patterns of oppressive relations are (re)produced become core to ensuring more just processes and outcomes. For instance, Bell et al. (2020) use political, economic, socio-ecological, and technological dimensions to identify the societal spaces in which particular power dynamics are revealed within the energy system. Addtionally offering various visions for what more equitable power relations would look like, from political pluralism and public ownership to prioritisation of well-being approaches over profit orientation. Building on this, Sovacool et al. (2023) highlight several approaches that can support in achieving transformative energy justice, relating to feminism and gender disempowerment, anti-racism and attention towards ethnic discrimination; indigenous justice, land justice and ecological knowledge; and postcolonialism and histories of domination. While each of these conceptual framings is deeply valuable to establish a foundation of the higher level understanding of power dynamics, it is important to ground these in ways relevant for grassroots initiatives, and the analysis thereof.

One way this becomes pertinent for local communities is understanding how their activities could support those at greater risk or vulnerable to energy burden or poverty. For example, when examining the need for residential retrofits, Jones (2022) highlighted three factors for assessing fuel poverty vulnerability of households: likelihood of exposure, sensitivity, and capacity to adapt. Characterising identities that intersect across multiple categories of empowerment, the symptoms, detriments, and solutions of energy

vulnerability are situated within a web of power. Whether due to relations with their landlord, limited financial resources, or lack of information about energy efficiency measures, households can experience multiple limits in capacity to adapt. Building an appreciation of what limits are faced by different individuals, groups, and communities can help identify the nature and extent of risk. In turn supporting the involvement in decision making and identifying organisations or institutions in close proximity to those in need, to support more equitably distributed outcomes (CLES 2020).

Role in present research

Bringing an intersectional lens into the present analysis, the attention to needs from the CA is complimented by emphasising the role of power within an energy community. There are several ways that this can happen, depending on the respective role and positionality of a stakeholder; but broadly relates to encouragiging an active reflection of the entangled power dynamics involved across the multiple levels of decision making. This means the (non-)representation of particular social groups amongst the membership (Dahl et al. 2004; Knijn et al. 2020): who the membership consists of, the practices of inclusivity, as well as potential blindspots. Moreover, what options exist for supporting those who are most vulnerable to energy burden or poverty, and understanding the how responsibility for tackling this is perceived. Additionally, understanding how power is held at a more systemic or strucutrual level for the communities themselves, within the institutional setting in which they coordinate with local authorities, businesses, banks, or network operators. This requires understanding the initiatives' own sense of recognition within decision making processes, and how power is shared within collaborations and partnerships.

The larger scale approaches to power and transformation serve as valuable lens to consider the refrence frames and associated issues of justice within the energy communties. The exploratory nature of the subsequent empirical research requires developing a greater understanding of how energy community practioners approach various intersectional issues. Rather than immediately quantifying particular effects of power dynamics, the aim will be to use these conceptual foundations to establish greater understanding for how communities engage with power, in order to support future work in which practioners can actively reflect and engage with their own power and positionality. Using the intersectional lens here helps to frame questions relating to existing approaches to power dynamics.

2.3.2.3 Spatiality

Definition

The energy supply system operates across multiple geographies, from the mining of natural resources, sites of manufacturing, and, finally, to the end consumer. Multiple scholars stress that (in)justice is a multi-scalar affect, especially with regard to the energy system (Ducre 2018; Sovacool et al. 2019). Bouzarovski & Simcock (2-17, 642) frame the importance of spatiality aptly: "Cutting across all the various dimensions of spatial justice is the issue of scale…averaging figures over units of political and material space both reveals and hides differences; justice in terms of distribution, procedure or recognition defined at one scale does not necessarily mean justice is achieved elsewhere."

Relation to Distributive Energy Justice

Understanding how various impacts within the energy system are distributed across different spatial scales is important for identifying where inequities and injustices are actually located. Sovacool et al. (2019) conceptualise this three level of scale: the micro-scale, within communities and most proximal to the infrastructure; the meso-scale, at national and supra-local levels; and the macro-scale, the transnational, regional or global interactions.

At the macro-level, global development of affluent countries, within Europe and North America for instance, has largley been dependent on colonial expansion, extraction and exploitation, off-shoring of environmental impacts, and perpertuation of systemic economic inequalities (Hickel 2020; Lenton et al. 2023). The patterns of unequal exchange exacerbate existing hierarchies, shifting vulnerability to environmental hazards from the global wealthy to the global poor. Dorninger et al. (2010, 10) highlight, that this 'is not coincidental or transitional, but systemic and pervasive in the current structure of the global economy.' Recognising this global historical context and understanding how benefits and burdens are distributed within the energy supply chain is crucial for a just energy transition. The meso-scale provides a lens for viewing national and regional inequalities that contribute to within-country disparities. This includes the spatiality of energy affordability, vicious cycles of vulnerability, and the geographies of misrecognition (Bouzarovski & Simcock 2017). For instance, uneven development of economic opportunities, low-income neighbourhoods in cities, and subsequent unequal access to resources or infrastructure in those neighbourhoods, embeds inequalities into the geography of a place.

The microlevel scale focuses on localised effects relating to the quality of energy services delivered to particular places. Further disaggregation of how energy needs and inequalities manifest within space becomes increasingly important when examining the role and responsibility of energy communities to tackle local energy inequalities. This means understanding the impacts for the local communities that are most proximal to energy innovations: who lives near the sites of RES infrastructure projects, which communities relied on fossil fuel industries and are vulnerable to job loss, which neighbourhoods are at risk of falling behind in the access and affordability of low-carbon innovations. The latter point often relates to smaller demographics, generally more isolated whether because they live rurally, or from social exclusion, that requires far greater efforts to reach (Ambrose et al. 2019; Sovacool et al. 2019).

Role in present research

Thinking in terms of spatiality primes the analysis of distribution of impacts to consider the scales that different energy communities functions across, as well as identifying the locations of vulnerability and risk. Where inequalities do emerge, they may be prone to be distributed unevenly across geographies (Munday et al. 2011). A greater sensitivity to spatiality becomes important for understanding underlying vulnerabilities due to systematically underinvested infrastructure within particular places (Bell 2020). In the context of energy communities, this lens can help identify potential blindspots emerging from a near-sightedness of thinking and acting too locally. Moreover, identifying where injustices across spaces emerge is an important step in allocating the responsibility for tackling them.

Bringing spatiality into the present research, will help understand how energy communities perceive their own responsibility across particular spatial scales. Many communities operating on a particularly local level, may have far more attention on tackling energy needs at the micro level. Giving particular attention to the spatial scales that local energy intiaitives are organised and operate at, can help identify the kind of distribution of impacts that are prioritised. Moreover, this can help establish the nature of responsibility that energy communities operate from, in particular, how particular responsibility falls inside or outside spatial scopes. For this research, this becomes a valuable insight into the emerging blindspots that may appear for organisations to tackle injustices at macro and meso scales.

2.3.3 From Concepts to Questions

The conceptual foundations presented above provide a reference frame for engaging with the impacts of energy communities. Grounding an approach that is sensitive to individual, household, and community needs, the power relations that emerge at across the multiple levels and systems of socio-technical

transitions, and an attention to the geographies and spatial impacts of the energy system. Each of these conceptual bases shapes the way in which an analysis of justice within energy communities is engaged with. Summarised in Table 2 are preliminary contributions that each concept provides in the form of core questions derived from the review of literature and relevance for distributive energy justice in the context of energy communities. These provide an initial formulation for understanding, analysing and evaluation the manifestation of (in)justice within energy communities. The next chapter will detail how these concepts will be further operationalised to inform the analysis of distribution justice of energy communities.

Two points should be noted here, the first is that Table 2 can be consider a first iteration of this exploratory work towards a usable toolbox within the energy community ecosystem. Specifically, the questions provided here will form the basis of an empirical examination of the distribution of benefits and burdens within energy communities, along with understandings and expressions of these justice concepts. What this lays the foundation for is a dashboard in which the results of applying these justice questions within energy communities will be integrated with the benefit categories. This will be presented as a question matrix in which each benefit category is analysed in terms of each justice concept (Table 7).

The second, is that each of these concepts interact, and while for the sake of analysis are treated distinctly - represented in Figure 2 as a neat circle with interacting lines - it may be more appropriate to understand them as simultaneously overlapping. For instance, when assessing the impact of revenue streams generated by the community, a capability perspective asks how these revenues support particular needs of community members better. Do these revenues actually support the provision of needs and services that enhance the life standard of members, if they do, the intersectional lens would ask for whom? Which community members are able to reap financial rewards from participation in the energy community, and who is excluded? Are there mechanisms embedded within the organisation that emphasise profit sharing upon those who are more vulnerable? Meanwhile, spatiality would encourage asking where the additional income is spent by community members, how well the value is actually retained within the local community, compared with spent on luxury consumption items. This can also be noted in the operationalisation process such that the variables of coding related to more than one of the concepts.

Table 2 Core Justice Concept Questions

Concepts of Framework	Contributing Considerations
Distribution	- What is the current focus of distribution: what are the benefits and burdens? - To whom are these benefits and burdens distributed? - How is the equitability of benefit/burden distribution determined, and what does fairer distribution look like?
Capabilities	- What are the needs of the energy community currently, are these being met? - Who is currently responsible for meeting the needs of individuals, institutions, or infrastructures within the energy community ecosystem? - What interventions could be made that could support the better distribution of benefits/needs that the energy community is able to provide?
Intersectionality	- Who are the key stakeholders involved within the energy community, and how is power managed and shared between them? - Which social groups are more vulnerable to being (un)intentionally excluded or unrecognised? - What interventions could be made that better recognises the marginalisation and vulnerability of groups, and subsequently supports their empowerment?
Spatiality	- Across which areas does the energy community operate, and how does it impact those regions? - Which specific areas are most focused on in terms of control, purpose, or interest in the current scope of the energy community? - Which locations are most at risk when it comes to energy related challenges?

Chapter 3 Research Design and Methods

The first substantive part of this research conducted an extensive literature review into the structure of energy communities, the nature of benefits and burdens, along with their distributions, and established a conceptual framework of distributive energy justice. The methods through which these conceptual foundations will be tested empirically, by operationalising and applying them to three cases studies, are explained and justified here. A qualitative, multi-case study approach was adopted due to the suitability for approaching the identified research problem, and in turn appropriate for answering the research question. Due to the exploratory nature of this research, a deeper understanding of perceptions of justice within energy communities, along with the stakeholders and practitioners involved, was sought. Causal mechanisms explaining how particular just processes or outcomes are not known, which deemed quantitative approaches inappropriate (Verschuren & Doorewaard 2010). Instead, multiple cases of different kind were chosen to establish a thorough understanding of how justice is currently understood, as well as appropriate for establishing a more holistic and reflexive approach for how a range of stakeholders within energy communities could benefit from engaging more actively with justice issues (Soifeman 2010).

3.1 Sample Selection

The multiple case study approach was adopted to due to the qualitative nature of the research question, requiring in-depth knowledge about relational variables (Verschuren & Doorewaard 2010). Specifically, understanding the experiences of benefit distribution within energy communities, existing attitudes towards energy justice, and insight into the extent of reflexive reflection of both. To conduct a comparative analysis, identifying patterns across different kinds of community initatives, three substantially different cases were chosen, the selection of which was based on establishing a diversity across location, geographic scale, organisational form, and operational function. Each of the cases were to be located within Europe while their activities were to spread across different georgraphic scales, i.e. local, regional and national. Additionally, choosing communities with different levels of maturation aimed to identify the varying set of benefit priorities and the capacity to distribute those benefits. Further, as identified in background, it is common for local initaitves to be organised in the form of cooperatives, however in order identify differences in distributional effects each of the communities studied were chosen based on varying business model structures, as presented in Section 2.2.1. Finally, communities were selected to create diviersity with respect to operational function. Since the most common activity for community energy initatives is collective generation, it was enough to ensure that there was a diversity of activities represented across the entire selection. In other words, choosing cases that engaged with multiple activities enabled a variety of activities to be represented across the entire sample. In the end, the three community energy intiatives selected for were: Zeeuwind, a well established, regional energy cooperative in the Netherlands; Solbyn, a small ecovillage in Sweden; and Big Solar Coop (BSC), a relatively young energy community operating across the United Kingdom.

3.2 Operationalisation Procedure

The results of the literature review, the impacts associated with community energy intiatives (Table 1) and the distributive energy justice conceptual framework (Figure 2), were operationalised for the purposes of the case study analysis. To do so, a combination of deductive and inductive methods were used. Since the main form of data collection would be semi-structured interviews, the conceptual bases presented in the literature review were deductively translated into an interview guide (presented in Annex V) that would provide an outline for conducting interviews. In practice, deriving interview questions from the conceptual framework at a general level, in order to make higher level concepts more accessible to a range of audiences that may be less familiar with the capabilities approach, intersectionality, and spatiality. This deductive

approach appealed due to the replicability, reliability and broadly objective nature. For each of the core concepts, various variables were pre-chosen that would reflect and inidicate qualities of the concepts if/when referred to in the interviews, thus justifying a relationship with elements of the framework. However, the disadvantage of a solely deductive approach is that the results become reductive, and unable to adapt or find further nuance based on insights from stakeholders (Azungah 2018). As such, operationalisation is also characterised by an emergent, iterative, and inductive approach. The consequence of an inductive approach for the operationalisation, is that throughout the course of interviews, new inisghts, variables, and elements associated with each of the core concepts were elaborated on. This became reflected in the coding tree used for analysis (Annex VI) with various core elements predetermined from the conceptual framework, along with multiple additions based on new learnings during the interview process[1]. The benefit of this is that the conceptual framework experienced evolution in the course of the research, with particular elements becoming refined, tailored to the experiences of interviewees. As is characteristic of qualitative research, using deductive and inductive approaches led to elements of data analysis occurring during the data collection stage (Soiferman 2010).

3.3 Data Collection

19 semi-structured interviews were held between 2-6-2023 and 30-8-2023 with a total of 24 stakeholders involved within the energy community ecosystem. 13 of which were directly involved in the selected cases, ranging from initiators and organisers, volunteers, members of the local authority, as well as stakeholders representing larger scale industry actors. One of these interviews included a round table discussion in which four members of the eco-community were present. The additional 6 interviews were held with experts that, while not directly involved with the selected energy communities, held experience within energy transitions at a local, regional, or national level (see Annex VII). Specifically, providing complimentary persepctives of wider stakeholders contributed insight and validated understandings about community empowerment, financing, and governance of energy communities. Semi-structured interviews were chosen due to the flexibility to adapt to the respective interviewees role, positionality, and understanding of the respective concepts. For instance, navigating academic language and abstract justice issues emerged as a challenge. As such, semi-guided interviewees enabled a sensitivity to participants' positions, encouraging to share perspectives based on their own experiences, positionality, and responsibilities. The approach allowed for in-depth conversations, bridging diverse knowledge and value sets, and contextualizing subjective understandings of energy transition issues (Azungah 2018; Brinkmann 2018).

Several steps were taken to gain greater insight into the functioning of respective communities. Due to language and logistical factors - affecting the kinds of meetings and discussions that could be participated in - slightly different approaches were adopted for each case study. For Big Solar Coop, multiple volunteer meetings were attended, including an AGM and open webinars, forming greater perception of how communication, decision making, and knowledge sharing was managed. Gaining a greater understanding of Solbyn involved visitng the ecovillage in August 2023, and along with a tour of the village hosting a roundtable discussion with members of the energy interest group. These enabled greater insight into the role of proximity when organising at the neighbourhood level, and the powerful role of governing a collective commons for distribution of benefits. For Zeeuwind, additional interviews were held with stakeholders involved in gaining insight into various aspects of a larger, well established energy community.

[1] Part of the insights from the inductive approach towards the inteviews led to the coding category 'Misc.'

3.4 Data Analysis

The interviews and roundtable discussion were later transcribed and uploaded to Nvivo for analysis. A coding tree (attached in Annex VI) was created based on the pre-established derived variables from the conceptual framework, as well as from the evolution of the framework and emerging themes, variables and framings from the interview process. The analysis process was iterative, beginning with processing transcripts and conducting an initial round of coding. Organising the responses across coding categories while identifying how responses reflected answers to the questions within the analytical framework of concept questions. This first stage produced a extensive extended set of results, which required synthesising to establish a more streamlined, while still broad, overview of benefit and burdens, distributions (presented in Tables 4-6), and respective justice concepts (presented in Annex I: Concepts Tables).

A second iteration involved recursive analysis, highlighting core issues, patterns, and themes in order to integrate and synthesise results (for instance, the synthesised benefits in Table 3). A final iteration of analysis was conducted with the aim of producing the question matrix. Using the insights from the preceeding analysis, to infer how expressions of justice reflected particular percpections of impacts, subsequently framing core questions that would support a critical reflection of those perceptions as well as engaging with blindspots.

3.5 Ethical considerations

Several steps were taken to address potential ethical issues emerging from interview based research. Each of the participants were provided with an information sheet outlining the purposes of the research, expectations of their involvement, and how their data would be handled. An informed consent form was thereafter signed which included participants' right to anonymisation, and the fact that their voluntary participation meant they had a right to remove their consent at any point during the research, including any follow up questions and updates on research progress. Finally, steps were taken to ensure that where interviewees were not entirely comfortable speaking in English, that they could express themselves in their native language. In the situations where this was necessary, either it was a language that the researcher could speak in, or it was held in a setting such that translation was made instantly available.

Chapter 4 Case Study Descriptions

This chapter will present thick descriptions of the three community energy intiatives selected. For each of the communities, there will first be an overview of organisational structure, engagement from members, and operational activity, followed by the purpoted benefits and value propositions offered. The chapter will serve as a foundation for the subsequent analysis and results of applying the conceptual frameworks in the following section.

4.1 Zeeuwind

Structure, Citizens, and Activities

Zeeuwind is an energy cooperative in the province of Zeeland, in the south of the Netherlands situated in a large delta. Located close to the coast has made wind energy particularly appealing, and in 1987 the cooperative Zeeuwind was formed. Beginning with the installation of a few modest projects of 70 kW. Zeeuwind has since grown, and is now a co-owner of 13 wind farms, contributing over 3.5% of the on-shore wind turbines in the Netherlands, and are the largest energy cooperative in the country (CBS 2022). Participation requires an initial membership fee of €10, to cover administration costs, along with a minimum investment of €100. The investments provide core financing for project developments which in turn generate revenue that is distributed amongst the membership for return on their investment. Besides this, membership is open, and consists mainly of residents within Zeeland, although not exclusively. Not only can citizens from all over the Netherlands get involved, if they so wish, but also collectives and organisations such as municipalities, small business and housing corporations (Maqbool et al. 2023). All members of the coop have the right to vote on key decisions in general meetings, such as allocating windfall profits made from energy crises. Given that most members are from Zeeland, and that most of Zeeuwind's projects are located within Zeeland, it is understood here as a community of place. Moreover, within the framing of the European directives, it can be considered a 'citizen energy community'.

As a well established cooperative, Zeeuwind has developed a professionalised organisational structure, with a core staff that oversee the key operations and organisation, and can coordinate with multiple partners. For instance, the 34 turbine wind park 'Krammer' is a joint venture between Zeeuwind, fellow energy coop Deltawind, and Kallista, an energy project developer, of which Zeeuwind owns 30% . Meanwhile, the 9MW wind park 'Noordpolder' was a 50/50 joint-venture between Zeeuwind and the local farmer, with the 2MW extension, Derde Dijk, owned 90% by Zeeuwind (Zeeuwind 2023c). Having established stable returns from wind projects Zeeuwind has gradually expanded operations, investing in several solar parks. With a capacity of approximately 17MW, the energy generated would be enough to meet the demands of close to 6,000 average Dutch households. More recently, Zeeuwind has invested in various energy system innovations. In June 2023, there was a residual waste heat network project agreement announced for the district of Hoek, and is a pilot for the wider region. In their capacity as a larger cooperative with access to more resources, they carry greater institutional power, and are able to work together with larger-scale actors in industry, finance, and level of governance. As well as able to connect with smaller scale community initiatives, and support projects connecting the local projects with larger actors.

Impacts and Value Propositions

Multiple benefits emerge from the cooperative's organisational structure and operational functions. Environmental benefits relate to emissions reductions from the wind projects, and the significant role in Dutch wind energy . A significant burden, environmentally, relates to the transparency of supply chains, or lack of it, and the challenge of tracking and communicating the broader environmental impacts from

extraction and manufacturing to consumption. Which in turn means that there can be large discrepancies of wider environmental effects depending on the sources and suppliers (Murphy & Elima 2021; Kim & Davis 2016).

The current regulatory landscape in the Netherlands makes it difficult for energy communities to share or sell the energy they generate from their own assets directly. This means that while citizens co-owned the energy generating assets, the physical electricity produced could not be sold to them directly. Rather, the energy is sold to the local energy supplier, in turn generating revenue for the cooperative. The business model adopted enables community members to invest in energy projects through share offers from Zeeuwind. Once the revenue streams are established, interest can be paid to investors and it becomes more possible to finance new projects.

Various actions have been taken to create wider social value, including climate awareness weeks, a solar powered boat race, not to mention an energy service centre, contribute to relevant peer and community effects (Kubli & Puranik 2023). A key initiative that supports these is the social benefit fund that is directed into projects that have an explicitly social purpose to benefit citizens. Portions of revenue from wind projects is ear-marked for the fund, for instance Wind Park Krammer donates €0.50/MWh to the wind fund. Meanwhile, after windfall profits from the energy crisis in 2022, members of Zeeuwind voted to contribute €3 million from profits to projects that had a social purpose to benefit citizens (Windfonds Krammer 2023).

Moreover, there are multiple ways that network learning effects occur. As an established cooperative with high revenues and increasing professionalisation, Zeeuwind have collected an institutional power and authority that enables knowledge transfers, as well as draw in larger institutional actors by providing the legitimacy, security and reduced risk for the projects - often a barrier to smaller energy communities.

The technical benefits from the energy being delivered to the grid to support more distributed and localised grid balancing. Alongside this, while the regulation in the Netherlands is challenging, the testing of new flexible contracts through special 'Sleeved' PPAs enable large energy consumers to be supplied directly with electricity generated by Zeeuwind. Businesses can enter an agreement for Zeeuwind to supply a portion of their electricity, with the remaining unmet demand purchased from the grid. This means that Zeeuwind does not take the risk of being obliged to meet all energy needs - balancing supply and demand - yet, by supplying directly it opens up the option for a collectively owned energy cooperative to become more involved in energy system activities. Additionally, residual waste heat networks and smart charging ports are further examples of diversification of the core business models. These recent technical innovations capture different kinds of value through increasing self-consumption, energy cost reduction, and living lab test sites (Kubli & Puranik 2023).

4.2 Solby

Structure, Citizens, and Activities

Solby is an eco-village situated in the South of Sweden in the region of Lund. Initiated in the 1970s, a small group organised together to create a collective living arrangement promoting sustainable and ecological living. Today, the village consists of 50 residences, with approximately 100 residents who are members of the housing association serving as the legal entity that owns the land and common infrastructure. The latter consists of a washroom area, collective tools and workshop space, and a community hall that is rented out to a kindergarten. Multiple different interest groups take responsibility for organising various aspects of the ecovillage, from communal activities such as a short course about gardening and foraging to developing

renewable energy for the village. With a fixed geography, Solbyn can be considered a community of place, in which all residents (and only residents) are members. This creates a challenge, in as much as it is not open to all citizens proper, but rather for those within a particular locality. While it is a particularly strict community of place, it remains appropriate to include the village as an energy community for present purposes. The position as an established eco-village organised around a non-exclusive commons supports the distribution of benefits across community members.

The name '*sun village'* may suggest that deployment of solar PV occurred early in its formation, however this was financially unviable for and it was only in 2019 that the first panels were installed. Prior to this, in 1992 the community was involved with the development of a local wind turbine, purchasing 30 shares that enabled a 'right-to-buy' 1000kWh electricity per year (Barnes et al. 2022). Some years later, in 2014-15, a thermal collector was installed within the village that is used for heat in common washing facilities. Finally, in 2019, Solar PV was installed in the village for on-site prosumption used in common areas; that year the solar system generated 36,470 kWh of electricity, roughly 53% was sold to the local energy supplier, while the rest self-consumed (Hansen & Barnes 2021, 14).

Impacts and Value Propositions

Through various investments in renewable assets Solby offers several value propositions for residents. By generating and consuming their own renewable energy, they reduce the village's total emissions footprint, along with increasing rates of self-consumption, and reducing their energy costs. Solby doesn't generate revenue from their renewable infrastructure, per se, rather it captures value by way of savings from reduced energy costs of the common areas, which in turn, frees up the budget of the housing association in the long term. When market energy prices become volatile as they have done for the past years since the invasion of Ukraine, stability from fluctuating prices means that value capture becomes even greater.

Given the environmental focus of the village, the emission reduction benefits are particularly convincing for residents, with financing an inconvenient hurdle to overcome, rather than the main object of focus to maximise. Further, as an ecovillage experimenting with multiple commoning practices, they can be seen as a living lab where practical innovations can be tested on a small scale. For instance, EV mobility services connecting to solar PV to test vehicle-to-grid charging.

The fact that the ecovillage was a pre-existing community of place with the energy dimension as an add-on, means that the social effects derived from the energy activities become more difficult to determine. The creation of community feeling, offered by Kubli and Puranik (2023), seems less appropriate here given the preexisting sense of community - interest groups working together for collective benefits. Rather there exist potential benefits in terms of knowledge distribution from the sharing of experiences of establishing collective energy infrastructure in the context of an eco-village. This can have a compounding effect on the environmental benefits whereby discussion around energy saving advice is shared within and between villages, can support changing of patterns and habits which both lower energy costs, by managing demand patterns, or reduce total energy demanded.

4.3 Big Solar Coop

Structure, Citizens and Activities

Big Solar Coop (BSC) is a relatively young cooperative, starting in 2019, with a mission to support decarbonisation by deploying rooftop solar on large buildings and empower citizens to participate in the energy transition. In terms of actors and members of the BSC community, there are several key stakeholders. Firstly, the volunteer members contributing to much of the core work of the cooperative.

Once the administrative fee, of £1, is paid a person can become a member of BSC, with the accompanying voting rights - one member, one vote - in the general meetings. The role of these volunteer members cannot be understated, and the functioning of BSC depends on the time they dedicate to contacting new sites, building relationships with them, and putting together technical plans of potential solar arrays. Next to the volunteers, there are investors. The first BSC share offer was completed at the end of 2022, involving 250 investors, raising £840,000 towards cooperatively owned solar PV. While in principle most investors are individuals, it is possible for local councils, charities or other such socially oriented organisations to invest. There is a small team of six paid staff of the coop who deal with the functions that are beyond the role and responsibility of the volunteer members along with a Board of Directors that consists of a mix of both volunteer members and investor members. Finally, there are the host sites that are approached who are expected to lease their rooftop to BSC. As for the nature of the community, BSC can be considered a community of interest, with the membership distributed across the country, what unites members is the common purpose of engaging in decarbonisation.

BSC aims to aggregate ownership of rooftop solar while optimising self-consumption of solar. They engage with businesses, schools, health care and other organisations with large roofs in order to enter an agreement to hold a lease of the roof space. BSC pays for the installation of the solar PV and in return the property owner agrees to purchasing a proportion of their electricity from BSC - the owner of the solar cells - at a guaranteed and favourable energy price. Similar to the Netherlands, the regulatory landscape makes it difficult for communities or cooperatives to share the energy they produce. To get around this, BSC has created novel energy contracts in which only a portion of a large consumer's energy demand is met, the remaining is brought from the grid. It is worth noting that due to the relative infancy of the coop, there is only one site that was recently made operational, with a second due to open in the coming year (BSC 2023).

Impacts and Value Propositions

BSC offers a multitude of values across the community by nature of their activities, increasing renewable energy generation, and their organisation and the participation of members. Naturally, decarbonisation and emissions reductions contribute to the environmental mission of the coop, installing 100 MW of rooftop solar, and the hundreds of thousands tonnes of CO2 emissions saved (BSC 2019). As an organisation, BSC state that they are 'Carbon First', meaning that all surplus profits are reinvested into developing more solar capacity, as such, there is less attention given to the social intersections of a renewable energy transition (BSC 2023). In this carbon/climate first approach however, explicit attention has been given to the ethical sourcing of solar panels, the challenges of opaque supply chains, and the higher costs willing to be paid for guaranteed sourcing, production conditions, and energy used for production (ie using renewable energy rather than coal) (Halle 2023a; 2023b). These, together, can be seen as a commitment to the wider environmental benefits that are often purported of renewable energy.

Key economic benefits are delivered to the building owners, who receive favourable energy prices relative to the market, and hence reduced energy bills. Since the clients they interact with are usually industrial building owners and factories, reducing energy consumption through awareness of consumption patterns is less likely than residential contexts, where understanding of consumption can lead to reductions of energy demand. The second core economic benefit is directed to the individual investors, who receive interest payments on their initial capital investment, with BSC proposing a targeted return of 5%. Naturally, investing capital in any project comes with risk, and the burden of this is shared across the community, both by the cooperative as an organisation, and by the individual investors.

Several functions of the coop, and features of organisational form, scaffold social networking effects. For instance, the community of volunteer members that are being mobilised hold multiple community and trust building benefits. As a community of interest it enables the connection of people around a common set of

values as well as abilities to contribute. Accompanying this is the specific training and experience that is gained within the solar PV field, creating significant learning effects for those involved. It is difficult to fully grasp the extent of impact from these knowledge building and distributing mechanisms, however there are a whole range of ways that knowledge is shared by BSC. The range of training offered to volunteer members, as well as public webinars and discussion blogs, about various aspects of community solar, from identifying potential sites, to more legal aspects of community solar, and the environmental impacts along the supply chain (BSC 2023a; 2023b). In terms of technical impacts, the core effect is on the increased production of solar energy and the self-consumption rate of building owners. At the current scale, there is relatively little impact for wider reduction of pressure on the national grid, however if deployed on more sites, a broader network effect could take place.

Chapter 5 Results

The results of the applying the conceptual framework in empirical case studies are presented here. Providing a deepened understanding of the various benefits of the energy communities, insights into their distributions and how these can be situated within the context of distributive energy justice, as conceptualised currently. This chapter will answer the third research question, *how can expressions of benefit distribution and justice concepts support reflection and discussion regarding energy justice within energy communities?* To arrive at a satisfactory answer, the chapter will be guided by three subquestions. First, *how do stakeholders within energy communities perceive benefits and burdens*, will be answered by synthesising the findings of benefits and value propositions found in the desk research as well as the results from interviews. It is worth noting that while various points of focus emerge from interviewees, not all aspects of benefit and burden elaborated on. Some omissions, such as a limited engagement regarding the material footprint of energy supply chains and consequential environmental impacts, will be returned to in the discussion as steps for future research. Building on the more neutral understanding of broad benefits and burdens, the second part of the results will answer the second sub-question, *what are the experiences of distribution for these benefits and burdens.* Applying the questions from the distributive dimension, more explicit expressions of how benefits and burdens are allocated across the energy community are presented. The final part of the results will present how the core concepts of distributive energy justice emerge within the energy communities. Synthesising observations from interviews and identifying core themes and patterns across cases and participants will answer the third sub-question, *what do experiences of benefit distributions reveal about energy justice within energy communities?* The chapter will culminate in a critical reflection of the results, producing a question matrix that can serve as a practical toolbox to support reflection and discussion of energy justice within energy communities.

5.1 Benefit and Burden Perceptions

Based on the insight from the case study analysis, as well as drawing out of common benefits across energy communities, there are several overarching sets of benefits that can be identified across the categories outlined previously. These will be presented along with expressions from stakeholders emphasising particularly pertinent benefits from each of the case studies.

Environmental

Most obviously, environmental benefits relate to the emissions reductions from deployment of renewable energy production. Each of the communities is involved with solar or wind generation, as well as other energy innovation, contributing to decarbonisation of the energy system. It is worth noting, however, that only Big Solar Coop shows specific emphasis and attention to the impact of their supply chains. Seeking to source 'ethical panels' from manufacturers that are closer to Europe, with greater transparency across the supply chain (UK005). The impact of this is the distribution of the benefits are concentrated on consumption, rather than spread across the life cycle from mining and manufacturing processes.

Due to the scale of the operations, wider environmental impacts can be found in the different innovations Zeeuwind co-initiates. For instance, the Carbon Bond project piloted in 2020 works with farmers around the Krammer wind park to store carbon in their agricultural land. Alongside the retention of carbon, such practices improve soil quality and water retention capacity, hence creating additional environmental impacts (Demeyer et al. 2022).

Economic

Each of the cases have quite different business models with varying economic benefits to stakeholders. While both Zeeuwind and BSC offer returns to their investing members through revenue generated by electricity sales, they deliver a diverse range of returns. For BSC, by dealing directly with large building

owners and contracting roof space for solar installation, they create the conditions to offer stabilised, if not reduced energy bills for clients. The small scale of BSC (an operational 295 kWp and planned 556 kWp) stands in quite some contrast to vast arrays of wind parks, solar farms, and other energy projects from Zeeuwind (generating well over 100MW from only their windparks Zeeuwind 2023c). The impact of which creates a greater security of economic benefit for stakeholders, due to business diversity, along with the return on investment to members. Moreover, having established a social benefit fund surplus profits earned from energy price spikes due to the energy crises can be directed into community projects to alleviate energy poverty, for instance (Nl002; NL003). Solby stands apart from BSC and Zeeuwind in the economic benefit created due to the collective ownership model of the ecovillage, and the various spaces that are held as commons. The energy bill reduction experienced from both the increased self-consumption and the arrangement with their energy supplier are non-exclusive benefits to all residents. Specifically, since living in the village one pays a contribution to the housing association, serving as the legal owner of the common areas, the reduced pressure of energy bills on the budget provides greater flexibility to spend on other collective goods and services (SWE01).

Social

Several kinds of social impacts have been highlighted across the interviews, two sets of particular emphasis were network and capacity building and social capital and trust. Interviewees stressed the importance and impact of building networks connecting citizens, local initiative groups, and institutional partners and organisations (NL02; NL03 SWE02; UK03). A common theme amongst them relates to the importance of information flows, and the power of stronger networks to support the distribution of relevant knowledge (NL004; NL02; UK04; UK05). This is related to the ability to empower people through better understanding of energy consumption, supporting the multiple processes involved when initiating a community energy project, be these technical, economic, administrative or legislative. This learning effect emerges across all case studies, and is considered a crucial role and responsibility that energy communities can take, both to support the education of citizen members, as well as collectively educating themselves to serve the community better (SWE02; UK03). An additional core benefit is the impact of engaging in community energy projects for social capital. The processes of participation and deliberation that enable contact and connection between citizens in local areas and regions have escalating effects for trust building amongst residents.

The multiple projects Zeeuwind are involved with across scales contributes to deeper network effects. Enabled by its larger size and access to resources, the cooperative uses its institutional legitimacy to empower smaller, more local community projects. In so doing facilitating multi-level network effects between larger scale actors to scaffold local initiatives with more limited resources (NL03). It is possible to understand a directionality of flowing social capital here, with accumulated trust and legitimacy from a larger scale energy cooperative able to offload and distribute some of this imbued trust into a diverse collection of initiatives. This stands in quite contrast to the social impacts within Solby, which can be understood as a continuation of a community building process at the village level, with additional projects creating new spaces to deepen the organisation of a commons. Given the existing basis of collective organisation, the multiple different interest groups, initiating and managing particular aspects of the village's function, establishes quite a stock of existing social capital. The energy project and interest group enable new focus for residents, deepening the collective ownership of core infrastructure through deliberative mechanisms. The large role of volunteer members within Big Solar Coop creates multiple avenues for social benefits, and is perceived as a core value for participating. Volunteers are provided with an extensive resource base and educational materials, providing insight into a range of issues relating to rooftop solar installations, grid connectivity, building suitability, and building relationships with clients (UK03). For volunteer members assessing suitability of sites, the potential of solar generation possible on a site, and becoming more aware of energy demand profiles, a core learning can be greater reflexivity on their own consumption patterns.

This point will be returned to later in the discussion about potential intervention points for leveraging knowledge flows. The nature of the community of interest enables wider networks to be formed across the geographies in which citizen members are located. One emphasis in terms of social impact is the power of uniting around a common purpose (UK01; UK03). Finding support through the connection with others concerned about climate change, decarbonisation and grassroots participation, and feeling compelled to channel these concerns into practical projects to support the energy transition.

Technical

While each of the cases uses different kinds of business models, there is a common approach towards generating electricity as a core function. Through the collective ownership of RES assets, electricity is, generally, sold to national grids or clients. This contributes to RES deployment and, depending on the scale of the project, grid balancing. Compared with social impacts, which are generally more affected by the organisational form of the community energy group, the technical benefits, however, depend more upon the operational function and business models adopted by the initiatives. With the majority of Zeeuwind activities devoted to wind and solar farms, a large part of the technical benefit relates to the increasing proportion of renewables in the Dutch electricity mix. Existing legislation has created a barrier to distribute the physical electricity amongst the membership, however alternative power contracts have explored this and enables increased levels of self-consumption which in turn contributes to local grid balancing. Additionally, projects such as the collaboration with the local community in Hoek to establish a residual heat network using the waste heat from the chemical manufacturing company Dow (Zeeuwind 2023a). The technical benefits of which explore the potential for energy cascades and implementing more circularity within energy use. At a more local level, Solby has been able to contribute to increased self-consumption, consuming approximately 40% of the electricity generated, and thereby reducing pressure on the wider electricity grid. One issue emerging in how much is known about impact that increased rates of self-consumption have for avoiding national grid upgrades. Given this is a core challenge for distribution and transmission operators, as well as a great potential for energy communities to reduce the need for, knowing the extent of this impact can be seen as a core area for future research within the field.

Table 3 Synthesised benefits across cases

	Environmental	**Economic**	**Social**	**Technical**
Benefits	*Greenhouse gas emission reduction* All of the energy communities have a focus on installing RES infrastructure (i.e. wind turbines, solar panels, solar heating) that reduces the emission intensity of energy production	*Revenue to members* Business models relying on member crowdfunding and investment deliver a range of return on investment rates, these are often in the form of return on investment payments to members or energy price stabilisation or reduction	*Network and capacity building* Energy communities are situated within their respective locality and wider network of energy initiatives. Much attention is given to distributive mechanisms such as knowledge sharing *Social capital and trust* Emphasis on the community pride for participating actively in local projects, with collective ownership, deliberation, and power sharing contributing to a more robust sense of responsibility, in turn supporting a multiplicity of value from positive social impacts in local areas	*Energy security and autonomy* Contributions to energy security and autonomy across scales, at the individual property level, the neighbourhood, or wider region *Local grid balancing/stability* In turn, there are contributions to grid balancing at local levels, managing and matching energy supply and demand
Burdens	*Embodied carbon effect* One concern that emerges with additional income from investment into green projects is a risk of rebound effect, in which this revenue will be spent on activities increasing energy consumption, undermining initial emission reductions *Mining and extraction processes* The broad lack of transparency within energy supply chains creates large challenges to ensure ethical sourcing for local communities, as well as making it difficult to factor in all issues of risk	*Capital investment risk management* Often requiring large initial capital costs these require complex sets of agreements and contracts in which the risk of operations need to be covered to meet investor risk aversion *Trade Offs* One trade of relates to the distribution of revenue, delivering larger returns for investors, or wider benefits such as feeding directly into new energy projects, establishing a community benefit fund	*Social capital pre-required* Community burden by challenge to factoring in the risk of inaction, and the missed opportunities of building social capital *Stretched for time and energy* Local initiatives often involve multiple approaches, which, while deeply valuable, can be slow. Yet, trust takes time, and should not be rushed There is often a small group of individuals bearing a great deal of the responsibility which can create vulnerabilities within the organisation Important to recognise differentiated desires, roles and responsibilities of all citizens, some people won't be able to nor want to participate extensively	*Legal barriers for collective ownership* Nature of the community, multiple common spaces makes things easier, but creating internal micro-grid remains particularly challenging *Risks* Technical risks of larger projects can often not be covered by the smaller energy communities, in need of larger actors, favourable rates or contracts Challenges of distributed/decentralised system requires larger restructuring of current system which favours large scale infrastructure projects

5.2 Distribution Perceptions

The results of applying the distribution based questions are presented below. As will be illustrated, the size and scale of the community creates the conditions for particular dynamics of distribution. Multiple design options exist for energy communities to distribute their associated benefits and burdens depending on their respective size. Whether this is by establishing consistent interaction and engagement with individual members contributing to trust building; or using institutional power to support smaller initiatives which are more embedded in the local community. By presenting this overview of experiences of distribution, the chapter will provide the foundation for a reflection of the manifestations of justice within the energy community case studies in the subsequent chapter. Specifically, characterising what it looks like for there to be more or less distribution across impact categories will help point towards directionality of distributive justice. This will help reveal particular power dynamics that ought to be paid attention to, and the mechanisms for empowering local initiatives.

Environmental

Discourse surrounding the energy transition and pathways towards Net Zero Emissions create a focus for environmental impacts anchored to the contributions towards decarbonisation. Participants highlight a core aim is achieving emissions reductions by installing renewables, such as solar or wind. Yet, there is also an acknowledgement that with stretched business models and limited resources, it is less of a priority to track the environmental impacts occurring across the supply chain (NL03; SWE02). The challenge of this means that the benefits of renewables are concentrated towards the consumption side. Effectively, without the guarnteee that detrimental ecological effects are not happening, it can be assumed likely that they are (Croes & Vermeulen 2020). While it is important to find ways to establish a broader system approach that accounts for the entire supply chain impacts, these also need to be proportionate to the power and responsibilities across stakeholders. For instance, understanding the responsibility of a local initiative to establish a sustainable supply chain should be different than a multi-national power company, however, there is nonetheless responsibility for both. Approaches that focus attention on emission reductions from energy production and consumption, as mentioned earlier, become vulnerable to ignoring broader ecological impacts across supply chains; particularly when there is limited transparency of what those impacts actually are. The implication of this is that the distribution of environmental burdens across the energy supply chain remains concentrated in the regions in which mining and manufacturing are located, with the praise of installing renewables attributed to energy consumers (Dorninger et al. 2021). It is worth highlighting, that only BSC make explicit efforts to prioritise sourcing a supply of 'ethical solar panels', that while up to 20% more expensive, supports a more regional supply chain with greater transparency in their environmental impacts (UK05; Halle 2023a).

Economic

The distribution of economic benefits and burdens depends greatly on the business model adopted. As identified a common economic return relates to the interest paid to investing members. Community groups have multiple options to distribute these returns as is highlighted by the three different models of the case studies. Within Zeeuwind, a sharing mechanism has been established, such that when surplus profits are made, such as those made in 2022 due to the energy crisis, increasing the price of energy without an increase in the cost of production, returns to investors are effectively capped, and additional revenue enters into a social benefit fund (NL03). Alternatively, distribution can happen earlier, in which an agreed proportion of revenue is directed into a so-called 'wind fund' used for sustainable projects (Wind Park Krammer 2023). This supports the distribution of economic resources across the wider community by enabling social projects seeking to alleviate energy burden and poverty within the region. Moreover, the engagement in various energy innovations includes collaborations with multiple different stakeholders, diversifying their

business models and creating additional distributive mechanisms. For instance, establishing a local residual heat network has involved arrangements with the industry giant Dow, as well as the network operator NetVerder (NL11). In this project, residents will pay only the charges to the heat supplier, rather than consumption charges, while it is not certain that this will reduce energy costs for households, there is expected to be stabilisation due to independence from gas prices (NL10). By creating energy cascades which reuse waste heat energy, the subsequent emission avoidance from residential heating, is manifested as an economic benefit for Dow in the form of a proposed emission credit (NL10).

The structure of the commons in Solby frames the distribution of economic benefits as a collective, public good, experienced as an energy bill reduction for the housing association (SWE01; SWE02). Since residents are, by default, part of the association, alleviating pressure from the budget means that alternative projects can receive funding. In terms of fairness of this allocation, the structure of the commons creates a particularly equitable internal distribution. Moreover, the economic motive, as mentioned previously, was an inconvenient hurdle, so long as the projects are not excessively costly, residents are often appealed to pro-environmental projects. Effectively, limited economic benefits need to be distributed for such projects to gain approval, as one interviewee put it: "Lets not look at the price tag, let's just do it because it's the right thing to do" (SWE002). The economic benefits within BSC relate to the returns to investor members and the energy bill stabilisation (if not reduction) for sites. Consistent with their approach to be 'climate first' any surplus revenue generated is earmarked to be directed back into new solar projects. There is a pragmatism to the approach adopted, emphasising that any economic benefit generated by BSC needs to motivate and mobilise citizens to support the grassroots financing of solar deployment, as well as create a strong business case that is appealing for prospective clients. The business model enables a more equitable distribution of electricity price, since BSC receives a higher price for the sold electricity to the site owner than they would from selling to the grid, simultaneously to the site owner receiving a lower price than they would otherwise pay from the market.

Social

The core social impacts of energy communities outlined above were characterised by network building and social capital effects, there are various patterns of distribution that can be noted. It is worth noting that while the organisation of the community have respective participatory opportunities to engage, enabling different particular distributions of social benefit, mapping and measuring these remains a core challenge. As such, the aim here is to provide a basis for stakeholders within the energy community ecosystem to better reflect on the potential of mechanisms. For instance, where there is an active volunteer base, regular meetings in which guidance can be sought, problems handled, and insights shared, provides an accessible space to actively engage in community functioning (UK03). Meanwhile, organisational forms which rely on a more less frequent involvement in community functioning, i.e. fewer collective or open meetings, can lead to a more passive participation from the membership and lower member turnouts (NL03). This interacts with the social capital effects since with space created for contact and connection between members, stronger relationships within the community are formed. In situations where the community establishes a more professionalised organisation, there are new opportunities for engaging in more collaborative projects.

One observation from the interviews relates to the perception of reduced risk when local initiatives have undergone some kind of process of professionalisation. The social impacts in these contexts relate to the legitimacy granted upon community energy groups at various stages of their development. Several interviewees highlighted that less matured groups struggle to establish trusting relationships, and when they do it is often thanks to deep processes of relationship building within the community energy ecosystem (NL03; NL04; NL05; SWE2; UK04). Building partnerships that are based on trusting relationships is entangled with the power shared with collaborators, and points towards the directionality and distribution

of power held by different stakeholders. For instance, the legitimacy held by Zeeuwind enables the organisation to engage in projects which seek to redistribute power to more local groups that may lack the broad set of resources held by the regional energy cooperative. This power sharing across the community energy network could be used to leverage further decentralisation and democratisation, and is an issue of pertinent to many local initiatives (Kooij et al. 2018)

For Solby, two kinds of information flows were highlighted, internally, within the village and between residents, and those as part of a wider, global network of ecovillages. Firstly, the organisation of interest groups in the village established nodal points for knowledge to be created, and from which could be shared with the wider residents. A core issue relating to insights about patterns of energy consumption, altering when energy intensive activities were performed, which could reduce household energy costs, was discussed as a powerful insight that could have an impact on energy bills, however, a challenge related to the most useful way to communicate this to other residents. Secondly, there were observations made about the broader connections with different ecovillages that could share insights with how Solbyn realised their solar projects, or learning from others who have achieved projects Solbyn would be interested in undertaking, an internal micro-grid for instance.

Big Solar Coop provides multiple learning opportunities and channels to share knowledge, in particular for the volunteer members. With an active Slack channel and an open web portal, volunteer members have an accessible bank of resources. Upon signing up, citizens are encouraged to familiarise themselves with core aspects of BSC, and participate in particular working groups. This working group format allows for internal knowledge sharing, which can then be communicated across groups during wider meetings. Moreover, the various workshops, webinars, and open calls that are organised aim to inform various stakeholders of the work BSC is doing, these include both a wider citizen base, local authorities, and other community groups interested in learning about undertaking share offers, for instance (BSC 2023). The fact that it is organised as a community of interest, with membership distributed across the country enables a more distributed cultivation of social capital. Indeed, operations are outside of the areas that have high levels of pre-existing social capital, in turn contributing to the slow work of building trust across and within areas where grassroots initiatives are less likely to form (Grignani et al. 2021; Gunderson et al. 2018)

Technical

Across communities, the main attention of distribution are the technologies required for the operational functioning of the communities. For the present case studies, these relate to the generation of electricity using renewable energy supplies. Attention to the technical impacts relate to where the physical electricity flows to, how it is distributed (NL01; NL02; SWE02; UK01). While there is ownership of the generation assets by the members of the community, there are core legislative barriers raised which prevent greater distribution. This relates to the challenges involved in sharing the physical electricity that is generated by the collectively owned renewables installations (NL03; UK02). That the self-produced electricity needs to arrive in a regional or national grid in order to be distributed creates a restriction in the possible structures for energy to be transported. Working within current regulations, smaller scale initiatives struggle to navigate the technical burdens regarding high initial investment costs, disadvantageous perceptions of risk, and navigating the administrative and legal mazes. An observation noted by several interviewees related to the lack of power held by such local groups and projects when trying to partner with stakeholders that could help tackle technical challenges (NL04; UK03). Part of this relates to how the existing energy system structure grants incumbent grid operators and energy suppliers considerable weight when considering innovations that would redistribute power towards more bottom up projects.

Using the established revenue stream to diversify their activities to include more innovative energy system interventions, Zeeuwind is able to integrate various technologies that contribute to greater distribution of

technical resources and benefits. Using their wider resource base, including financial capital, human resources (the reliable stock of energy and time derived from a more professionalised community functioning), installing new low-carbon technologies for community groups that would otherwise struggle to initiate their own renewables project are facilitated. In Solby, the core technical impacts relate to the increased collective self-consumption of common areas within the village, and hence a level of local grid balancing, along with the surplus electricity that is sold to the grid. It is worth noting that less than half of the electricity generated is, in fact, used for such self-consumption. This is a common issue emerging from initiatives seeking to stimulate the prosumption of renewable energy, such that demand profiles do not match the periods of larger supply and production. The implication of this means that direct technical benefits become more tenuous, in as much as it is advantageous for initiatives to increase levels of self-consumption and self-sufficiency. A core struggle emphasised by members of the energy interest group relates to the legislative challenges of creating an internal micro-grid enabling the distribution of collectively generated electricity for residents. Core technical benefits for BSC similarly relate to increased levels of self-consumption and, on a more micro-scale for large energy consumers, grid balancing. One observation from interviews with community members highlights the extent of self-consumption that building owners can actually achieve. Again mismatches in demand profiles and periods of solar generation, a more constrained level of prosumption in turn leads to disappointment about the quantity of electricity that still needs to be purchased from the grid, limiting the proportion of energy consumption that is protected by stabilised (or reduced) costs.

Table 4 Zeeuwind Benefit Distribution

	Environmental	**Economic**	**Social**	**Technical**
Benefits	*Greenhouse gas emission reduction* In terms of environmental benefits, the core focus of distribution relates to emission reduction and decarbonisation of the energy system. Since the physical electricity is sold to the grid, it is less the case that emissions are allocated to particular individuals, but rather contribute on aggregate to regional and national RES and decarbonisation	*Revenue to members; Social Benefit Fund* The economic benefits from the operations relate to the revenues generated from the self-generated electricity being sold to the grid. Members receive a financial return on their investment. With a profit sharing mechanism established so that surplus profit is funnelled into a community benefit fund that is to be spent on social projects.	*Network and capacity building; Social capital and trust* The nature of social benefits relate primarily to the knowledge sharing and trust building impacts of the energy communities. Several aspects of Zeeuwind support broader and deeper distribution of these, such as implementing the community benefit fund for non-profit making projects focused on tackling energy poverty, or using their large scale and institutional power to support smaller, more local energy initiatives	*Energy security/independence* *Energy Innovations* The core object of technical distribution relates to the physical electricity that is generated by the wind farms. Since this is, currently, sold to the national grid, energy community members do not benefit directly in terms of self-consumption or self-sufficiency. Rather, this relates to more regional/national RES deployment. However, the expansion into energy innovations, i.e. Sleeved PPA or residual heat networks, provides novel ways to directly distribute energy more locally
Burdens	*Embodied carbon effect; Mining and extraction processes* Two core issues regard the distribution of burdens, the impact of rebound effects and the transparency of supply chains. The former relates to the consequential increase in energy consumption, or emissions, due to additional income. This implies increasing burden across the climate system. The latter relates unreported and distanced effects occurring throughout the energy supply chain: the detrimental social and environmental impacts.	*Capital investment; Trade Offs; Risks* A core economic burden relates to the initial capital costs and the challenges of factoring in risk and opportunity to business models. This involves ensuring a profitability of operation that covers uncertainties of project failure.	*Social capital pre-required; Stretched for time and energy* A core burden here relates to the limitations of social resources, time and energy of participants, and the underlying dynamics of *who* is in a position to donate their time, energy and surplus capital. Firstly, that relationships of trust take time, which should not be rushed, this means that places with lower social capital require greater attention and time afforded to build local initiatives. Secondly, a concern that energy communities function as an 'investment club for green rich people'.	*Costly capital infrastructure*; *Legal barriers for collective ownership; Risks* Core technical burdens relate to navigating the risks of coordinating the wider grid and national energy balancing, through bottom-up initiatives, along with the burden exerted by the current system and challenges of regulation and legislation that are particularly unfavourable for energy communities.

Table 5 Solby Benefit Distribution

	Environmental	**Economic**	**Social**	**Technical**
Benefits	*Greenhouse gas emission reduction* In terms of environmental benefits, the core focus relates to emission reduction and decarbonisation of the village's energy supply. Due to the existence of common areas, and the contract that has been established with their energy supplier, these benefits are, non-exclusively, allocated to the village as an entity in itself.	*Revenue to community; Bill reduction*; *Pay-back-period; Social Benefit Fund* The economic benefits from the operations relating to the energy bill reductions from both the self-consumption of electricity and heat, as well as the surplus electricity sold to the energy supply company. Due to the arrangement of the common areas, these benefits are experienced directly by the housing association budget, which indirectly supports all villagers.	*Network and capacity building; Social capital and trust* The existing social capital held within the self-organised village finds new developments by the organisation of the energy projects. With a few residents tasked with developing energy proposals, knowledge sharing of issues related to energy can be supported.	*Local grid balancing/ stability; Grid upgrades avoided*; *Energy demand reduction* Core technical benefits relate to the increased self-consumption of electricity and local grid balancing. These support reducing pressure across the energy system, and are concentrated upon the residents primarily.
Burdens	*Embodied carbon effect* *Mining and extraction processes* A core issue within the energy supply chain relates, again, to lack of transparency, making decision making on sourcing particular panels more difficult. The impact of which means that knowledge of embedded impacts across the supply chain are unknown.	*Capital investment* *Trade Offs* *Risks* A core economic burden involved in the Solbyn case relates to underlying dynamics making the village, broadly, more expensive to live in, and concentrating the benefits of collective ownership of RES for those that can afford to live in such a place.	*Stretched for time and energy* Despite the existing levels of social capital within the village, a social burden for the energy interest group relates to limitations of time required to research feasible energy projects and prepare technical documents. This means that responsibility can often fall onto a small handful of individuals	*Legal barriers for collective ownership* *Risks* A core technical burden that falls onto the village relates to the limits of existing regulation and legislation for sharing self-produced electricity between neighbours. This is particularly disadvantageous for the community, while maintaining the existing status quo in which power is held by large scale producers and distributors.

Table 6 BSC Benefit Distribution

	Environmental	**Economic**	**Social**	**Technical**
Benefits	*Greenhouse gas emission reduction* *Wider Environmental Gains* As a 'carbon-first' coop, the principle environmental benefit relates to decarbonisation and emission reduction. In terms of who benefits from this, building owners are now supplied with the larger amounts of low-carbon electricity, while volunteer members experience the value-based benefit for contributing collective emissions reduction. Additionally, BSC pays particular attention to the sourcing of their panels, taking measures to reduce the distance of the supply chain, as well as choosing manufacturers with cleaner production processes.	*Revenue to community* *Bill reduction* Economic benefits relate, primarily, to return on investment to investor members and bill stabilisation (and potential reduction) for property owners. This largely makes sense in terms of who is most vulnerable to the economic risks involved, however, there are underlying questions regarding a business model that is dependent upon a volunteer workforce.	*Network and capacity building* *Social capital and trust* Various social benefits are experienced by nature of the organisation and operation, most notably the knowledge sharing and social capital generated between volunteer members. These are most clearly concentrated amongst the volunteer members, with a range of resources available to distribute information. Broader network effects from organising as a community of interest become more challenging to identify	*Local grid balancing/ stability* *Grid upgrades avoided* *Energy security/independence* Technical benefits relate to increasing rates of self-consumption, which supports local grid balancing. These are benefits mostly affecting individual property owners, when/if deployed at scale this benefit would affect local grid operators to a greater extent.
Burdens	*Land-use change effects* *Mining and extraction processes* While efforts are made to ensure the supply chain is as ethical as possible, there are inevitable challenges faced by the distribution of environmental damages across the geographies of the supply chain.	*Risks* Economic burdens of the energy community relate broadly to the perceived risks of committing to a BSC project, as well as the investor members' capital at risk. The former point relates to establishing the proof of concept and viable benefits that building owners would receive in a situation of uncertainty	*Social capital pre-required* *Stretched for time and energy* The social burdens of the community are broadly mitigated by the voluntary nature of the community organisation, with members able to decide themselves how much time they contribute. There is some attention to the risk of imbalance of responsibility and power between volunteer members and paid staff.	*Costly capital infrastructure* *Legal barriers for collective ownership* Core technical burdens relate to the arduous processes of feasibility assessments and locating appropriate sites, accurate demand profiling that might lead to site owners having lower self-consumption rates than initially expected, and legislative challenges regarding regulation that supports and streamlines solar installations.

5.3 Expressions of Energy Justice

The aim of this subchapter will be to consolidate, synthesise and outline the expressions of distributive energy justice that emerged in interviews in response to particular perceptions of benefits and distributions. In doing so, there will be a reflection offered that will answer the third sub-question: *How do the experiences of benefit and burden distribution manifest in expressions related to distributive energy justice?* First, an overview of the interview findings will present a sample of core perceptions that express aspects of distributive justice concepts. Following this, the results from the previous chapter will be integrated to provide a basis for a critical reflection on how these expressions of justice relate to and interact with the distribution of particular benefit categories. The outcome of this will be a matrix of justice concepts with the benefit categories, providing a series of critical questions that can support practitioners within energy communities to reflect on their own positionality within the energy transition, the power that they hold, and the extent (and limits) of their responsibility.

Capability

Attitudes regarding capabilities were observed at two key levels, the needs of the individual members and the needs of the community as an entity in itself. The capabilities of citizens were expressed through two recurring themes: meeting energy needs in affordable and accessible ways and establishing structures that enable active participation. For the former, while it is the case that multiple interviewees highlighted energy poverty as a core deficiency that needs to be tackled, due to the demographic and social group composition of community energy initiatives, this is something less experienced by the membership directly (NL02; NL05; SWE03; SWE04). Rather, it is framed as an interdependent responsibility for grassroots initiatives to support the needs of the wider community, and in turn relates to creating processes which can help identify which groups are most vulnerable to energy poverty, and the most appropriate mechanisms that can support them. This becomes entangled with the second theme, focusing on enabling the engagement of members and broader citizens. Due to the voluntary nature of many community energy groups, flexibility to commit time and energy to active participation in local initiatives runs the risk of becoming a luxury afforded to only a few in more privileged socio-economic-political situations (NL01; UK02). As explained earlier, there is a need to engage with the existing structures of wealth and socio-economic inequalities that enable particular groups to invest. Several interviewees highlighted that this was done as much as possible, in both BSC and Zeeuwind, £100 and €100 respectively, are relatively low investment costs required to become a co-owner of a renewable energy project; especially compared to the thousands it costs to own these technologies privately (Stewart 2021).

The needs of the community as an entity included issues relating to trust and relationship building in collaborative projects, the need for stronger networks that enable clearer channels of communication, and the sharing of relevant insights that would support groups (NL03; NL04 SWE02; UK03). These are highlighted as core needs for communities since they each represent existing barriers for the initiatives to fulfil their potential function. Knowledge flows, especially, emerge as a core dimension. These can be seen as enabling information exchange across multiple levels of the community energy ecosystem. One level relates to sharing knowledge within the network of community energy groups, providing insights for how particular administrative, legislative or technical challenges were tackled (NL05; NL06; NL11 SWE01; SWE02 UK03). Another relates to relationships with organisations across levels of governance, from the national, municipal, and local levels. Establishing the trust and recognition as legitimate partners between actors as well as understanding what kind of communication is needed, and what this is to look like in order to be properly heard and recognised (NL04; SWE; UK04).

Intersectionality

Expressions concerning intersectional power dynamics emerged in two key ways. First, and more precisely intersectional, regards the attention to inclusion of particular social groups in the energy community initiatives. Here, there is an acknowledged concern that more marginalised groups are at risk of being disproportionately disadvantaged by the energy transition (NL05; UK01; UK02). Interviewees showed simultaneous concern for marginalisation of groups as well as questioning the extent of responsibility and power that energy communities had to intervene in this (NL003; NL005; SWE002; SWE003; UK002; UK004). A common theme amongst each of the cases is the presence of privileged social groups within the energy communities. Power-holding groups, higher income households, educated, older, white and male, were pointed out as particularly prevalent within community membership. When engaging with this as a potential issue, interviews arrived at a discussion of whose responsibility it is to tackle this, and what it would actually look like to intervene in this dynamic. The scale and scope of each initiative's operations create unclear limits of how far this responsibility extends. For an ecovillage with a limited number of residents who can participate in community energy activities, there is a clearer boundary of responsibility defined by the border of the village. While it may be that the more expensive housing situation becomes exclusive for low income households, or there exist particular socio-cultural contours that make living in an ecovillage more appealing to particular social groups, it remains uncertain what responsibility or power existing residents or housing association have to make participation more accessible (SWE002). Alternatively, for a community of interest whose voluntary participation is totally open, there emerges a challenge related to some potential ideal level of diversity amongst the membership. Identifying which steps can be taken to increase participation across social groups would improve the representation, and likely have compounding effects for the social capital and trust building experiences within the community. As pointed towards, there is a question regarding the extent of responsibility of the communities to ensure this happens, along with the level of diversity which could be deemed 'enough'. Two further issues emerge in this context, first, navigating the dynamics of empowerment. What does it mean to 'empower' even? Is this something that can be thrust upon an individual or group, something that needs to be claimed for themselves, or a mix of the two in which conditions are created that enable empowerment (NL004). Second, and relatedly, navigating the risk of projecting particular standards of participation, and expectations of responsibilities to participate onto individuals and groups that can not or do not want to engage in such a way (SWE03). The lens of intersectionality is a valuable reminder to consider the power dynamics within social contexts, giving appropriate attention to identify where power is held, by whom, and what the impacts of these distributions are. This focus, particularly on the compounding marginalisation of particular social groups, was often linked to broader power dynamics that interviewees identified within the context of community energy initiatives (NL02; SWE02; UK02; UK03). Specifically, the legitimacy and trust they were treated with in collaborations with other stakeholders, such as local authorities and policy makers, banks and investors, or network operators.

Considering the way power is held and the potential mal-recognition of particular groups, a sense of intersectionality emerged in interviews focusing on the discursive power present in current configurations of a socio-technical energy system (NL04; SWE2; UK03). The struggle that local initiatives have in establishing partnerships with incumbent actors, often due to lack of legitimacy, trust, or perceived value, was emphasised by several interviewees. One of which highlighted the importance of taking time to create strong, trusting relationships (NL004). One insight here relates to the processes of unlearning that are necessary to equalise the relationships that have conventionally held unbalanced positions of power, in order to build trust between them. Illustrative of how this is the role that Zeeuwind takes, using the institutional legitimacy built over a successful history, to empower small community groups by partnering with them to provide necessary economic, legal, or other resources. Identifying the particular aspects of support provided by Zeeuwind that establishes the required credibility of these smaller initiatives can help understand which existing power dynamics are in need of intervention. For instance, if core barriers relate

to navigating the array of legislative and regulatory barriers, a direction is gained to focus on how to provide more groups with such support.

Spatiality

Three themes of spatiality were particularly prevalent within stakeholder interviews relating: collaboration with social groups proximal to local commnunities, role and transparency of wider supply chains, and supply energy locally. The first builds on the need to build relationships with organisations that have greater proximity to local communities, adding a particularly spatial dimension to partnerships (NL03; NL04). As highlighted earlier, the power of building trust and collaborations with groups embedded within local communities can use existing social capital to support projects, as well as the greater understanding of particular local needs (NL06; UK01). For communities of place that have more defined geographic boundaries, whether this is at the neighbourhood or village level, or distributed across entire provinces and regions, this can lead to a group think of responsibility: we are not responsible for those outside of our region (NL06; SWE02; SWE03). The point here is to make more explicit the role of spatiality when looking at the responsibility of particular actors, and ensure that organisations that have explicit power, responsibility and accountability across levels and scales of spatiality are included in these projects. This points towards the problem that injustices occur when specific places and regions are systematically 'left behind'. In the Netherlands, Sweden, and the UK, there are very real geographic inequalities, manifesting in spatial injustices (Mulder et al. 2022; Department for Energy Security and Net Zero 2023). Tackling these requires building the capacity and capability across levels of governance and at different spatial scales. How an energy community situates itself within a wider geographic context, establishing a network and interacting with stakeholders involved at multiple spatial scales can, however, create challenges for the boundaries of responsibility.

The second, spatial theme that emerged relates to the attention given to the wider supply chains that the community activities were embedded in. All community energy groups are entangled in supply chains that extend across multiple geographies, however, most attention is given to impacts in areas that are most proximal to their activities. Two core reasons prevailed for this, relating to creating genuinely viable business models or lack of transparency within the supply chains, making ethical sourcing either more expensive or particularly challenging to evaluate (NL03; SWE02; UK03). By nature of the particularly local or domestic lens of communities, there can often be a near-sighted view of where the groups actually have impact. This further contributes to the conditions in which smaller scale community initiatives, with less financial and human resources capacity are not incentivised to extend the attention of their spatial scale across the supply chains they are involved in. Again, the issue of responsibility emerged within these discussions, with emphasis placed on the duty to establish viable business models for the communities' membership. While it may be more ideal to purchase solar panels or parts for wind turbines from manufactures guaranteeing 'sustainable' sourcing practices, this cannot come at the cost of a viable business model or ensuring guaranteed returns on for members.

The final theme relates to creating communities in which electricity is generated and consumed locally. For many working within the community energy groups, this is an ideal vision, energy needs are met by local production, with the entire system of provisioning under democratic control of residents (NL02; NL08; NL09; SWE02). This requires establishing clear boundaries of the places and spaces that are included in that locality, as well as establishing regulatory frameworks that support local initiatives, and create some kind of financial incentive that makes it worthwhile, rather than defaulting to incumbent economies of scale.

5.4 Towards a reflexive reflection of distributive energy justice for energy communities

The present discussion examining the expressions of justice from stakeholders across energy communities aims to recognise the diversity of ways attention is given to benefits and burdens, and how these manifest in perceptions of justice. Having presented the perceptions of benefits, and distributions thereof, along with subsequent expressions and interpretations of how the distribution of these interact with concepts of energy justice. Table 7 presents an integration of benefit categories and justice concepts, reflecting on the inisghts when these strands are brought together. This is a starting point for practitioners working within the energy community ecosystem to adopt an exploratory, reflexive and reflective approach to the ways that their work contributes towards energy justice. The questions represent the various insights that have emerged in the course of this research, and seek to encourage local initiatives to both celebrate their contributions towards building a more equitable energy system, as well as acknowledge existing puzzles, contradications and challenges. The matrix should serve as a tool for theorists and practitioners alike to reflect on their current operations and organisation, how these may shape particular benefit distributions and be able to identify places in which interventions could contribute to more just processes and outcomes.

How this table could be used will depend on the particular context of its application. However, one suggestion would be a workshop or interest group discussion within energy communities going through the matrix, identifying the questions that are most pertinent for their context, and mapping out responses, along with answering why others seem less relevant. An example of this could take insights from a capabilities approach to the impacts of social benefits, with knowledge transfers and information flows being of particular emphasis. This may shed insight on several dynamics within the community, including a better understanding of what knowledge gaps exist within the membership, as well as highlighting what channels of communication are present within the community organisation, including between the members. For the former, this could include particular technical issues that are currently encountered by groups, and together with core partners and collaborators identify where knowledge sharing could occur. Considering what kind of channels of communication or even activities could support greater information flows could be applied both to the community/ organisational level, as well as to the individual and member level. For instance, asking how contact and connection between members could additionally be framed to build trust and social cohesion. Alternatively, engaging in collective discussions around the vulnerabilities to energy burden or poverty within the local communities could be framed within a broader context of what kind of responsibility is to be taken as a collective. This would imply a greater understanding of spatial distributions, and what kind of support is actually needed by particular groups, and consider what power the community group has to intervene or meet particular needs.

A final note would reiterate the overlapping nature of the concepts, highlighting that some questions may be relevant at multiple intersections. This can be noticed in the matrix where similar themes ermerge throughout the each of the concepts, framed slightly different for each benefit category. For instance, interest in the demographic of the membership is relevant both for the distribution of economic benefits, in as much as identifying the socio-economic groups that are benefiting, as well as for social benefits, for identifying the patterns of social trust and community building across particular groups. Moreover, this can be seen across particular benefit categories, for instance, environmental impacts are often of a particularly spatial nature, which may be particularly useful for framing particular needs for individuals and communities.

Table 7 Question Matrix of Distributions and Concepts

	Distribution What is being distributed, who benefits, and who is burdened?	**Capability** What are the needs of individual members and the energy commmuntiy?	**Intersectionality** What power dynamics exist between actors involved, how is power held and shared?	**Spatiality** Across which spaces, places, and regions do impacts occur?
Environmental	What are the main environmental impacts of the energy community? Who recieves/benefits from the associated benefits from emission reduction?	*Community* Which environmental impacts receive greatest attention within the energy community, and how are these communicated? *Individual* In what ways do local residents depend on the local ecosystems, how could the energy community support this?	How does the energy community acknowledge or speak about rights of nature? Who is most at risk or vulnerable to environmental impacts?	What are local environmental and geographic conditions, how do these support particular RES infrastructure? What are the limits of scale and size of RES infrastructure that the local environment create? How are the environmental impacts across the supply chain reported, and how can energy communities communicate these to members?
Economic	What are the economic benefits, how are these benefits distributed between local stakeholders? How are economic impacts distributed across the supply chain; where are benefits concentrated? What kind of diversification of activities and operation could support wider distribution of economic benefits within the community? Which risks represent the largest barriers for community business models?	*Community* What are key barriers or blocks for professionalising? How does the community deal with/manage risk? What resources are in greatest deficit within the energy community? (i.e. financial capital, human resource - time and energy etc) *Individual* What are the ways that members or residents economically benefit?	What is the demographic of shareholding members, how do those owners benefit economically? How can social benefit projects that best support excluded or marginalised social groups be identified? What mechanisms are available to the energy community that support value retention within the local community? What partnerships and collaborations could support and mitigate the risks?	What are local socio-economic/techno-economic conditions within the local area, how do these compare to the national averages? What employment opportunities are created, where are these located within the supply chain?

Table 7 cont.

	Distribution	**Capability**	**Intersectionality**	**Spatiality**
Social	What kind of social capital and trust building is supported within the energy community? What kind of information is most needed to be heard or understood between partnerships and collaborations?	*Community* What channels of communication would help build trust between the community organisations and other actors/ stakeholders? *Individual* What kind of spaces and activities can best support social trust building between members? What core knowledge gaps are present within the membership, what could bridge these? What spaces, processes, and structures within energy communities make participation more accessible?	What is the demographic of the membership, which groups or perspectives are potentially overrepresented? What processes are currently in place to help identify, listen to, support more marginalised groups within, or excluded from, the energy community? How is solidarity between social groups understood, and spoken about, within the energy community? What are the held presumptions, expectations or projections of responsibility for different stakeholders? (for instance, in engaging in practices of solidarity or perspective overrepresentation)	Where are the boundaries of energy 'community', who does this include? What organisations are already present within the local and/or wider community with whom collaborations could be support social trust? How is social capital and trust within the wider community understood, and what physical spaces could be created to support wider engagement and trust building practices by the energy community?
Technical	How do the technological innovations currently pursued support more accessible and afford low-carbon energy? What legislation and regulation is currently supporting local energy initiatives, what are core barriers?	*Community* What are core knowledge gaps regarding legislation and technicalities? What scale of collective generation would support grid balancing? *Individual* Which technologies are able to meet particular energy needs of members? What kind of communication is most needed to facilitate understanding about technicalities of local energy initiatives?	What insight and technologies can best support households to understand, intervene on, and reduce energy demand? With which actors and stakeholders would collaborations empower communities? How could responsibility between those actors be distributed in ways that would support empowerment?	What are the known impacts across the supply chain? What level of transparency is offered by partners and collaborators? What technologies exist that could support local energy sharing/local consumption? What barriers are there preventing local sharing of collectively produced electricity?

Chapter 6 Discussion

This research has explored the perceptions and expressions of distributive energy justice within local initiatives. A range of themes emerged within the results above of which a few will be highlighted in the present discussion, these reltate to situating the contributions and revelations within existing research and social relevance, the next steps practically and academically, and finally some key limitations of the research.

6.1 Contributions and Revelations

The results above provide a thorough view of the perceptions of benefits and burdens within energy communities, along with the subsequent expressions of the core concepts of energy justice as understood presently. There are various scientific and societal contributions of the research, three of which highlighted here relate to the respective core concepts of the conceptual framework, followed by a revelation on the prominence of responsibility as a common theme throughout. First, the contributions for using the Capabilities Approach emphasised a core need for clear channels of communication to support knowledge and information flows between both the membership of the communities, as well as between partners with the community itself. Understanding the importance of education as a core need for human flourishing is well substantiated within Capability Approach research (Nussbaum 2011; Sen 2005; Velasco-Herrejon & Bauwens 2020), however, understanding this in terms of specific aspects of knowledge within and for energy communities is less understood. Specifically, by framing knowledge and information as a core need *with respect to* multiple benefit and burden categories. This relates to understanding the environmental footprint across the supply chain, the various economic risks with a community business model, or the particular aspects of legislation and regulation that need to be campaigned for in order to leverage the power of energy communities. Bringing an attentiveness towards needs across these impact categories, and the power of knowledge distribution, the present research emphasises the importance of collaborations that support learning at the individual and collective level.

Second, and relatedy, is the implications of power within those collaborative relationships. With knowledge holders occupying more powerful positions, applying the intersectional lens within energy communities that it is important to identify which stakeholders are more marginalised. In doing so, a more nuanced analysis of needs can identify, for instance, what kind of knowledge is most useful to be shared. For instance, where there are social benefit funds, emphasis on supporting vulnerable households at risk from energy poverty requires identifying what kind of energy service and advice is most valuable to those households individually. In turn, considering whether there are existing organisations that function to deliver such services can mean that partnships can be formed that empower those who are already working on these issues. As the vision of a 'Thousand Flowers' emphasises, the value here for energy communities is to encourage and flourish within an empowered an active citizenary and plurality of local organisations.

Third, while the spatial dimension supports the search for collaborating with organisations embedded within local communities, it simultaneously invites a global approach towards supply chains especially with regard to environmental impact. This ought to be highlighted as one of the key challenges for energy communities given limited resources and observations of opaque supply chains. Yet, for this reason emphasises the importance of establishing information flows that can support better knowledge distribution of supply chain impact. Moreover, engaging with wider environmental impacts across the multiple geographies that the energy system operates can encourage discussion within energy communities regarding the extent and expectation of responsibility. This issue, has been revealed as a re-emerging issue throughout the research, and could serve as a useful and practical framing for interventions within local initatives.

Specifically, it has become clear that the nature, limits and expectations of responsibility is a common theme within energy communities, yet, often remains implicit within discussions. For instance, woven into the fabric of energy communities is the value placed on the active involvement of citizens, the open ability to participate and shared control over collective resources is a central principle of cooperatives (Karakas 2019). In turn, responsibility is imbued within that shared control, and supports a distribution of power amongst engaging citizens. This has been highlighted within each of the expressions of energy justice concepts, and holds pertinent insight for the practical application of the question dashboard. Collective discussions around expectations of responsibility for social institutions, including grassroots energy initiatives, is key for accountability to be upheld. For those working in energy communities, achieving an operational renewable energy supply that generates revenue for a local community is success enough, and this ought to be applauded. Yet, engaging with expectations of responsibility could reveal particular capabilities that the energy community possess. These may be relevant to various kinds of benefits, from the inclusion of marginalised social groups to acknowledging wider environmental impacts across the supply chain. To be sure, responsibility may well be more limited for smaller scale initiatives with narrower ability to respond, or response-ability (Beausoleil 2015). When decision making is happening that involves or affects multiple actors across various levels of governance, the results above highlight the risk that burden shifting leds to no-one actually taking the necessary responsibility. As such, it becomes important that when engaging with stakeholders, establishing clear channels of communication where expectations of responsibility between partners and collaborators can be immensely valuable.

6.2 Next Steps and Future Research

Several themes of distribution have emerged throughout the research and point towards gaps that would stand to benefit from further research. Two of which are particularly pertinent to mention here relating to community value retention and knowledge flow. Establishing systems that are distributive by design has become an increasing focus on new economic thinking, and a shift towards local co-ownership of energy supply represents a fundamental design change in which value is generated and retained within local communities (Raworth 2017; CLES 2020). As presented throughout this research, there are a range of opportunities for communities to access a multiplicity of value from bottom-up organisation of energy, yet, evidencing what these look like and the dynamics of their retention is lacking. Moreover, there is absent understanding of the impact that configurations of ownership have for value retention. There has been little systematic work done to map the ownership structures of actors and investors in the present energy system, and identify, precisely, the extent of value extraction that could otherwise be distributed within the community. With increasing attention being given to the dynamics of socio-economic inequality, including in income and wealth, future research on the energy transition would benefit greatly from integrating these perspectives, to analysis the design principles of a local energy system that would contribute to crowding in the real, community economy (Lode et al. 2022; Lacey-Barnacle et al. 2023).

Information flows have been emphasised to impact a range of benefits and is understood to be a powerful dynamic for supporting energy communities activities and establishing more equitable distribution of benefits and burdens (Kooij et al. 2018). Understanding which kinds of knowledge are particularly useful for the community groups emerges as a valuable area for future research. This could take multiple different forms. At the community level, there are a range of technical, administrative, and legal areas which were emphasised as challenging to realise the potential of community functioning. This may mean documentation which clearly communicates technical aspects of grid connectivity or local energy sharing. Alternatively, greater transparency about supply chain impacts would enable more complete assessments of embedded, life-cycle impacts, facilitating pro-environmental decisions making. Importantly, this would analyse and evaluate broader categories of ecological impacts, communicating the trade-offs between energy

supply technologies (Wiesen & Wirges 2017; Regueiro-Ferreira & Alonso-Fernández 2023). To be sure, this is something that is a present theme within sustainability and supply chain management research, for instance, the recent EU framework for Corporate Sustainability Reporting directive establishing more thorough rules for companies to declare supply chain impacts (European Commission 2023), however, ensuring that this knowledge is tailored in ways that makes it accessible to community energy groups that may possess less specialist knowledge sets would be deeply valuable. Finally, understanding the impact that proximity and participation within an energy community have for household demand profiles, would provide valuable insight into the mechanisms of learning effect and consumption patterns. In turn, pointing towards the kind of information flows that can have the biggest 'bang-for-buck' in terms of energy system change (Meadows 1999).

6.3 Research Reflections and Limitations

This research has sought to provide theoretical insight for understanding the nature of justice in the context of local energy initiatives, along with establishing usable insights for practitioners within the field. The exploratory nature of the project enabled a particular flexibility which, given, reflection on the research methods, highlight several features that posing limits on the findings presented, three of which are worth highlighting presently. Firstly, the semi-structured interviews established a methodological agility, enabling the positionality, experiences, and insights of participants to be explored during the interviews. This was a large appeal of the approach in the first place, and enriched the broad knowledge and understanding of stakeholder perceptions within the energy community ecosystem. However, a consequence of this was that when interviews were coded and analysed, there were inconsistencies to how complete all interview questions. Emerging gaps made it challenging to compare some stakeholders' perception of benefit distribution with others, since this was not part of their knowledge base or specialisation, and therefore interviews did not pursue or explore these deeply. While this reflects and enabled a more in-depth understanding of each interviewee, it nonetheless led to an incompleteness within the broader results. Additional methods, that could have enabled greater triangulation through follow-up interviews, a workshop to connect stakeholders together in-situ, or a survey that would ask participants to complete may have filled existing gaps, and established a more holistic view; unfortunately, these fell outside of the present scope.

Secondly, the sample of case studies chosen were substantially different, enabling a more holistic overview of various features of distribution and perspectives of just concepts. While focusing on the particular structures of the communities themselves, the analysis did not consider the wider strucutral or institutional features within the national contexts, for intstance, which enable particular distirbutions of benefits and burdens. The impact of this means that results derived are aggregated, untailored for the diversity of community energy groups as well as variety of national and institutional contexts that exist. While this allows for a general toolbox of questions for energy communities, additional work would benefit from tailoring for specific contexts.

Thirdly, the core aim of this research was to support practitioners engage in discussion about energy communities contribution to distributive justice. Yet, a limit in this regard has been establishing a common understanding of directionality of justice, in part this relates to the inherent normativities of justice (van Uffelen et al. 2024). The impact of this could be problematic for the application for the analytical toolbox in practical contexts, since there is less guidance in terms of what it means, precisely, to be achieving more or less justice. Additionally, this means that when operationalising the conceptual framework, relevant elements and variables of justice are subsequently missed, and therefore not measured within the cases. This was almost inevitably the case when applying a framework of justice in any project, let alone one of the present scale and scope. Since justice is gradual and context deeply dependent, engaging in particular

activities or organising in a given way provides no guarantee that just processes and outcomes will be fully accounted. This motivated the mixed deductive and inductive approaches in order to allow the experiences wihtin the present cases to shape the understandings of key justice issues. The organisation of the matrix is then a reflection of this, aimed to facilitate the active engagement and critical thought of what justice could look like within energy community, influenced by those analysised presently. The exploratory nature of the research was structured to reflect not causal explanations for particular justice outcomes, but rather to create a basis that can stimulate community energy groups, and involved stakeholders, to engage in these discussions more critically.

Chapter 7 Conclusion

The present research project has sought to create an analytical toolbox that can practically be used within energy communities to facilitate understand, reflections and critical engagement of contributions towards a just energy transition. The research reviewed core literature within the field of energy justice, synthesised these into an operational framework, and applied this to empirical case studies, enriching the literature in the meanwhile. The practical insights that local initaitves can derive regard an understanding of justice built around the three concepts of capabilities, intersectionality and spatiality. This includes, amongst other factors, reflecting on the needs of individuals within their membership and local communities; the empowerment of local residents, social groups and organisations, as well as the impact that their activities have across the energy supply chain. Engaging critically with the toolbox of questions produced here can lead to pertinent insights, potential interventions and actions relevant for energy communities to achieve distributive energy justice. Yet, this is also to be a first step, since the toolbox also provides a foundation for future research to establish greater causal explanation for the outcomes of distributive energy justice.

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Annex

Annex I: Concepts Tables

Table AI I. Synthesised Concepts

Capabilities	**Who are key stakeholders? What are their needs? How are they satisfied?** - Needs vary depending on the kind of membership and business model of the energy community. - For investing members, this relates to security in their returns, either through stabilised, reduced or at least transparent energy prices, relative assurance of returns on investment, or support to alleviate aspects of energy burden or fuel poverty. - A need for the organisation of local initiatives relates to access of information regarding administrative processes including support across legal and legislative issues, technicalities of system design and implementation, as well as financial and business elements for reducing risk - Time often features as a deeply scarce resource for many volunteer based community energy projects, with small handfuls of individuals often bearing great responsibility for initiating and maintaining the operations of the initiatives. - For governmental or commercial stakeholders, a key need is to de-risk and remove uncertainties of local initiatives **Who is taking responsibility to satisfy these needs? Who should be taking responsibility?** - For many community energy groups, key responsibilities emerge by nature of smaller scale and proximity to local citizens, with greater awareness of the needs of those in the local community. This can often mean partnering with organisations embedded within the community that support social projects, in turn, this creates a responsibility to search for multiplicity of value, finding the places and spaces in which multiple benefits can be made possible i.e. solar installations for schools to support both the energy bills of core community buildings, as well as provide educational tools for students - With knowledge of grid balancing, greater individual responsibility is experienced to match household energy demand with the collective surplus/scarcity - Supporting the techno-economic needs of community organisations becomes a responsibility and power held by governing institutions. The responsibility here can vary from engaging in different kinds of support, network and trust building processes, as well as supporting legislative reform to enable and prioritise local energy production for self-consumption and sharing. **What is needed that could support the better distribution of benefits/needs that the energy community is able to provide?** - Community energy groups need to forge collaborative relationships with local authorities in which they are seen as legitimate partners, taking the necessary time to build trust as well as support a level of professionalisation that can lead to innovative business models that reduce perception of risk and uncertainty - Identifying the individuals that are most prone to be burdened with greater responsibility for community functioning, as well as those embedded within a community and holding high social capital, in order to recognise their efforts and provide necessary support. - Across communities, there is a need to identify marginalised households most vulnerable to energy burden/poverty, in order to understand the particular kinds of support that would, presently, be most beneficial. - Legislatively, energy communities need to be enabled to share their self-produced locally. Supporting collective self-consumption would enable

	greater energy autonomy, as well as empowering a larger range of services under more direct democratic control, and subsequently able to be distributed with greater consensus - Knowledge networks, commons, and communication across local initiatives and levels of governance, to provide insight into the administrative needs for community energy projects, share relevant and most needed resources, as well as present the multiplicity of value potential with projects. Specific kinds of appropriate knowledge will vary depending on context, however information - broadly speaking - emerges as a critical resource that presents bottlenecks and barriers for energy communities.
Intersectionality	**Who are the key stakeholders involved within the energy community ecosystem, and how is power held and shared?** - Core stakeholders relate to the citizen members, investor members, the organisational staff, municipalities and local authorities, incumbent network operators and energy suppliers, and banks and loan providers - Power sharing varies greatly depending on the size and structure of the local initiative, for those organised as a cooperative, each member will receive one vote each based on the 'OMOV principle', regardless of investment. - As actors in themselves, larger and more established community energy initiatives have the opportunity to leverage their institutional power (which includes professional services, larger capital resources, as well as institutional legitimacy) to support smaller scale projects more embedded within local communities **Which groups are more vulnerable to being (un)intentionally excluded or unrecognised?** - Demographics of community energy initiatives often highlight an overrepresentation of privileged or power holding social groups, middle class, older, white, well-educated, and male. Creating large barriers for groups that may struggle to find free time to join meetings, have disposable income/capital to invest, or feel put off by perceptions of elitism within the initiatives (i.e. highly technical language, overly pro-environmental or pro-community values serve to exclude those whose worldview does not entirely align) - Groups that are more likely to experience disempowerment within the broader energy transition, and energy communities specifically, relate those in rental living situations (versus landlords/homeowners), ethnic/religious minorities, and lower income households. - The extent to which marginalisation, exclusion, or mal-recognition occurs depends on existing power dynamics and demographics of the local area and the extent that community energy initiatives create access and incentive for those groups - While many community energy groups establish share offers that allow very small minimum investments, these are nonetheless predicated on the ability to invest, as well as risk repeating existing wealth and ownership inequalities. **What is needed that could provide better recognition of more vulnerable groups and distribution of power within the energy community ecosystem?** - Clearer processes for identifying which groups within a particular community are more vulnerable to energy poverty/burden as well as those prone to exclusion within the energy, establishing clearer channels of communication that engage with those groups, and supporting their empowerment within the organisation of community energy initiatives. - Establishing partnerships with organisations that are closer to the social groups/individuals that are at higher risk of experiencing energy injustices - ie providing energy coaches for advice and support or home assessments - in order for community benefit funds to be directed most effectively - Depending on the kinds of vulnerability present, identifying which services would be most beneficial for at risk groups is an important first step. For instance, understanding where knowledge gaps exist which, when filled, would support behavioural changes or simple household level interventions that reduce energy burden. - Identifying which services are most needed is also connected to how to distribute knowledge to the groups where support would be most needed.

	This relates to establishing stronger partnerships with local organisations more embedded within the communities themselves. - Including more diverse social groups requires both communicating the multiple values found within energy community activities, as well as establishing a flexible or dynamic vocabulary that can speak across different sets of priorities or located at different intersectionalities
Spatiality	**Across which geographic regions does the energy community operate, and which spatial scales are given most attention?** - Community energy initiatives inevitably operate across multiple spatial scales, with extraction, mining, and manufacturing processes broadly off-shored to resource rich and labour cheap regions and countries. Specific scale depends on the form, function, and focus of the initiative, with little prescription of spatial boundaries. - Regional communities, acting across municipalities, have the opportunity to deliver broader impacts to wider regions, provided their membership adopts a sympathetic approach to collective responsibility to support social benefits projects. The consequence of functioning at wider spatial scales can lead to more power held at higher levels of governance, and in turn creating more attention to a wider spatial scales with more tenuous connection and proximity to local communities. Although, this power can also be used to leverage and support the more local initiatives - At the neighbourhood level, community energy groups focus on collective ownership for residents within far more proximal scales, i.e. villages, towns, or city-districts - Alternatively, communities of interest have a more distributed view of spatial scales, not fixed to anyone place or space, this creates far more flexibility with the regions that they operate across. **What are the distributions of impact across these spatial scales?** - While supply chains operate across multiple geographies, greatest attention is given to domestic issues, with the crucial challenge that opaque supply chains and increased cost of more European production processes becoming a barrier for viable business models - Depending on local geography, it becomes important to consider where the communities are not operating, for instance, harder to reach rural regions that would benefit from a more locally owned energy supply **What geographic/spatial needs should be taken into consideration within the processes of the energy community?** - A core value of energy communities relates to the proximity between the organisation of energy activities and the citizens whose needs are being met, ensuring that there are clear channels of communication, collaboration, and representation for households and neighbourhoods (as the smallest spatial scale) across the governing structures - Given the relevance of local geography, weather, and climate for RES infrastructure, there is a need to communicate the opportunities rooted in geography for energy projects, i.e. located close to the sea or on open plains making wind strongly viable. Additionally, this can include identifying industry partners that could support energy cascading with residual waste heat networks. Such partnerships could lead to more strategic decisions regarding the siting of new industry in order to connect with local communities that would be open to collaboration - Engaging with the prospect of energy sharing amongst communities, a challenge relates to demarcating the boundaries of 'community' and neighbourhoods, identifying which specific households are eligible to participate - In terms of network building, there is a longing for a more global-local community, to share experiences of grassroots initiatives - There are questions about how to scale a community of interest up, out and across, and how networks can be formed across the country to support development of small and medium sized installations, rather than very big ones. This is linked to a perception that communities operating at the more local level will be better placed, to adapt to local needs - While information needs to flow better, there is also the issue of consolidating reporting across levels of governance, how to evaluate the different kinds of impacts occurring at each of these spatial scales, and what insights are most important to report

Table AI II Zeeuwind Concepts Table

Concepts	Contributing Considerations
Distribution	**What are the current subjects/objects of distribution?** - Ensuring that the business model returns reasonable and stable return on investment, however emphasis is made that those who participate in energy communities are less concerned with the profits, rather about the social role, and responsibility, that energy communities have (NL002) - The surplus profits generated by the energy community are able to be funnelled into a community benefit fund that can serve as a public good to be spent on projects which do not serve to earn money (NL003) **To whom are these benefits and burdens distributed?** - Concerned perspective that members of the 'green investment clubs' reproduce existing wealth inequalities, effectively hoarding the financial benefits of decarbonisation (NL005) - Energy communities can be organised to support the wider creation and distribution of benefits within the broader, non-membership, community (NL007) **How is the equitability of benefit/burden distribution understood, and what does this look like?** - There is a concern that energy poverty as a deeply systemic issue, not only for the individual experience, in turn, there are challenges involved measuring, assessing and evaluating the network benefits form energy communities (NL005; NL004) - The difference between 'profit-sharing' versus 'profit-taking' leads to a core task to both deliberately and deliberatively establish what it means to justly distribute profits (NL009)
Capabilities	**What are the (currently) identifiable needs of stakeholders within the energy community, and how are these satisfied?** - For individuals, there needs to be stable, transparent, and fair energy prices - Appropriate information flows to support facilitate other energy communities, i.e. sharing experiences of initiating and operating an energy community, the administrative systems to set up, or the bureaucratic procedures (NL004) **What responsibility is (or is not) currently being taken by the individuals, institutions, or infrastructures for satisfying these needs?** - Greater responsibility can be taken by energy communities that are closer to and, broadly, more aware of the needs of citizens, this can mean partnering with organisations to direct windfall profits into social projects, i.e. tackling energy poverty (NL003; NL002) - Different actors, especially large energy consumers, have the capability to serve the wider energy system in as much as they can demand energy at more appropriate times, depending on surplus/scarcity of production (NL009) **What is needed that could support the better distribution of benefits/needs that the energy community is able to provide?** - A theme emerging relates to meeting needs sufficiently, and the partnerships that need to be established for good collaborations. Specifically, energy communities need to be better recognised as legitimate partners by local authorities and decision makers (NL004) - There is a need to identify and support the individuals that hold high social capital, who are already embedded within the community, and how to support them directly (NL004) - Mechanisms to identify the specific needs of more vulnerable households, and establish processes to connect them with appropriate organisations

	or provide information on relevant government programs (NL005) - Subsequently, intervention from governments to support energy communities deliver particular sufficiency services (NL006) - Legislative challenges are core barriers for energy communities, government support whether advice, legitimacy, funding, or regulatory changes are emphasised (NL011) - Energy communities need to manage uncertainty and risk to establish stronger business models, a key issue in doing so relates to processes of professionalisation (NL002)
Intersectionality	**Who are the key stakeholders involved within the energy community ecosystem, and how is power held and shared?** - Core stakeholders relate to the citizen members, investor members, the organisational staff, banks and loan providers, and project managers - Given the cooperative organisational form, each member, regardless of investment, receives one vote based on the 'OMOV principle' - Using the institutional power of held by a larger energy community - with larger professional capacity, time, energy, money - Zeeuwind support smaller initiatives that are more proximal to local communities (NL003) **Which groups are more vulnerable to being (un)intentionally excluded or unrecognised?** - Concerns regarding the exclusion of disadvantaged groups from the energy communities, the broad make up of these local initiatives consisting, often, of middle class, older, white, well-educated and male (NL002; NL005) - There is risk that using highly technical language runs the risk of further excluding those who are not energy experts, or holding value sets not especially aligned to the rooted pro-environmental or pro-community based - In times of energy crisis, low-income households are especially vulnerable to energy price shocks, those with less power over their living situations, ie renters generally, and specifically those in poorly insulated homes (NL004) **What is needed that could provide better recognition of more vulnerable groups and distribution of power within the energy community ecosystem?** - Establishing partnerships with organisations that are closer to the social groups/individuals that are at higher risk of experiencing energy injustices - ie providing energy coaches for advice and support or home assessments - in order for community benefit funds to be directed most effectively (NL002; NL003) - Depending on the kinds of vulnerability present, identify which services would be most beneficial, for instance, if there are core knowledge gaps, understanding the how to distribute this information to the households or social groups (NL004) - Re-evaluating the tools used to assess benefit distribution: what are the needs of citizens and local initiatives, how should we conceptualise genuine benefits for them? (NL004) - Including more diverse social groups requires both communicating the multiple values found within energy community activities, as well as establishing a flexible or dynamic vocabulary that can speak across different sets of priorities or located at different intersectionalities (NL001; NL007)
Spatiality	**Across which geographic regions does the energy community operate, and which spatial scales are given most attention?** - As a regional energy community, most attention is given to residents within the municipality; and while there is greatest engagement with members of the community, it seems that proximity to place also motivates broader societal benefits for non-members (NL003) - Due to the large growth of Zeeuwind since its inception, increasing attention is given to the greater distance between the organisation and household/neighbourhood levels, as such effort is being made to establish partnerships with the more local community initiatives (NL003)

	- There is a mix between focusing on rural and urban needs, and the particular geographies that make energy interventions technical possible and applicable, i.e. heat networks most viable in areas with high population density (NL008) **What are the distributions of impact across these spatial scales?** - Priority is on the residents or members within Zeeland, even if projects are created to support non-member residents, there is an omission of the people working across the supply chain in earlier stages of the supply chain (NL003) **What geographic/spatial needs should be taken into consideration within the processes of the energy community?** - A core value of energy communities relates to the proximity of the organisation of energy activities and the citizens whose needs are being met, structure that seek to harness this proximity, building further relationship with the local needs in a region hold greater power (NL002; NL006) - While the supply chains operate across multiple geographies, greatest attention is given to domestic issues, with the challenges of opaque supply chains and the increased cost of more proximal production processes a barrier for viable business models (NL003) - Given the relevance of weather and climate for RES infrastructure, there is a need to communicate the opportunities rooted in geography for energy projects, i.e. located close to the sea or on open plains making wind strongly viable (NL006) - Additionally, this can include identifying industry partners that could support energy cascading with residual waste heat networks. Such partnerships could lead to more strategic decisions regarding the siting of new industry in order to connect with local communities that would be open to collaboration (NL009; NL010) - When exploring the issue of energy sharing, a challenge relates to demarcating the boundaries of the community, and identifying the households that are eligible to participate (NL008)

Table AI III Solby Concepts Table

Concepts	Contributing Considerations
Distribution	**What are the current subjects/objects of distribution?** - The core object of distribution relates to the self-produced electricity and heat from solar PV and solar heating installations, and the subsequent energy bill reduction for the common areas - More broadly, Sweden has enjoyed particularly cheap low-carbon electricity due to early investment into renewables (SWE002) **To whom are these benefits and burdens distributed?** - Woven into the structure of the ecovillage are common areas, the nature of which are open and non-exclusive to all residents - The cheap low-carbon electricity across the country is accessible all citizens **How is the equitability of benefit/burden distribution understood, and what does this look like?** - Within the village, the existence of commons, and their non-exclusivity, means that all residents have equal access to the benefits. In particular, the bill saving for the common budget can be spent, upon agreement for other common good purposes (SWE001) - Moreover, from a municipal perspective, there is a perception that issues such as energy poverty is not particularly an issue in Sweden given the strong social safety net (SWE003)
Capabilities	**What are the (currently) identifiable needs of stakeholders within the energy community, and how are these satisfied?** - Time investment is a core barrier, the energy projects are dependent upon a small group of residents researching, initiating and implementing installations (SWE001) - One need relates to the ability to internally distribute self-produced electricity, with legislative and technical barriers preventing private self-consumption (SWE002) **What responsibility is (or is not) currently being taken by the individuals, institutions, or infrastructures for satisfying these needs?** - Villagers experience a responsibility to the wider energy system, consuming at more appropriate times (SWE002) **What is needed that could support the better distribution of benefits/needs that the energy community is able to provide?** - While there is interest for the community to establish an internal micro-grid, this is perceived as particularly challenging, due to technical and legislation barriers, which requires the initiative and time of someone within the village to dedicate to the understanding of (SWE001) - Subsequent, greater government support for communities wanting to self-consume using internal micro-grids (SWE002) - Understanding how individual demand can better serve the broader, or localised, energy system so that intense consumption takes place in times of surplus or when electricity is cheapest (SWE002) - For those ecovillages that already exist, support is needed to initiate RES installation, leveraging their existing distributive capacity (SWE003)
Intersectionality	**Who are the key stakeholders involved within the energy community ecosystem, and how is power held and shared?** - The ecovillage can be seen as an entity itself and emerging from the interaction, relationships, and organisation of the residents. Power is distributed fairly evenly, with ability to become involved in activities and vote for particular actions

	- Network/grid operators are identified as powerful actors within the wider Swedish context, holding onto the status quo of a centralised system (SWE002) **Which groups are more vulnerable to being (un)intentionally excluded or unrecognised?** - The risk of exclusion relates to the broader societal structures in which the ecovillage is situated: only those who can afford the more expensive rent and housing association fees are able to live there, along with spaces becoming available. - Within the village itself, the common areas, and collective management thereof, are non-exclusive public goods (SWE001) - This is contrasted with private household investments, i.e. personal heat pumps, in which there are no mechanisms to financially support individual residents with installations, presenting a barrier for households with less disposable income (SWE002) **What is needed that could provide better recognition of more vulnerable groups and distribution of power within the energy community ecosystem?** - Emphasis is given to the role of education to empower people to participate, this relates to the efforts made to communicate information about energy consumption behaviours and patterns in accessible ways (SWE001; SWE002; SWE004)
Spatiality	**Across which geographic regions does the energy community operate, and which spatial scales are given most attention?** - There are two sets of core geographies focused on in the Solbyn energy projects, the wind turbine, in which shareholders need to live in proximity ('so they could see the wind turbine') and the solar and solar heating within the village (SWE002) - In terms of production, the solar PV and heating panels are not produced domestically, and imported through a **What are the distributions of impact (benefits and burdens) across these spatial scales?** - The distributed population of Sweden creates particular spatial structures, with more RES being produced in the more sparsely populated regions of the North, with more electricity imported and consumed in the South. Alongside this, the particular geographies, environment and rural demographics, make development of RES in the countryside, while appealing, in trade off with agricultural land (SWE003) **What is needed that could support the better distribution of benefits/needs that the energy community is able to provide?** - Considerations for distributing and delivering electricity for local production create a particularly local focus on renewable infrastructure (SWE002) - The lack of transparency within supply chains was also highlighted as a barrier to decision making, especially given the limited budget and need for reasonable pay-back-period, suppliers were chosen based on the best offers (SWE002) - The point is also made that in terms of network building, there is a longing for a more global-local community, to share experiences of grassroots initiatives (SWE002)

Table AI IV Big Solar Coop Concepts Table

Concepts	Contributing Considerations
Distribution	**What is the current subject/object of distribution?** - The objects of distribution are worked into the business model increase self-consumption, stabilise/reduce energy bills, provide return-on-investment for investors from the sold electricity to building owners - A subject of distributive relates to a shift in discursive power: from a passive citizen-consumer, to an empowered member of an energy community (UK002) - One dimension of distribution for BSC is the nature of the community of interest, and the social value that are established within the local groups, and the 'feeling of belonging with the shared vision of how to improve the world' (UK003) **To whom are these benefits and burdens distributed?** - The core beneficiaries of the business model are the building owners (receiving the panels), the investor members (obtaining ROI), and volunteer members (educated on the dynamics of solar installations and empowered to act) **How is the equitability of benefit/burden distribution understood, and what does this look like?** - The equitability of the business model is approached as a particularly good 'try-before-you-buy' scheme, with building owners getting a very good deal. - Investor members receive reasonable rates of return, the focus is on carbon reduction, with any surplus revenue directed into new projects - Meanwhile, volunteer members are free to commit variable amounts of time to supporting the operations, based on their own volition
Capabilities	**What are the (currently) identifiable needs of stakeholders within the energy community, and how are these satisfied?** - Large attention is given to optimising the self-consumption rates of individual building owners - Needs of the volunteer members to have a bank of resources that streamline their ability engage with potential new sites, in particular tackling the existing bottleneck that prevents signing of exclusivity agreements with BSC **What responsibility is (or is not) currently being taken by the individuals, institutions, or infrastructures for satisfying these needs?** - Emphasis is placed on the power of bottom-up/grassroots initiatives in which citizens are empowered to find solutions for energy challenges, this relates to organisations, i.e BSC, to take responsibility and find the tools to educate individuals on energy interventions - This relates to the role and responsibility of different kinds (sizes) of organisation, and that the smallest community groups were best suited to communicate or share information with local residents (UK004) **What is needed that could support the better distribution of benefits/needs that the energy community is able to provide?** - Emphasis is made on connecting energy community groups to support more knowledge sharing based on their experiences so far, in the context of the BSC business model, this means providing focused insight into energy consumption patterns in order to create strategies to reduce demand (UK002) - One of the key challenges identified for broader energy community relates to the technical and legislative challenges relating to grid connection (UK002) - Given the nature of the community of interest, from a local authority perspective there needs to be a clearer link between the energy project and the wider societal benefits that could be possible from the money that is made available (UK004)

	- Improved communication across governance levels is emphasised, this intersects the capabilities of the governing institutions, there is also a point that this is an issue of governing places, and that should information flow more smoothly across the parish and town level, the municipal and county, up to national, for groups to be better supported (UK002) - The BSC business model is not organised around a social benefit fund, however, establishing systems that would support volunteer members identify sites whose function is to deliver services to more vulnerable social groups could find compounding value without changing the business model itself
Intersectionality	**Who are the key stakeholders involved within the energy community ecosystem, and how is power held and shared?** - The board of directors has combination of volunteer and investor members, to bring the voices of those with capital at risk and those investing their time and energy for the functioning of the coop (UK005) - BSC operates under a OMOV principle, regardless of investment, volunteer members have the same voting rights as investing members **Which groups are more vulnerable to being (un)intentionally excluded or unrecognised?** - The demographic of volunteer members is highlighted as a potential issue in as much as it consists of older/retired people, white, often middle class (UK005) - The point is made that the minimum investment in projects is 'reasonably low' which opens up investment to a larger portion of the population, which makes community financing of renewables far more accessible than requiring individuals to invest in their own private instals (UK003) - Concern for the fact that while volunteering is particularly accessible, all that is needed is time and internet, the issue of time will be quite a constraining factor for many people (UK002; UK003) **What is needed that could provide better recognition of more vulnerable groups and distribution of power within the energy community ecosystem?** - The particular business model creates some constraining conditions for the kind of redistribution possible, however, the point is made that identifying properties that provide public goods in themselves can generate multiple benefits through partnerships with BSC, ie schools, community centres, other public buildings. This is realised within the notion of having a 'cherished site', but with absent systematisation for how this could be a greater focus (UK002; UK003; UK005) - The point of working with schools is emphasised to deliver 'multiplicity of value' in terms of price stability for common good, as well as an educational tool to more practically learn about climate and renewables (UK003) - From the responsibility local authority more knowledge sharing of the support available to low-income households for energy advice and services, as well as linking these to the possible sources of funding (UK002) - Greater capacity to identify, connect with and engage households that are most at risk/vulnerable to energy poverty, those who are already participating less (UK004) - Given the demographics of the volunteer members, there is a potential to focus on diversifying volunteer members, who might not immediately be drawn to committing their time to a coop, one thought is connecting with schools to have practical traineeship positions that would involve younger people and provide experience in energy (UK005)
Spatiality	**Across which geographic regions does the energy community operate, and which spatial scales are given most attention?** - As a community of interest, BSC operates nationally, although has generally focused on Northern areas due to less prevalence of energy communities (UK002) - BSC emphasises their ethical sourcing of solar panels, while more expensive there is a prioritisation of ensuring a cleaner supply chain (UK003; UK005)

	- From the perspective of the local authority, there is an explicit focus on the very local level, and a desire to speak into and connect with the needs of local residents (UK004) **What are the distributions of impact (benefits and burdens) across these spatial scales?** - A concern is raised about the risk that larger commercial projects, or potentially energy communities that reach a certain size or scale, face challenges to deliver and distribute genuine community benefit (UK002) **What is needed that could support the better distribution of benefits/needs that the energy community is able to provide?** - There are questions about how to scale a community of interest up, out and across, and how networks can be formed across the country to support development of small and medium sized installations, rather than very big ones. This is linked to a perception that communities operating at the more local level will be better placed, to adapt to local needs (UK002) - While information needs to flow better, there is also the issue of consolidating reporting across levels of governance, how to evaluate the different kinds of impacts occurring at each of these spatial scales, and what insights are most important to report (UK002)

Annex II: Benefits, Burden and Distributions Tables

Table AII I Zeeuwind Benerfits, Burdens and Distributions

	Environmental	**Economic**	**Social**	**Technical**
Benefits	*Greenhouse gas emission reduction* • Focus given to the local developments of wind parks and contributions to local RES (NL003) • Increasing proportion of wind farms and RES provides lower-carbon electricity (NL010)	*Revenue to members* • Diversification of energy activities creates more resilient business models that can absorb shocks better (NL07; NL08; NL09) *Social Benefit Fund* • Some of the revenues generated by the community owned assets are able to be directed into a collective fund for future local projects (NL03; NL06) • "We are not put on this Earth to make such huge profits, we want to propose to give these profits back to our members….you see more and more that putting money towards energy poverty or other societal benefits is needed to get local support for your wind or solar project" (NL002)	*Network and capacity building* • The value of partnerships between stakeholders, with larger/more powerful actors able to support the smaller scale activities and organisations (NL01; NL02) • Intentions to deliver benefits and social impact to the wider community, rather than just the energy community membership (NL03; NL007) *Social capital and trust* • Emphasis of the pride created within the community for participating actively in local projects, collective ownership seems to feed into a more dynamic sense of responsibility (NL01) • Building relationships within neighbourhoods and local communities can lead to positive feedback between multiple kinds of social benefits (NL01; NL002; NL04) *Governance Structures* • Importance of deliberation and power sharing within decision making processes that serve to connect different perspective as well as distribute power as well as create social capital (NL001; NL002)	*Energy security/independence* • Producing a significant proportion of Dutch wind energy to increase domestic RES, creates greater degrees of energy autonomy from the centralised grid and energy markets (NL004) *Energy Innovations* • With a more established business model and consistent revenue streams, testing energy innovations (i.e. heat networks, innovative power contracts) has been made possible (NL07; NL08; NL09) • Additionally, exploring various energy innovations also provide the opportunity to diversify business models, for instance, refurbishing old wind turbines • Circular Energy: energy cascades support getting more use phases out of energy (NL09)
Burdens	*Embodied carbon effect* • Risk of rebound effect: additional	*Capital investment* • Finding alternative channels for	*Social capital pre-required* • Trust takes time. Often local	*Costly capital infrastructure* • For grid operators, investment into

	income to members is spent on energy/emissions intensive goods, leading to more environmental damage (NL006) *Supply chain transparency* • Challenge of lack of transparency across supply chains, along with expense of transparency (NL003)	investment, ie leveraging existing assets as higher risk capital (NL09; NL10) • For many energy projects, there are large initial capital costs, ie establishing a heat network, these require complex sets of agreements and contracts in which the risk of operations need to be covered (Nl10; NL11) *Risks* • Establishing business models that include the risks of energy investments and local production in competition with the wider energy market (NL03; NL05; NL09) • The fact that taking larger risks in projects means that more profit needs to be made to cover those risk (NL08; NL11) • Risk that energy communities descend into becoming 'green investment clubs' (NL08)	initiatives and grassroots projects are slow processes with multiple approaches, and while deeply valuable, it can often be very slow to establish such trust (NL004) *Stretched for time and energy* • All too often there is a small group of individuals bearing a great deal of the responsibilities, too much, which creates vulnerabilities for the organisations (NL003)	projects requires quite some scale and scope to be worthwhile, requires large mobilisation of multiple communities (NL001) *Legal barriers for collective ownership* • Challenges of distributed/decentralised system requires larger restructuring of current system (NL03; NL05; NL06) *Risks* • Technical risks of larger projects can often not be covered by the smaller energy communities, in need of larger actors, favourable rates or contracts (NL003)
Distributions	*Benefits* • *I*n terms of environmental benefits, the core focus of distribution relates to emission reduction and decarbonisation of the energy system. Since the physical electricity is sold to the grid, it is less the case that emissions are allocated to particular individuals, but rather contribute on aggregate to regional and national RES and decarbonisation *Burdens* • Two core issues regard the distribution of burdens, the impact of rebound effects and the	*Benefits* • The economic benefits from the operations relate to the revenues generated from the self-generated electricity being sold to the grid. Members receive a financial return on their investment. With a profit sharing mechanism established so that surplus profit is funnelled into a community benefit fund that is to be spent on social projects. *Burdens* • A core economic burden relates to the initial capital costs and the challenges of factoring in risk and opportunity to business models.	*Benefits* • The nature of social benefits relate primarily to the knowledge sharing and trust building impacts of the energy communities. Several aspects of Zeeuwind support broader and deeper distribution of these, such as implementing the community benefit fund for non-profit making projects focused on tackling energy poverty, or using their large scale and institutional power to support smaller, more local energy initiatives *Burdens* • A core burden here relates to the limitations of social resources, time	*Benefits* • The core object of technical distribution relates to the physical electricity that is generated by the wind farms. Since this is, currently, sold to the national grid, energy community members do not benefit directly in terms of self-consumption or self-sufficiency. Rather, this relates to more regional/national RES deployment. • However, the expansion into energy innovations, i.e. Sleeved PPA or residual heat networks, provides novel ways to directly distribute energy more locally

	transparency of supply chains. The former relates to the consequential increase in energy consumption, or emissions, due to additional income. This implies increasing burden across the climate system. The latter relates unreported and distanced effects occurring throughout the energy supply chain: the detrimental social and environmental impacts.	This involves ensuring a profitability of operation that covers uncertainties of project failure. • One trade off relates to the distribution of revenue from the energy assets, a decision can be made to provide larger returns for investors, or wider benefits such as reducing energy price stability (if this is within their power), alternatively establishing a community benefit fund	and energy of participants, and the underlying dynamics of who is in a position to donate their time, energy and surplus capital. Firstly, that relationships of trust take time, which should not be rushed, this means that places with lower social capital require greater attention and time afforded to build local initiatives.	*Burdens* • Core technical burdens relate to navigating the risks of coordinating the wider grid and national energy balancing, through bottom-up initiatives, along with the burden exerted by the current system and challenges of regulation and legislation that are particularly unfavourable for energy communities.

Table AII.II Solby Benefits, Burdens and Distributions Table

	Environmental	**Economic**	**Social**	**Technical**
Benefits	*Greenhouse gas emission reduction* • Installations of solar thermal, wind farm and solar contributed to a decarbonisation of villages energy (SWE01; SWE02)	*Revenue to community* • From the initial investment into the windmill, there was a right to purchase several kilowatt hours (SWE001) • Renewable energy policies also mean that the community get tax dedication for producing renewable energy (SWE001) *Bill reduction* • Nature of the ecovillage design mean that the energy generation was linked directly to the bills of the common areas (SWE001) *Pay-back-period* • Estimation that the investment into the windmill has been paid back four times over (SWE002) • Due to functioning within current energy markets, locally owned RES can benefit from excess profits in times of energy price volatility, while this is an benefit to Solbyn it is also recognised as a burden of the current system (SWE002) *Social Benefit Fund* • Assets which reduce the spending of the collective budget are now made available to be spent on other collective needs for the benefit of all member (SWE002)	*Network and capacity building* • Function of the energy interest group creates a space to learn and share insights about the role of local energy initiatives as well as action that is possible to be taken by individuals (SWE002) *Social capital and trust* • Nature of the ecovillage means that there is already a well establish stock of social capital which can be built on with the energy interest group (SWE001)	*Local grid balancing/ stability* • A large amount of the energy produced is self-consumed, and along with the right to purchase kWh from the windmill, there is increasing self-consumption (SWE001) *Energy demand reduction* • In part, an outcome of the energy interest group has led to sharing of how to live more energy sufficient as well as efficient, through behavioural change, energy saving devices, and basic home renovations (SWE002)
Burdens	*Embodied carbon effect* • Environmental injustices are an issue at the macro/global level, not	*Capital investment* • While there is an initial capital expenditure there is a greater	*Stretched for time and energy* • Important to recognise differentiated desires, roles and	*Legal barriers for collective ownership* • Nature of the community, multiple common spaces makes things easier,

	within Sweden (SWE004) *Supply chain transparency* • The challenge of opaque supply chains and limited resources prevent the extended and supply chain impacts to be known (SWE002)	priority of the social and environmental benefits of organising locally ("Lets not look at the price tag, lets just do it because its the right thing to do") (SWE002) *Subsidies* • Design of subsidies relates to the installation/labour aspects, which are the smaller/less significant aspects of the installations, rather than production/ capital (SWE001; SWE002) *Trade Offs* • The ecovillage has a high initial cost from living there in the first place, while the energy doesn't add anything to residents now, this is because they have effectively already paid by virtue of the association fee (SWE001)	responsibilities of all citizens, some people won't be able to nor want to participate extensively (SWE003)	but creating internal micro-grid remains particularly challenging (SWE001) *Risks* • While there is large potential for a holistic energy strategy available from energy communities, there is also a concen that this would risk disrupting and destabilising the existing energy system and market (SWE004)
Distribution	*Benefits* • In terms of environmental benefits, the core focus relates to emission reduction and decarbonisation of the village's energy supply. Due to the existence of common areas, and the contract that has been established with their energy supplier, these benefits are, non-exclusively, allocated to the village as an entity in itself. *Burdens* • A core issue within the energy supply chain relates, again, to lack of transparency, making decision making on sourcing particular panels more difficult. The impact of which means that knowledge of	*Benefits* • Structure of the ecovillage means that the benefits are distributed across the entire collective, held as a commons, rather than particular individuals. The economic benefits from the operations relating to the energy bill reductions from both the self-consumption of electricity and heat, as well as the surplus electricity sold to the energy supply company. *Burdens* • A core economic burden involved in the Solbyn case relates to underlying dynamics making the village, broadly, more expensive to live in, and concentrating the benefits of collective ownership of	*Benefits* • The existing social capital held within the self-organised village finds new developments by the organisation of the energy projects. With a few residents tasked with developing energy proposals, knowledge sharing of issues related to energy can be supported. *Burdens* • Despite the existing levels of social capital within the village, a social burden for the energy interest group relates to limitations of time required to research feasible energy projects and prepare technical documents. This means that responsibility can often fall onto a	*Benefits* • Core technical benefits relate to the increased self-consumption of electricity and local grid balancing. These support reducing pressure across the energy system, and are concentrated upon the residents primarily. *Burdens* • A core technical burden that falls onto the village relates to the limits of existing regulation and legislation for sharing self-produced electricity between neighbours. This is particularly disadvantageous for the community, while maintaining the existing status quo in which power

	embedded impacts across the supply chain are unknown.	RES for those that can afford to live in such a place.	small handful of individuals	is held by large scale producers and distributors.

Table AII.III Big Solar Coop Benefits, Burdens and Distributions Table

	Environmental	**Economic**	**Social**	**Technical**
Benefits	*Greenhouse gas emission reduction* • Focusing on climate/carbon first aims to prioritise larger amounts of RES and self consumption (UK002; UK003) *Wider Environmental Gains* • Particular attention has been given to ethical sourcing of solar panels, looking for, at the very least, transparency and validation of where and how the panels are produced (UK005) *Land-use change effects* • Rooftop solar is fairly flexible/agile to work around planning, installations, and grid connectivity, so minimal land-use change effects (UK002)	*Revenue to community* • Investor members receive yearly ROI *Bill reduction* • Energy bill stabilisation and variable reduction for the building owners (UK003) *Business Model Innovations* • Innovative business model organised around streamlining solar installations by mobilising grassroots finance (UK005)	*Network and capacity building* • Education and resources are woven into the functioning and structure of the community, i.e. workshops, trainings, and regular meetings to support knowledge sharing (UK004; UK005) *Social capital and trust* • By finding overlaps/intersections of benefit, can also create more support and trust from the local community, ie focusing on buildings that hold particular social value, ie schools (UK003)	*Local grid balancing/ stability* • Electricity generated from the solar on the rooftop is consumed by the building owner as well as sold to grid (UK005) • Support building owners, businesses, industries to understand their demand profiles, opportunity for energy consumption strategies (UK002) *Grid upgrades avoided* • With focus on larger energy consumers, these activities can reduce strain on grid
Burdens	*Supply chain transparency* • Challenge of opaque supply chains and factoring in environmental uncertainties to models of risk (UK002)	*Risks* • For local authorities, more risk averse and in need of more secure guarantees, and seemingly somewhat blind to the additional benefits. (UK002) • Considerable challenge to factor in risk, and different types of risk, into models (UK002)	*Social capital pre-required* • Functioning of the community majorly dependent on volunteers that have already moved there to take action (UK005) • Community burden by challenge to factoring in the risk of inaction, and the missed opportunities of building social capital (UK002) *Stretched for time and energy* • Given the already stretched nature of energy communities, further challenges involved in identifying, evaluating, and meeting the needs of vulnerable groups (UK002) • Potential asymmetry in power	*Costly capital infrastructure* • Challenges for scaling small-medium in a context which is geared towards large scale (UK002) *Legal barriers for collective ownership* • Processes for projects are long and arduous, with technical / feasibility studies, evaluations, and legislative needs to be met (UK002)

			between the paid employees and volunteers	
Distribution	*Benefits* • As a 'carbon-first' coop, the principle environmental benefit relates to decarbonisation and emission reduction. In terms of who benefits from this, building owners are now supplied with the larger amounts of low-carbon electricity, while volunteer members experience the value-based benefit for contributing collective emissions reduction. Additionally, BSC pays particular attention to the sourcing of their panels, taking measures to reduce the distance of the supply chain, as well as choosing manufacturers with cleaner production processes. *Burdens* • While efforts are made to ensure the supply chain is as ethical as possible, there are inevitable challenges faced by the distribution of environmental damages across the geographies of the supply chain.	*Benefits* • Economic benefits relate, primarily, to return on investment to investor members and bill stabilisation (and potential reduction) for property owners. This largely makes sense in terms of who is most vulnerable to the economic risks involved, however, there are underlying questions regarding a business model that is dependent upon a volunteer workforce. *Burdens* • Economic burdens of the energy community relate broadly to the perceived risks of committing to a BSC project, as well as the investor members' capital at risk. The former point relates to establishing the proof of concept and viable benefits that building owners would receive in a situation of uncertainty	*Benefits* • By nature of community of interest, ability to weave together distributed network organised around a common purpose and support local groups (community of place) to emerge • Various social benefits are experienced by nature of the organisation and operation, most notably the knowledge sharing and social capital generated between volunteer members. These are most clearly concentrated amongst the volunteer members, with a range of resources available to distribute information. Broader network effects from organising as a community of interest become more challenging to identify *Burdens* • The social burdens of the community are broadly mitigated by the voluntary nature of the community organisation, with members able to decide themselves how much time they contribute. There is some attention to the risk of imbalance of responsibility and power between volunteer members and paid staff.	*Benefits* • Technical benefits relate to increasing rates of self-consumption, which supports local grid balancing. These are benefits mostly affecting individual property owners, when/if deployed at scale this benefit would affect local grid operators to a greater extent. *Burdens* • Core technical burdens relate to the arduous processes of feasibility assessments and locating appropriate sites, accurate demand profiling that might lead to site owners having lower self-consumption rates than initially expected, and legislative challenges regarding regulation that supports and streamlines solar installations.

Annex III: Information Sheet

This research project is being conducted as part of a Master Thesis research examining the various benefits that emerge from citizen energy communities, the evidence base that currently exists, and the contributions towards distributive justice.

Increasing attention is being given to energy communities as part of a citizen led energy transition. The thriving field of grassroots energy communities emphasises the multiple benefits to the direct members of the energy communities, the wider benefits to the local communities, as well as broader contributions to a just energy transition. While there has been work to document these benefits to support and encourage energy communities, there is often an absent understanding of the most relevant benefits. As such, the aim of the research is to build a more coherent case for the social, environmental, and economic benefits that emerge from community energy projects by identifying the key themes related to the fair distribution of benefits and burdens. In doing so, the outcome of the research aims to contribute to the coherent communication of how the distribution of these benefit contribute to a socially just and environmentally sustainable energy transition.

How will the research be conducted and what is expected of you?

The research will engage with stakeholders active within energy communities in order to draw from the perspectives regarding relevant features of distribution as experienced by those involved. This will consist of interviews, which will focus on 3 themes: the organisational structure of energy communities; the activities taken up by the communities; and the subsequent benefits and burdens. and distribution thereof.

With your consent, there will be a sound recording that can serve as data for the research, using the recordings for citations or paraphrasing. After the interview, I will send a copy of the transcript for you to correct any factual errors, thereafter, the interview will be analysed. Naturally, your identity can be confidential, if you so wish.

The online interview will take approximately one hour, and you should feel comfortable to decline any questions. To respect the often already stretched energies, especially due to the voluntary nature of energy communities, no preparation time is necessary outside of the interview. Unfortunately, due to the limitations of the project, participation is entirely voluntary and without financial compensation. However, the results of the research can be shared with participants if they so wish.

Handling of data

Naturally, your personal data will not be distributed to anyone not involved in the project. However, the use of the interview data can be used in the Master thesis and presentation, and potentially any subsequent

scientific publication. This will be through, either general insights and understanding illuminated by the interview that informs myself of energy communities or providing specific information during the interview that can be quoted or paraphrased. It is important to note tha participation in this interview is voluntary and you can quit the interview at any time without giving a reason and without penalty. If this were to occur, the data provided up until this point may still be used in the research.

In terms of storing the data, ie your data, the interview recording and transcript, it is required that these are saved and stored on the secure servers at Utrecht University for 10 years. You consent to this by participating in this research.

We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act). Please respond to the questions honestly and feel free to say or write anything you like.

If you have any questions about the research, your involvement or the data handling, feel welcome to contact me via email, Alex Myerson: a.c.myerson@students.uu.nl .

Annex IV: Informed Consent Form

To be completed by the participant:

I confirm that:

- I am satisfied with the received information about the research.
- I have been given opportunity to ask questions about the research and that any questions that have been risen have been answered satisfactorily.
- I had the opportunity to think carefully about participating in the study.
- I will give an honest answer to the questions asked.

I agree that:

- the data to be collected will be obtained and stored for scientific purposes.
- the collected, completely anonymous, research data can be shared and re-used by scientists to answer other research questions.
- video and/or audio recordings may also be used for scientific purposes.

I understand that:

- I have the right to withdraw my consent to use the data.
- I have the right to see the research report afterwards.

Name of participant: _____

Signature: _____ Date, place: ___ / ___ / ____, _____

To be completed by the investigator:

I declare that I have explained the abovementioned Participant what participation means and the reasons for data collection. I guarantee the privacy of the data.

Name: _____

Date: ___ / ___ / ____(dd/mm/yyyy)

Signature:

Annex V: Interview Guide

Introduction

- Welcome: Intro to the research

Establishing Position(ality) of Interviewee

- Roles and responsibility within the energy community space?
- How did you come into this role and what were the driving forces behind this?
- Which other actors do you interact with most of the time?

Energy Community: descriptions

Functioning

- What role do you feel energy communities could, or should, be taking within the energy transition?
- Are there particular activities, whether regarding services and information, generation, supply etc, that you feel energy communities are in a particularly good place to deal with, or should be focusing?

Form

- *Organisation/Ownership*
  - What aspects of community or cooperative organisation do you feel are most valuable for community functioning?
  - What are the current organisational structures that you are involved with or experience in your role?
  - How do you feel the organisational structure of the community supports the distribution of benefits from the activities?

- Business model
  - What is most important or needed for community organisations to reduce their risk? Diversification? Professionalisation? How can they do this?
  - How can the projects be structured that retains the more value/wealth within the community?

Benefits

- What are the key types of benefits that you experience or would want to communicate about energy communities? From the social, environmental, economic, technical, or any others?
- Out of these benefits, which are most important to pay attention to how they are distributed?
- To whom is it important that the benefits are distributed to?

(Distributive) Energy Justice

The field of energy justice focuses on the inequities and inequalities emerging from the current transformation of the energy system in the processes of decarbonisation. This can relate to the accessibility and affordability of low-carbon technologies, the proportionate impact of climate and energy policy across social groups, and, broadly, ensuring that those most vulnerable to the detriments of climate change have their energy needs met. Often, this can be understood as the what, who, and how of justice.

For instance, what fuel tax is being implemented, across which social groups does this affect, how were the processes of decision making organised that arrived at this decision.

- In your field, are there particular energy related inequalities or injustices that are currently being experienced, and do you see a particular role that energy communities could have for tackling these?

Capabilities

- From your perspective, what needs are important to pay attention to when considering the role of energy communities to provision for?
- Again, from your perspective, how do you approach understanding the different needs of energy consumers?

Intersectionality

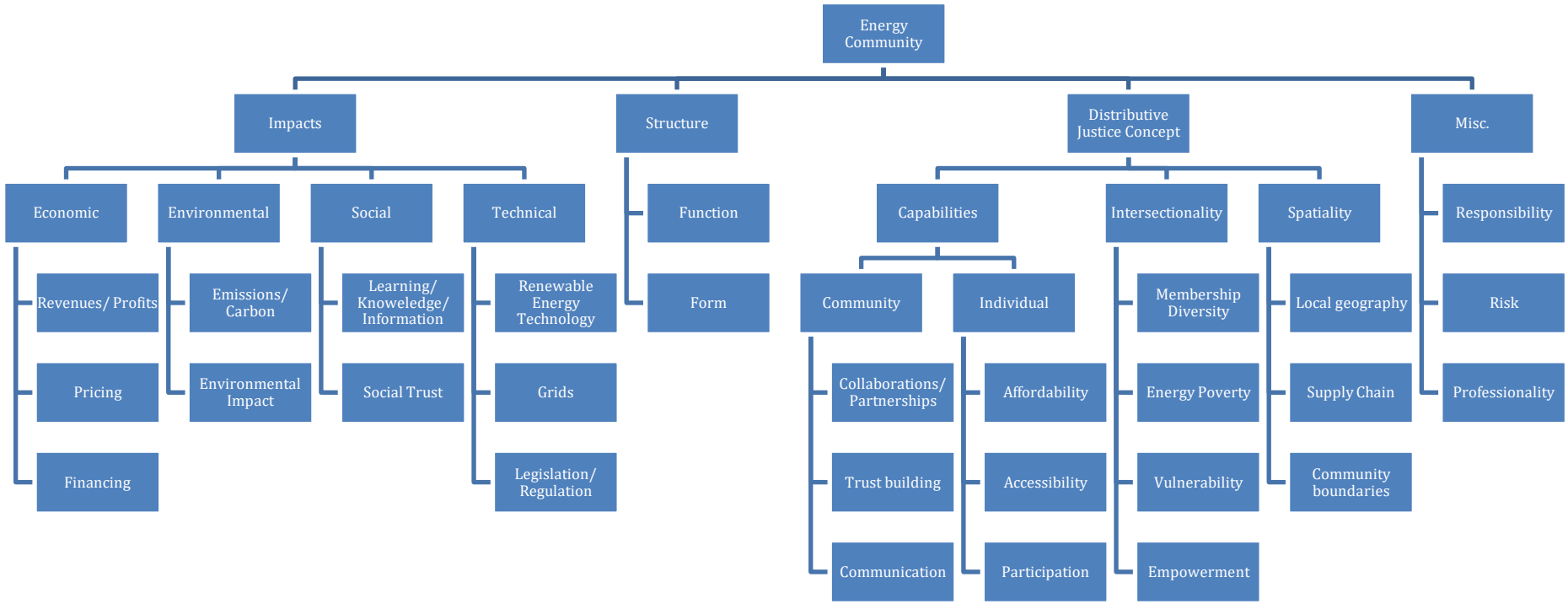
- A key component of energy justice relates to identifying who is most vulnerable to energy related injustices, such as fuel poverty. How do you think that the benefits of the energy system could or should be distributed to tackle these? What kind of support should be offered to those most in need?

Spatiality

- What kind of area do you think would be best for an energy community to be organised in, neighbourhoods, villages, towns, city levels?

In terms of communicating the benefits of energy community and how this approach of organising the energy system could create wider social benefits, what would you most like to know, understand, or be able to communicate better about the field?

Annex VI: NVivo Coding Tree



Annex VII: Interview List

Interview	Stakeholder Postion	Relevance to Case Studies
NL01	Energy Community Organiser/ Coordinator	Expert involved in national level energy community coordination
NL02	Energy Community Member & Coordinator	Expert involved in both local level energy community coordination as well as local governance
NL03	Energy Community Coordinator	Directly involved in Zeeuwind operations and organisation
NL04	Regional Governance Respresentative	Expert involved in municipal coordination and strategy for energy justice and transitions
NL05	Energy Community Organisor	Expert involved in local energy communities as well as local governance
NL06	Energy Community Coordinator	Expert involved with established regional energy community
NL07	Regional Governance Respresentative	Involved in the regional energy transition of Zeeland Province
NL08	Sustainable Banking Stakeholder	Expert involved in sustainable finance
NL09	Industry Stakeholder	Industry expert involved with Zeeuwind partnship project
NL10	Energy Community Coordinator	Local coordinator of Zeeuwind partnership project
NL11	Industry Stakeholder	Expert involved in Network Operator involved in Zeeuwind projects
SWE01	Energy Community Member	Directly involved with organisation of the energy interest group in Solbyn
SWE02	Energy Community Members	Roundatable discussion with four members and organisers of the energy interest group of Solbyn
SWE03	Local and Regional Governance Respresentative	Invovled in environmental and climate governance and strategy within Lund province where
SWE04	Regional Governance Respresentative	Expert involved with regional energy strategy
UK01	Energy Community Members	Two experts involved with adjacent local energy community
UK02	Energy Community Member	Active member within Big Solar Coop
UK03	Energy Community Member	Active member within Big Solar Coop
UK04	Local Governance Representative	Member of town council involved in with climate projects
UK05	Energy Community Coordinator	Local coordinator within Big Solar Coop