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BUSINESS MODELS OF ENERGY COMMUNITIES AND DIFFERING INCENTIVES TO JOIN THEM

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ABSTRACT

Ville-Pekka Haukijärvi: Business Models of Energy Communities and Differing Incentives to Join Them
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The whole energy sector is in the midst of a disruptive period as the emission control tightens and prices of emission allowances go up. Especially companies face tremendous pressure from society to extensively deploy renewable energy and to ensure the sustainability of their operations. Roles in the energy sector are changing and totally new roles are forming. Change offers companies new business opportunities and some old practices disappear. With the disruption in the energy sector, new business models are shaping and one of these models is the energy community. Actors such as companies, municipalities, universities, housing cooperatives and private persons are involved in energy community pilots that look for functioning practices.

The purpose of this research is to study company drivers for sustainable development and energy communities. Purpose is also to study the business models of companies through energy communities, sustainable development and innovation ecosystems. This approach is quite unexamined, and the goal is to provide new information on company motives and procedures related to sustainable development.

First, an initial theoretical framework that is based on fairly recent research on business models, innovation ecosystems and energy communities, is presented. The research was conducted as qualitative semi-structured interviews. Based on the theoretical framework a basic template for the interview questions was created and then used to interview companies strongly linked with energy communities and renewable energy. The analysis phase followed an abductive approach.

The results were structured based on drivers, challenges and changes happening in the ecosystem. In the result chapter the interviews are examined through these lenses and propositions are backed by relevant citations from the interviews. Most relevant drivers for the companies for sustainable development and energy communities were climate change, carbon neutrality targets, supporting circular economy and biodiversity, long term financial profitability, demands from stakeholders, possibilities from renewable energy, new business opportunities and the necessity of actions to preserve the environment and the business. The biggest challenges that came up were delays caused by the current legislation, missing of top-level coordination, scalability of solutions and providing plug & play solutions.

In the discussion chapter, results gained from the interviews are linked with the initial theoretical framework. Ideas and models presented in the theory framework are quite well in line with the results derived from the interviews. Especially sustainable business models and the ecosystem thinking seem to fit the operations of the companies also in practice. And the companies in the energy sector seem to have already integrated these themes strongly to their operations.

In conclusions, the results of the research are summarized, and the reliability and generalizability of the research are examined. Also, possibilities for future research are investigated.

Keywords: energy community, business model, innovation ecosystem, sustainable development

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Koko energiasektori on murroksen keskellä päästörajoitusten tiukentuessa ja päästöjen hintojen kohotessa. Varsinkin yrityksiin kohdistuu suuria yhteiskunnallisia paineita uusiutuvan energian käyttöönotossa ja toimintojen kestävyyden varmistamisessa. Energiasektorin toimijoiden roolit muokkautuvat ja myös kokonaan uusia rooleja ilmaantuu. Muutos tarjoaa yrityksille myös uusia liiketoimintamahdollisuuksia, joidenkin vanhojen poistuessa. Energiasektorilla uudet liiketoimintamallit hakevat murroksen myötä muotoaan ja yksi näistä malleista on energiayhteisö. Muun muassa yritykset, kunnat, kaupungit, korkeakoulut, taloyhtiöt ja yksityiset henkilöt ovat mukana energiayhteisöjen piloteissa, joilla haetaan toimivia malleja.

Tämän työn tarkoituksena on tutkia yritysten ajureita kestävään kehitykseen ja energiayhteisöihin liittyen. Tarkoitus on tutkia myös yritysten liiketoimintamalleja energiayhteisöjen, kestävän kehityksen ja innovaatioekosysteemien kautta. Kyseessä on melko tutkimaton alue ja tavoitteena on tuottaa uutta tietoa yritysten motiiveista ja toimintatavoista kestävään kehitykseen liittyen.

Työn aluksi esitellään alustava teoriakehys, joka pohjautuu melko tuoreeseen tutkimukseen liiketoimintamalleista, innovaatioekosysteemeistä ja energiayhteisöistä. Tutkimus toteutettiin kvalitatiivisena puolistrukturoituna haastattelututkimuksena. Teoriakehyksen pohjalta rakennettiin haastattelukysymysten runko, jonka avulla haastateltiin energiayhteisöihin ja uusiutuvaan energiaan vahvasti linkittyviä energiasektorin yrityksiä. Haastatteluiden analyysi noudatteli abduktiivista lähestymistapaa.

Tuloksia lähdettiin jäsentämään ajurien, haasteiden ja ekosysteemissä tapahtuvien muutosten kautta. Tuloskappaleessa haastatteluita käydään läpi näiden linssien avulla ja väitteitä tuetaan haastatteluista poimituilla sitaateilla. Oleellisimpia ajureita kestävään kehitykseen ja energiayhteisöihin olivat yritysten kannalta ilmastonmuutos, hiilineutraaliustavoitteet, kiertotalouden ja biodiversiteetin tukeminen, pitkän aikavälin taloudellinen kannattavuus, sidosryhmien vaatimukset, uusiutuvan energian mahdollisuudet, uudet liiketoimintamahdollisuudet ja toimien välttämättömyys luonnon ja liiketoiminnan säilymiseksi. Isoimpia haasteita yritysten keskuudessa olivat nykyisen lainsäädännön aiheuttamat hidasteet, korkean tason ohjauksen puuttuminen, ratkaisujen skaalautuvuus ja avaimet käteen ratkaisujen toimittaminen.

Keskustelukappaleessa haastatteluista saatuja tuloksia liitetään alun teoriakehykseen. Teoriakehyksessä esitellyt ajatukset ja mallit ovat melko hyvin linjassa haastatteluista johdettujen tulosten kanssa. Erityisesti kestävät liiketoimintamallit ja ekosysteemiajattelu näyttäisivät sopivan yritysten toimintaan myös käytännössä, ja energiasektorin yritykset ovatkin vahvasti integroineet nämä jo toimintaansa.

Loppupäätelmissä tiivistetään tutkimuksen tuotokset ja käydään läpi tutkimuksen luotettavuutta ja yleistettävyyttä. Myös jatkotutkimuksen mahdollisuuksia käydään läpi.

Avainsanat: energiayhteisö, liiketoimintamalli, innovaatioekosysteemi, kestävä kehitys

PREFACE

This thesis was done at the IEM unit in Tampere University to provide new information on company incentives concerning energy communities. I would like to thank my thesis supervisor and examiner for the interesting research topic. I have learned so many new things during this thesis.

I would like to thank my supervisor Jussi Valta and my examiner Saku Mäkinen for their valuable guidance and support throughout this process.

Thank you to my family, friends and girlfriend for supporting me during my university studies and this thesis project, you know who you are!

Tampere, 11.5.2020

Ville-Pekka Haukijärvi

CONTENTS

LIST OF ABBREVIATIONS

BM	Business Model
BMC	Business Model Canvas
CEC	Clean Energy Community
CEC	Citizen Energy Community
CEP	Clean Energy Package
CHP	Combined Heat and Power
CSR	Corporate Social Responsibility
DER	Distributed Energy Resource
DR	Demand Response
DSO	Distribution System Operator
EC	Energy Community
EMDII	Electricity Market Directive
ESC	Energy Sustainable Community
EU	European Union
IC	Impact Canvas
ICES	Integrated Community Energy System
ICT	Information and Communication Technology
MW	Megawatt
NGO	Non-governmental organization
O & M	Operation and Maintenance
PSS	Product-Service System
PV	Photovoltaic
REC	Renewable Energy Community
REDII	Renewable Energy Directive
SBM	Sustainable Business Model
TSO	Transmission System Operator

1. INTRODUCTION

Worldwide emission control and increasing prices of emission allowances are putting pressure especially on the energy industry. The energy sector faces pressure from society to move more towards renewable energy and otherwise sustainable operations. Roles in the energy industry are changing and new roles are forming to serve the new functionalities of the system. Novel business opportunities appear for companies as some old revenues disappear. New practices and models form in the disruption and one of these models being piloted around the world is the energy community.

On the EU level steps have been taken to react to the emerging energy communities and directives considering the definitions of energy communities have been given out. It is now on the responsibility of member states to implement these directives into their own legislation. Definitions in the directives are rather loose so there may be strong variance in the national level solutions. Also, in Finland the legislator is working to implement the directives into the legislation.

Company drivers considering sustainability and energy communities are a rather unexplored topic, especially from the combined perspective of business models and ecosystems. It is useful to know what sustainability functions the companies have already implemented to their systems and what are the motivations for future development.

1.1 Research aim

Aim of this research is to study company motives related to energy communities and sustainable development. With energy communities the focus is to study how different companies in the energy sector perceive their roles in relation to energy communities. Also, what might incentivize companies to join an energy community or to engage in business related to energy communities. And possibly what problems companies dealing with energy community pilots have encountered.

The second approach is business models, especially sustainable business models. So, what functions of sustainable development have companies in the energy sector already implemented to their operations and what goals do they have related to sustainability.

Based on the theoretical framework and questions traced from there the aim is to interview experts from the energy industry and get first-hand information considering the subjects of sustainability and emerging energy communities.

The third approach being the changes happening in the ecosystems of the companies. The emergence of sustainability, renewable energy and energy communities bring about changes to the operating environments of the companies and thus their business models. It is interesting to examine the changing elements around the companies and how they affect different actors in the ecosystem.

The combination of these three elements makes the research interesting. How the introduction of new elements, such as energy communities, affects the dynamics between ecosystem participants or the location of actors in the ecosystems? And how these changes alter the business models of companies. Hence, the research is guided by the following research questions:

> *What incentivizes companies to join energy communities and to invest in sustainable development?*
>
> *What changes are energy communities and sustainable development causing in the operational environments of companies?*

Especially the interviews and the analysis phase of this research are guided by these key questions. The literature review gives basic information on the selected theoretical lenses, and keeping in mind the research questions, sets up for the formation of the interview questions. In the results section these research questions give direction to the analysis.

1.2 Structure of the thesis

This thesis is composed of eight chapters, including this introduction chapter. Chapters from two to four are dedicated to the initial theoretical framework. Chapter two is about business models, chapter three about innovation ecosystems and chapter four about energy communities. Popular definitions and most cited publications are used in these segments to introduce the basics of these literature streams. Fifth chapter describes the research methods and data collection and analysis. In the sixth chapter the results of the research are presented and backed by citations from the interviews. Seventh chapter links the results to the theoretical framework and in chapter eight the conclusions are presented, and the research is evaluated with common evaluation criteria.

2. BUSINESS MODELS

The business model concept has gained much interest since the Internet boom of mid-90's [1]. The business model is a tool used in commercializing technologies. The same technology commercialized with two different business models leads to two different outcomes. The other one might be successful, and the other one a failure. [2]

In this chapter the concept and uses of the business model are explained. First, we define the business model concept and investigate some of the uses it has in practice. Then we look at some different business model designs. We also examine what are sustainable business models. The concept of product-service systems is discussed at the end of the chapter.

2.1 Definition and uses

Although scholars have been interested in the concept of business models and agree that the model is of importance, there seems to be a lack of consensus when defining the concept. Also, ways to implement the business model have been argued among scholars. [3]-[6] Because of this heterogenous view of the business model, there are many definitions by the most cited scholars in this field. We will now represent some of those definitions here to reach a basic understanding of what a business model is.

Osterwalder [7, p.14] provides one of the simplest definitions in the field:

> *A business model describes the rationale of how an organization creates, delivers, and captures value.*

Osterwalder also points out that we need a concept that everybody understands so people are talking about the same thing, when discussing business models. The difficulty is to have a simple concept, and at the same time not to oversimplify the functions of organizations. [7, p. 15] In the next sub-chapter we will take a closer look at Osterwalder's Business Model Canvas. Another popular definition of a business model is by Chesbrough [3]. This definition is more detailed and comprises of six different functions. It is presented in Table 1.

Table 1. The business model definition by Chesbrough. [3]

The functions of a business model
• **Articulate the *value proposition*, i.e. the value created for users by the offering based on the technology**
• **Identify a *market segment*, i.e. the users to whom the technology is useful and for what purpose, and specify the revenue generation mechanism(s) for the firm**
• **Define the structure of the *value chain* within the firm required to create and distribute the offering, and determine the complementary assets needed to support the firm's position in this chain**
• **Estimate the *cost structure* and *profit potential* of producing the offering, given the value proposition and value chain structure chosen**
• **Describe the position of the firm within the *value network* linking suppliers and customers, including identification of potential complementors and competitors**
• **Formulate the *competitive strategy* by which the innovating firm will gain and hold advantage over rivals.**

Chesbrough [2] also summarizes that:

> *a mediocre technology pursued within a great business model may be more valuable that a great technology exploited via a mediocre business model.*

Teece [8] states that *"there are almost as many definitions of a business model as there are business models"*. His definition of a business model is how an organization creates and delivers value to customers, gets payment from the customers, and turns the payments to profit [6] Teece sees the business model as a conceptual tool that can help figure out the earning logic of a company and the way they enter a market. He also points out that strategy and business model are not the same thing, although they are linked. [6] More recently, Wirtz [9] suggests that there is increasing consensus regarding the business model concept. Based on previous literature and their own views Wirtz et al. define business model as a simplified representation of the company's main activities. They emphasize that by considering strategic, customer and market components, competitive advantage can be gained. And to maintain that advantage, business model evolution or innovation might be needed when facing internal or external changes. [9] Also Teece stresses out that pairing strategy analysis with business model analysis is very important to sustain that competitive advantage gained from implementing new business models. That is because business models are more generic than business strategies and are therefore easy to imitate. [6] The business model's placement in an organization, adapted from Osterwalder [5], is visualized in Figure 1.

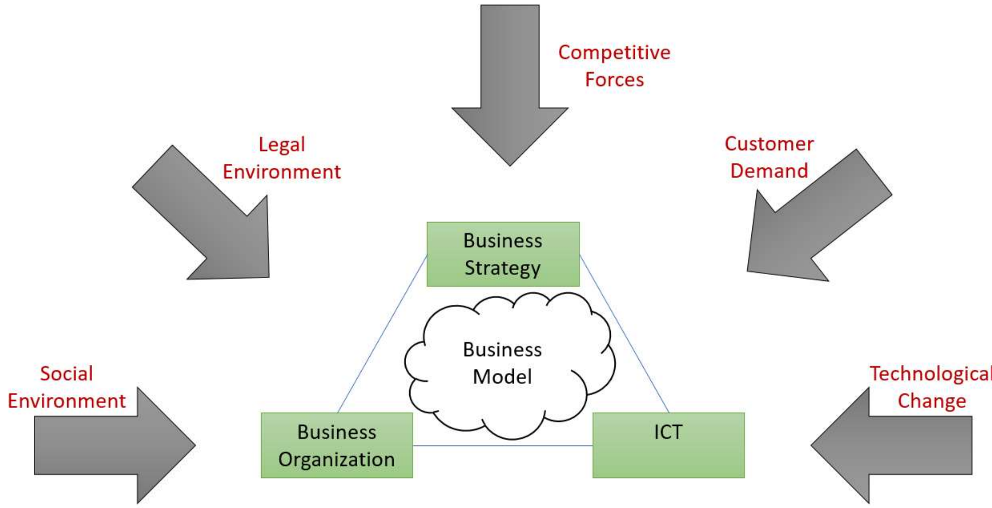

Figure 1. Business model's place in a company adapted from Osterwalder. [5]

Osterwalder et al. say that is important to differentiate model and implementation. They believe that a business model can't be successful on its own. The model must be implemented with strong management skills. Implementation means turning the business model plan into real life elements, such as structures, processes and infrastructure. Also, financing for the business model implementation must be sourced internally or externally. [5]

2.2 Business Model Canvas

The Business Model Canvas by Osterwalder et al. [7] is one of the most popular business model frameworks. The book in question is "Business Model Generation" and it is based on previous research by Osterwalder [5]. The book is based on nine basic building blocks that describe the earning logic of a company, these blocks are 1) customer segments, 2) value propositions, 3) channels, 4) customer relationships, 5) revenue streams, 6) key resources, 7) key activities, 8) key partnerships, and 9) cost structure. These building blocks cover the four main areas of a business: customers, offer, infrastructure, and financial viability. [7, p. 15–17] An adapted version of the Business Model canvas is presented in Figure 2.

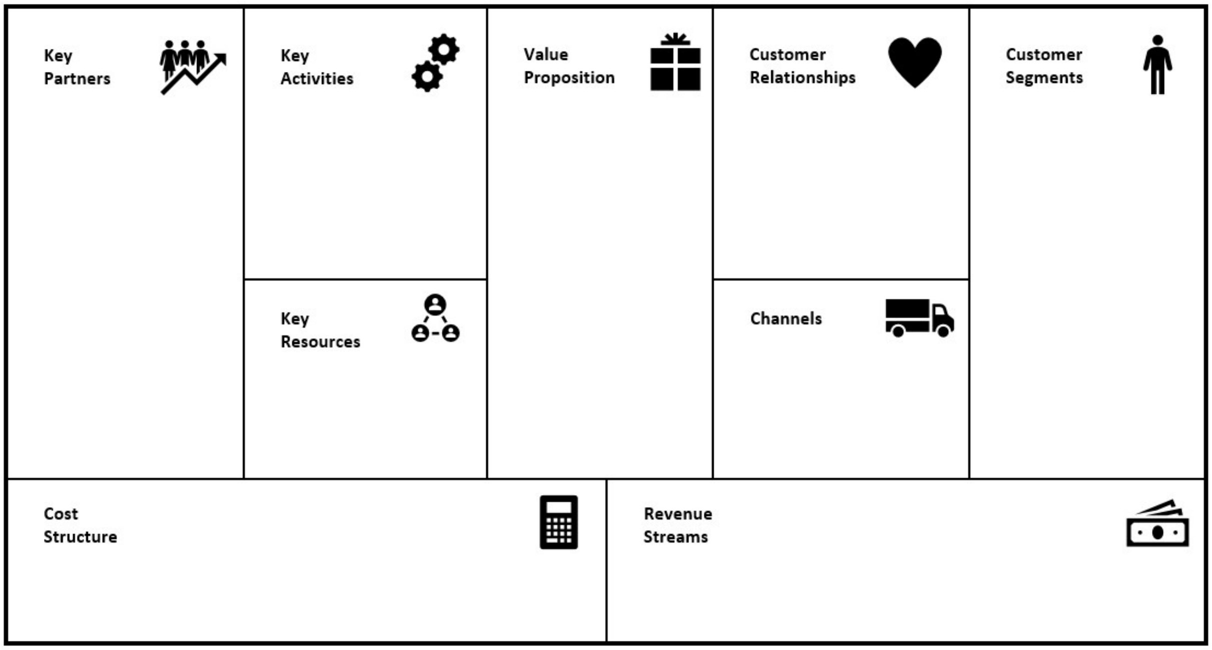

Figure 2. The Business Model Canvas adapted from Osterwalder et al. [7, p. 44]

Customer segments. Like any other business model, this one starts with the customer. Profitable customers are the key to the company's survival, which is why the customer segments must be carefully defined and specific customer needs understood. *"For whom are we creating value?"* [7, p.20–21]

Value propositions. Products and/or services that serve the needs of a specific customer group. *"What value do we deliver to the customer?"* [7, p. 22–23]

Channels. Describes the delivery of the value proposal and communication with the customer. How do the customers want to be reached and what channels could be used? Customers can be reached through own or partner channels, or both. [7, p. 26–27]

Customer relationships. Communicates the types of relationships a company wants to establish with each customer segment. Different motivations for relationships are customer acquisition, customer retention and boosting sales. [7, p. 28–29]

Revenue streams. *"For what value are our customers really willing to pay."* A company creates revenue streams from each customer segment. Different pricing mechanisms may be applied, such as asset sale, usage fee, subscription, or licensing. [7, p. 30–31]

Key resources. What important assets are required by the value propositions? Key resources can be owned or acquired, and the nature of the resources can be physical, financial, intellectual, or human. [7, p. 34–35]

Key activities. The most important functions of a company. These are needed in order to operate successfully and to make the business model work. These activities can be related to manufacturing, problem solving, or platforms. [7, p. 36–37]

Key partnerships. *"the network of suppliers and partners that make the business model work"*. There are three main reasons for partnerships. Cost reduction from optimization and economy of scale. Reduction of risk and uncertainty from alliances, even among competitors. Acquisition of some resources and activities, since it might not be logical to own all resources or perform all activities. [7, p. 38–39]

Cost structure. Describes what important costs are induced from operating a specific business model. Most business models are somewhere between cost-driven and value-driven. In cost-driven models the focus is on minimizing costs, while in value-driven models the focus is value creation. For example, a low-cost airline versus a luxury hotel. [7, p.40–41]

2.3 Sustainable business models

The concept of sustainable business models is even younger than the concept of business models, hence the literature is even more fragmented. Slightly differing terms are used when sustainable business models (SBMs) are discussed in scholarly journals: *"business model innovation for sustainability"*, *"business models for sustainability"*, *"business models for sustainable innovation"* etc. Some of the most cited and relevant articles on the topic will be used here to give a general view on SBMs.

As value is strongly associated with business models [3], [7], Evans et al. [10] provide a holistic view of sustainable value, which is presented in Figure 3. A company should integrate also social and environmental goals into their value creation logic, in addition to economic goals [10].

In addition to this holistic view of environmental, social, and economical values, Evans et al. make four other propositions to innovate towards SBMs. The propositions are:

2) a system of sustainable value flows among multiple stakeholders including the natural environment and society as primary stakeholders

3) a value network with a new purpose, design and governance

4) a systemic consideration of stakeholder interests and responsibilities for mutual value creation

5) internalizing externalities through PSS[1] enables innovation towards SBMs

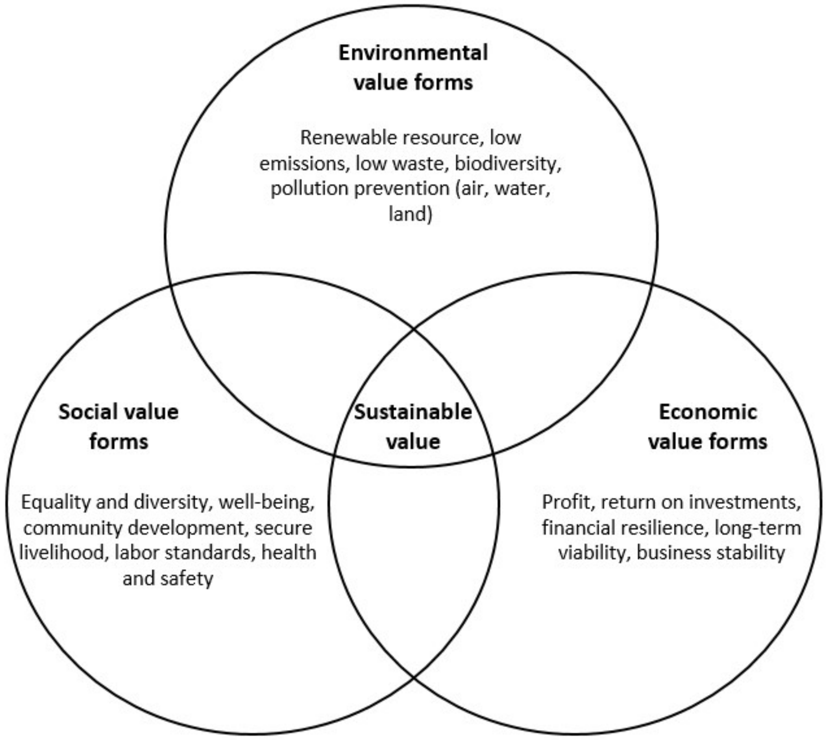

Figure 3. Sustainable value. [10]

Also, Schaltegger et al. [11] present their own general definition with similar attributes:

> *A business model for sustainability helps describing, analyzing, managing and communicating (i) a company's sustainable value proposition to its customers and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social and economic capital beyond its organizational boundaries.*

The process of sustainable development involves inter-organizational networks and wide societal systems. These networks include many stakeholders in addition to companies. [12] Based on these stakeholders and networks, Boons et al. [12] use four elements of a business model to propose requirements for successfully marketing sustainable innovations:

1) *The value propositions.* Measurable ecological and social value are in balance with economic value. This proposition also reflects a business-society dialog. The

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[1] Product-service system

balance of values is embedded in existing products and services, and actively incorporated in new solutions.

2) *The supply chains.* Suppliers take responsibility towards their own and the focal company's stakeholders. The socio-ecological burdens of the focal company are not transferred to its suppliers. Sustainable supply chain management is demanded from the suppliers. This includes closed loop material cycles etc.

3) *The customer interfaces.* Motivate customers to take responsibility for their consumption. The focal company's socio-ecological burden is not transferred to its customers. Customer relationships are created with sustainability challenges of different markets in mind.

4) *The financial model.* "reflects an appropriate distribution of economic costs and benefits among actors involved in the business model and accounts for the company's ecological and social impacts".

There are many challenges for marketing SBMs. Sustainable innovations must fit the focal company from the technological and organizational point of view, innovations must be economically viable and at the same time help in solving sustainability issues. [12] Evans et al. list barriers SBMs are facing. *Triple bottom line* is the challenge of balancing between profits and social and environmental benefits. *Mind-set* of companies is dominated by business rules, guidelines, behavioral norms and economic performance metrics, which hinders the introduction of SBMs. Companies are reluctant to allocate *resources* to business model innovation and to reconfiguring their business. *Technology innovation integrated* with business model innovation is complex. Extensive *external relationships* with stakeholders require extra effort. Sustainability driven *business modelling tools* are hard to find. The effects of business model innovation on sustainability are also hard to measure because metrics are not understood or are still under development. Also, the measurement of success cannot anymore rely only on shareholder value, rather it needs to be extended to all stakeholder relationships that will become essential in the long-term success and survival of a company. [10]

Schaltegger et al. provide to the literature stream of sustainable business models with their articles [13] and [14]. In these articles they introduce and discuss the *business case for sustainability*, which is based on the *triple bottom line*. Hence, the core of the business case for sustainability is to create economic success *through* voluntary environmental and social activities, instead of them being separate from the economic drivers. It is also emphasized that there is no automatic connection between those sustainable activities and economic success, rather the business case(s) for sustainability must be found and realized.

Three requirements are set for the business case for sustainability. The company must take a proactive voluntary approach, which offers solutions to sustainability problems concerning the society or the environment. Also, a measurable positive business effect must follow from these voluntary sustainability activities. And lastly, it must be accountable that the positive sustainability and economic effects are caused by “a certain management activity” and that economic success is in fact connected to sustainability. [13] Renewable energy industry is given as an example where business case for sustainability is applied and there is an orientation towards multiple stakeholders. Renewable energy companies are tackling the number one societal and environmental problem: climate change. By doing that they are creating value for their stakeholders for example by creating demand for suppliers, offering returns to investors, offering jobs in a growing industry, improving air quality locally, creating tax flows and providing customers with sustainable solutions. [14]

Porter and Kramer discuss creating *shared value* in their article and give concrete examples on sustainable business models. The text handles same themes as Schaltegger et al. [13], [14] and other stakeholder oriented sustainability literature, but from a slightly different angle. Porter and Kramer define three different ways for creating shared value: a) reconceiving products and markets, b) redefining productivity in the value chain, and c) building supportive industry clusters at the company’s locations. Under the productivity in value chain are also subcategories of energy use and logistics, resource use, procurement, distribution, employee productivity, and location. Motivation of the article is reshaping capitalism and using its power to solve societal and environmental problems while also creating economic value. [15]

Reconceiving products and markets mean altering business models so that they also meet society’s needs instead of just manufacturing an artificial demand. For example, food companies focusing on better nutrition instead of volume. Also serving the needs of overlooked poor communities and developing countries is brought up in the form of low-priced cellphones and banking services for example. [15]

Solving societal and environmental problems along the value chain is likely to result in avoided costs and improved efficiency. The way of thinking is changing, and companies are starting to realize that there is a connection between sustainable progress and productivity. A real-life example is given where Wal-Mart reduced packaging and re-routed its deliveries, saving hundreds of millions of dollars. [15]

Porter and Kramer talk about “clusters”, which are local concentrations of companies, suppliers, infrastructure, institutions etc. [15] Basically, they are describing business ecosystems or innovation ecosystems although the term “ecosystem” is not used. Success of the companies is greatly affected by other actors in the “cluster” or the “ecosystem”, and these regional clusters drive productivity, innovation and competitiveness [15].

2.4 Impact Canvas

The Impact Canvas (IC) is a tool specifically designed for testing early-phase ideas in sustainable business model innovation. Adaptation of the Impact Canvas is presented in Figure 4. The IC tool emphasizes a multidisciplinary approach to the ideation of sustainable businesses. For example, researchers and businesspeople teaming up to assess a novel business idea. Professionals are faced with fast paced innovation cycles and user interaction already in the early ideation phase, and accordingly the IC tool has an iterative approach. Complex societal challenges require knowledge from many sources, hence the multidisciplinary team approach. In the IC tool, *Vision* of the team is surrounded by six different sections: *Customer, Solution, Competition, Resources, Actions, and Team*. Under each of these categories are questions presented that the team can ask itself to test and develop their initial idea. [16]

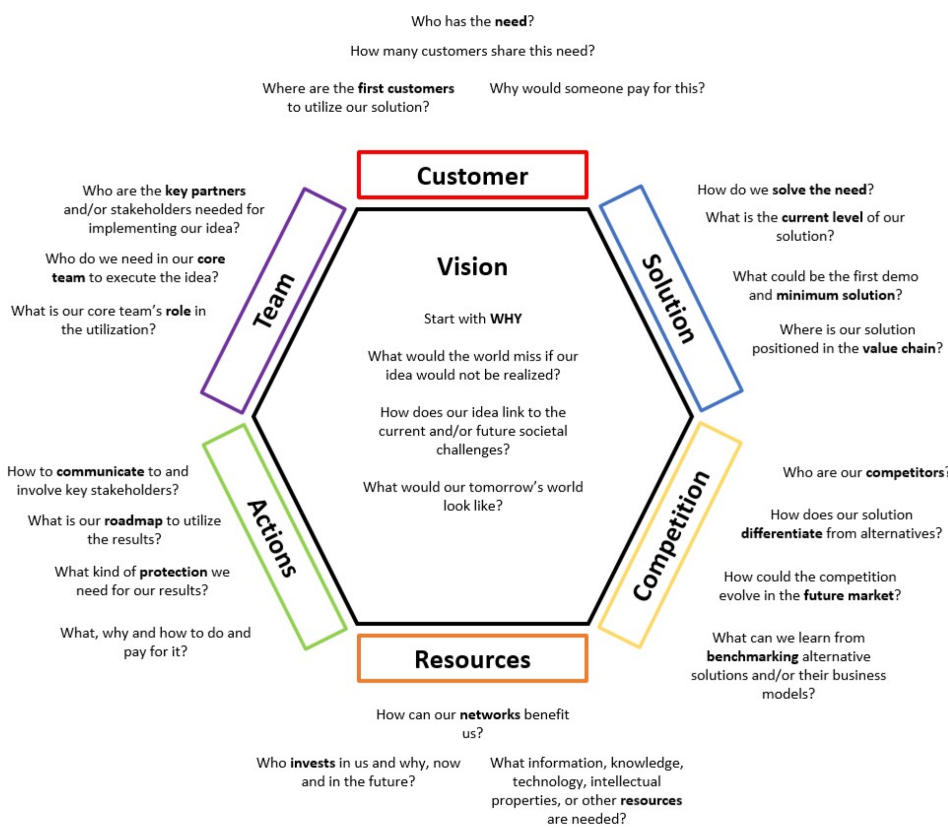

Figure 4. Impact Canvas [16].

There are many common features with the Impact Canvas and the Business Model Canvas, although the presentations differ. The IC is more rooted in sustainable thinking, while the BMC is focused on traditional business thinking. The IC is also more iterative by nature with its circular form, as it is intended to be used in early ideation where many suggestions are not eventually viable. The sections the IC shares with the BMC are customer, solution, resources, and actions. Corresponding segments in the BMC are customer segments, value proposition, key resources, and key activities. Also, key partners, cost structure and revenue streams are covered in different sections of the IC. The vision segment of the IC tool somewhat relates to the value proposition of the BMC but is maybe the most differentiating part between the two. The BMC does not include a long-term element, as the IC tool does with the vision segment.

2.5 Product-service system

Product-service systems (PSS) are often brought up and discussed with sustainable business models or sustainable innovations. Since the 1990s there has been growing interest in the concept of PSS [17]. This has been due to the potential of PSS to enhance competitiveness and sustainability. Tukker states that PSS *“consists of a mix of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling final customer needs”*. The basic idea with PSS is that the final customer need and satisfaction is taken as the starting point of business development, rather than designing a product for that need. This creates more freedom to make sustainable improvements. Then a business system answering this customer need must be implemented. Tukker also states that the PSS does not automatically equal sustainability but is a system that enables sustainability and competitiveness. [18]

Tukker divides PSS into three main categories: product-, use-, and result-oriented services. Product- and use-oriented services deal with product related consultancy and leasing/renting/sharing/pooling products. Result-oriented services on the other hand deal with a functional result, where no pre-determined products are involved. He says that the result-oriented services possess the biggest, possibly disruptive, sustainability potential. The other two are seen more as incremental solutions. [19] Although it can be argued that use-oriented services can be disruptive, depending on what products are being leased. If the technology being leased is itself disruptive, the use-oriented service can be sustainably disruptive. For example, when PSS is applied to solar photovoltaics. This has been the case for example with SolarCity power purchase agreements, the company has acquired over 35 % of the solar market share in the US [20].

3. INNOVATION ECOSYSTEM

Moore [21] introduced the concept of *business ecosystem*. The concept of *innovation ecosystem*, which has derived from business ecosystems, will be discussed in this chapter. First, we try to create a general view to what an innovation ecosystem is and what purposes it might have. Then some important roles in the ecosystem construct are introduced. Some risks and challenges involved in innovation ecosystems are discussed along with effects to strategy. Finally, ecosystem reconfiguration is discussed.

3.1 Definition and uses

Moore states that innovative businesses need cooperative networks that involve resources, capital, partners, suppliers and customers. These networks create business ecosystems where companies evolve together around innovations, cooperating and competing to create new products and satisfy customer needs. [21] The concept of innovation ecosystem has emerged more recently, gaining interest in fields such as strategy, innovation, and entrepreneurship. Different definitions have been created with altering labels, meanings and purposes. There is no generally accepted definition for innovation ecosystem, which can create confusion in the use of this term. Several scholars also use innovation ecosystem synonymously to business ecosystem. [22]

Oksanen describes innovation ecosystem as *"a dynamic, interactive network that breeds innovation."* [23]. Ritala et al. note that it might be used to refer to physical or virtual clusters of innovation with specific themes such as biotechnology or software. On the other hand, it might refer to innovation driven business ecosystems. [24] de Vasconcelos Gomes et al. [22] suggest that:

> *an innovation ecosystem is set for the co-creation, or the jointly creation of value. It is composed of interconnected and interdependent networked actors, which includes the focal firm, customers, suppliers, complementary innovators and other agents as regulators.*

They also propose a difference between innovation ecosystem and business ecosystem: innovation ecosystems are focused on value creation, while business ecosystems refer to value capture. Although, business ecosystem and innovation have common features: 1) both have interconnected and interdependent network actors, such as customers and complimentary innovators, 2) they may be led by a key actor or by a platform leader, 3) it is suggested that ecosystems are built on a platform, such as technological platform or industry platform, 4) members in both face cooperation and competition, 5) both could have a lifecycle with different phases. [22]

Adner [25] presents his own view on ecosystem definitions, based on his previous work and relevant ecosystem literature by other authors. He states that the growing interest in ecosystems and related ideas, such as business models, have brought into light new ways of creating and capturing value. There is also confusion when and where the ecosystem perspective should be used, hence Adner proposes his own definition to bring clarity on the subject.

Adner divides ecosystems according to two general views, ecosystem-as-affiliation and ecosystem-as-structure. The affiliation view accentuates the role of actors, networks and platforms, while the structure view focuses on the value proposition and the activities and interactions behind it. Focus of the paper is on the ecosystem-as-structure, as the author finds it different from the existing literature and more intriguing from a strategy viewpoint. [25]

Most of the existing literature seems to fall under the perspective of ecosystem-as-affiliation in the categorization made by Adner. This perspective revolves around a central actor or platform which attracts new participants to the ecosystem. When the size and density of the ecosystem increase, the bargaining power of the focal leader increases, interactions inside the system increase and therefor also value creation increases. However, from a strategy point of view the details of value creation are shadowed by general governance and other aspects. [25]

The ecosystem-as-structure starts with the value proposition and evaluates the actions needed for realization of the proposition and lastly considers the actors that need to be involved. As opposed to the ecosystem-as-affiliation perspective which starts with the actors and actions, links them together and ends up with the value propositions. Based on this structure view Adner [25] provides his own definition on ecosystems:

> *The ecosystem is defined by the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize.*

A set of four basic elements is also listed, these elements are needed for the above-mentioned value proposition to materialize. As the ecosystem-as-structure is focused on activities rather than actors, the first element is *activities* needed to materialize the value proposition. The second one is *actors* performing these activities. Third, *positions* of the actors in relation to each other. And finally *links* that define the flow of materials, information etc., a straight link to the focal actor is not necessary. When considering ecosystem strategy, the recognition and management of these indirect links is in a central role. [25]

3.2 Ecosystem roles

Some common roles emerge when examining the literature on innovation and business ecosystems. As de Vasconcelos Gomes et al. [22] state, there is a consensus among scholars that ecosystems compose of a network of actors with certain dependencies. These actors can include for example the focal company, suppliers, complementors, competitors, customers and regulators. The number of these interconnected actors can vary from tens to thousands. [26]

Also, a common feature suggested by many authors is an “ecosystem leader” or a “keystone actor”. Dedehayir et al. [27] describe the ecosystem leader as an entity that designs and assigns roles and links the different actors together. Once the ecosystem platform has been created, the ecosystem leader orchestrates the operation of the ecosystem, including value creation and capture. The ecosystem leader is included in all phases of the ecosystem development. Some actors come in later in the process or are involved only in the early phases. [27]

Iansiti and Levien [26] refer to the leader as a keystone organization. The main function of the keystone according to them is to ensure the health of their ecosystem “by providing a stable and predictable set of common assets”. Linking together network actors is also mentioned. Keystones keep improving the ecosystem and making it more efficient to ensure their own success. Effective keystones enable value creation in the ecosystem by introducing a platform, which can be physical or intellectual. Although the keystone creates value also itself, most of the value is created by other actors around the platform. Important part is the sharing of value throughout the network. The ecosystem is on sustainable basis only if the keystone shares much of the acquired value, keeping only a part of it to itself. This feeds the ecosystem and makes it thrive. [26]

In addition to keystones, niche actors are an important part of the ecosystem. They have a narrow area of expertise and specialized capabilities. Niche actor tries to differentiate itself from other ecosystem companies while acquiring complementary resources from them or the keystone. Under favorable circumstances niches form the majority of the ecosystem and also create most of the value. [26]

However, there is also a leader type that abuses its power position in the ecosystem, called the dominator. The dominator uses its powerful integrated or strategic position in the network and extracts as much value to itself as it can. This might lead to the dominator devouring the whole ecosystem or extracting all the value out of it, hence leading to the destruction of the ecosystem. The niche players cannot survive in these conditions and the benefits of the ecosystem construct, such as productivity, robustness and niche creation, are lost. [26]

3.3 Risks of ecosystems

Adner [28] suggests that great innovations don't succeed on their own. Complimentary innovations might be needed for your product or service to attract paying customers. He proposes assessment of the ecosystem risks to have more realistic expectations and plans for new offerings. These risks can be evaluated through a set of questions. Also, ecosystem strategy is discussed. [28]

Initiative risks. Such things as usefulness of the product, benefit to customers, competition, supply chain and quality of the project team must be considered when creating new innovations. The important decision is which initiative risks the firm should handle itself, and which risks should be dealt with by a partner. [28]

Interdependence risks. A single innovation is usually a building block of a bigger system. So, the success of an innovation depends also on the development and deployment of other parts of the system. If all the other parts are delayed, one part of the system cannot succeed on its own. More partners mean less control over your own success. The chances of succeeding can be evaluated by doing thorough background work, by double-checking with partners and by investigating historical cases. If problems occur, solutions vary by case. The solution can be for example finding a new partner or moving into your partners business. [28]

Integration risks. Depending on how high the focal firm is in the value chain, there could be many intermediaries between the innovation and paying customers. The bigger the number of intermediaries the bigger the uncertainty of succeeding in the market. *"If benefits don't exceed costs at every adoption step, intermediaries will not move your offering down the line." [28]*

Adner states that forming an ecosystem strategy is an iterative process as setting is so complex and there are many interconnected actors. First the initial innovation strategy is formed and things such as performance levels and markets are determined. Then this initial strategy is evaluated through the ecosystem risks presented above. The strategy is then adjusted accordingly and put to the test. Then if needed the process is repeated in accordance to its success. [28] Visualization of this strategy formulation is presented in Figure 5.

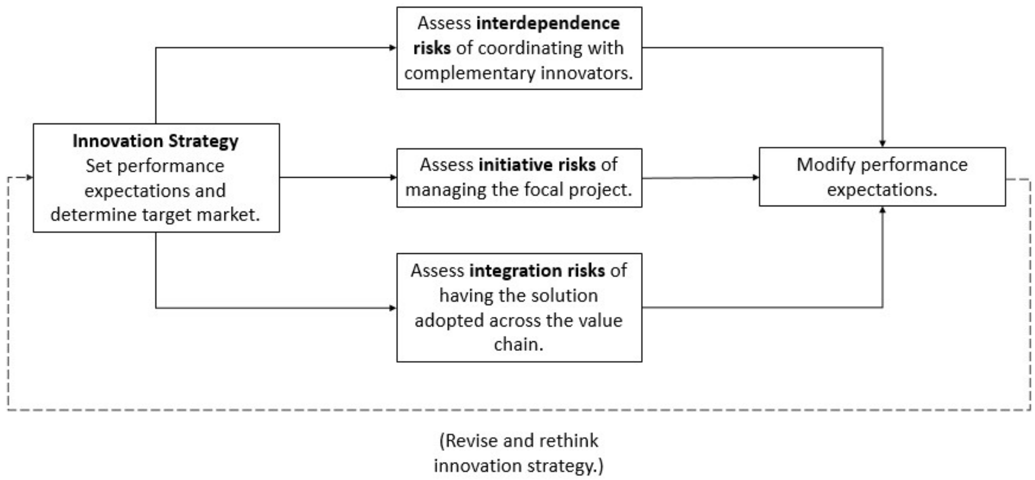

Figure 5. Ecosystem strategy formulation adapted from Adner. [28]

Managing risk is an essential part of any ecosystem strategy. The risk can be caused by technical difficulties, coordination of the ecosystem or delayed market emergence for example. Different adversities are to be expected and the innovation ecosystem strategy should work to mitigate these risks. Questions like where, when and how to compete must be considered through an ecosystem lens that extends beyond the company's internal boundaries. [28]

3.4 Ecosystem reconfiguration

Dedehayir et. al. [29] suggest, based on Christensens [30] framework, that disruptive innovations can't at the early stage compete with the incumbent technology or system in the mainstream market. Hence the disruptive innovation gathers momentum in an emergent market first. After achieving the performance level demanded by the mainstream market, the disruptive innovation can start competing with the incumbent technology. And possibly as an outcome of the rivalry between the firms producing the disruptive innovation and the firms producing the incumbent technology, the incumbent firms are replaced by the firms behind the innovation. However, the surrounding actors are not considered here. The disruption effects also other actors involved in the delivery of the incumbent value proposition. These actors are part of the incumbent innovation ecosystem. Disruptive innovation brings a new value proposition, that is delivered by a different innovation ecosystem where actors and connections have been restructured. [29]

If the disruptive innovation prevails in this competition between two innovation ecosystems, the incumbent innovation ecosystem's value blueprint is reconfigured to fit the value proposition of the disruptive innovation [29]. Adner [31] proposes five ways the reconfiguration can take place:

(i) *separation* of bundled elements into separate elements

(ii) *combination* of uncoupled elements

(iii) *relocation* of existing elements to new positions

(iv) *adding* elements that are currently absent

(v) *subtraction* of existing elements for the benefit of the ecosystem

These reconfigurations are such that they "can create new value and move the value proposition forward" [31].

Dedehayir et. al. [29] also discuss the nature of disruptive innovation: low-end disruption described by Christensen [30] and new market disruption by Christensen and Raynor [32]. Low-end disruption is based on lower unit price and design simplicity, compared to the incumbent system. Dedehayir et. al. make two propositions considering the low-end disruption: (i) when the product or service is modular, i.e. compliant with the current platform, reconfiguration is likely based on *separation and addition*; (ii) when the product or service is not modular, reconfiguration is likely based on *combination and subtraction*. In the case of new market disruption, the unit price might be higher in the disruptive ecosystem, but the value proposition is still more tempting because of improved functionality for example, i.e. additional features. One proposition is made considering the new market disruption: (i) reconfiguration is likely based on *addition.* [29]

3.5 Summary on business models and innovation ecosystems

Osterwalder describes the business model being surrounded by business strategy, business organization and company ICT in Figure 1. These are then surrounded by external pressures and changing surroundings. These pressures can also be perceived as ecosystem risks and other pressures faced by the focal company. So, the business model and the ecosystem around the focal company are linked together by the ecosystem changes afflicted on the business model and company strategy. Relationship between the business model and the ecosystem strategy is presented in Figure 6. The original model is adapted from Moore [33] and the ecosystem risks and sustainability elements are added.

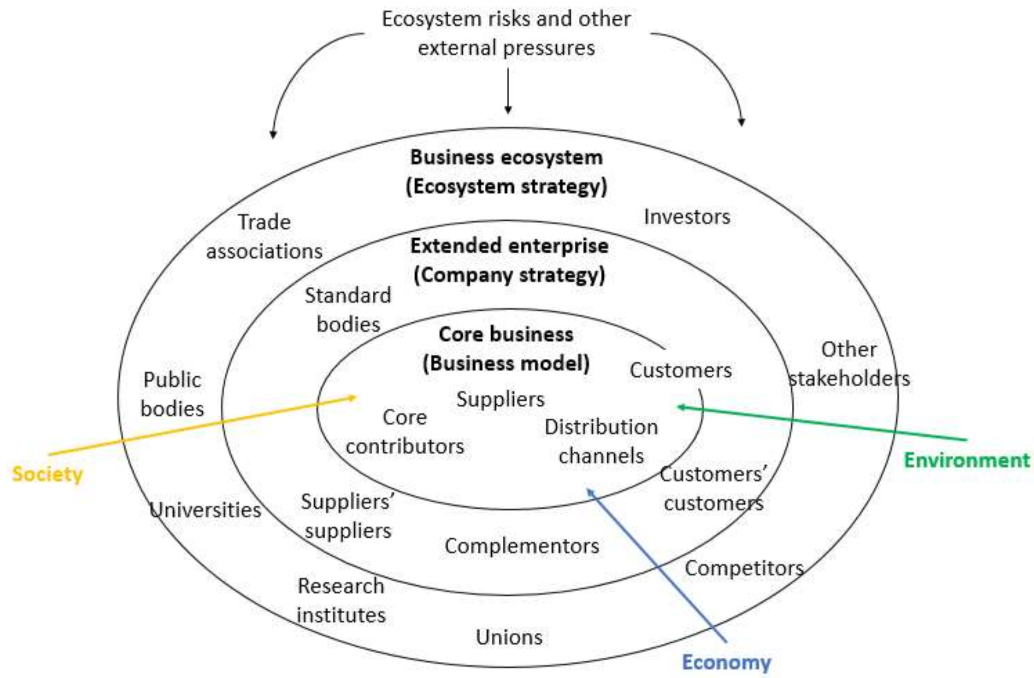

Figure 6. Relationship of business model and ecosystem strategy adapted from Moore [33].

The earning logic of the company, i.e. the business model, is included in the extended company strategy with the external risks in mind. The ecosystem strategy includes the company strategy, and they are both affected by external factors such as legislation, customer demand, competitive forces and so on. These external factors described in Figure 1 can be included in the ecosystem risks as well. So, reconfigurations in the surrounding ecosystem cause adjustments to the business model of the company, in order for the company to prosper in the changed setting of the ecosystem. In accordance to sustainable business models, the triple bottom line of social, environmental and economic factors is injected to the business model of the company and thus to the key operations of the company. This model is also in line with Schaltegger et al.'s [13] business case for sustainability and Porter's and Kramer's [15] shared value.

4. ENERGY COMMUNITIES

In this chapter we will discuss different attributes of *energy communities*. The focus will be specifically on the energy aspect of communities, not on other sustainability features such as waste management. First, we discuss the concept of energy community. Then we classify different types of energy communities into subcategories. Some relevant technologies are discussed next. Also, actors and motives to join energy communities are considered. Some challenges faced by energy communities are brought up. The Business Model Canvas is applied to the case of ICES and an example case of an energy community is presented. Finally, new policies related to energy communities are discussed.

4.1 Concept of energy community

There are many different definitions and views from slightly different perspectives when discussing energy communities. These include for example *clean energy communities* (CEC) [34], *energy sustainable communities* (ESC) [35], *integrated community energy systems* (ICES) [36] etc. The functions of an ICES are presented in Figure 7. Energy communities are a subcategory of sustainable communities. Sustainable community is a more holistic approach including all areas of sustainability, some of which are water, food, transport, waste and energy [37]. Energy communities on the other hand are focused on supply, consumption and storage of energy.

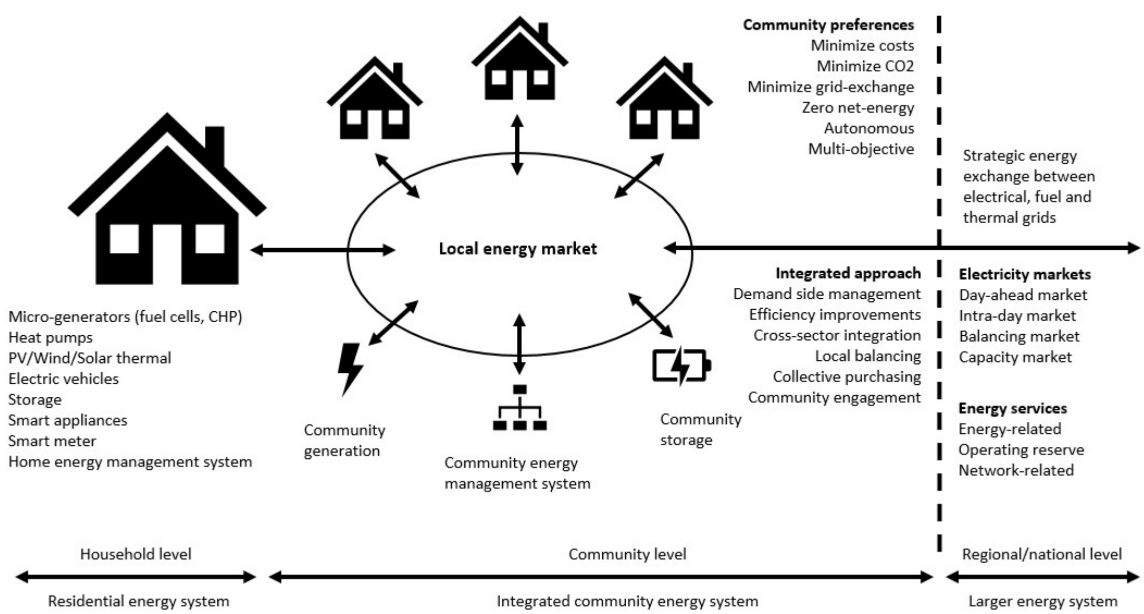

Figure 7. Functions of an integrated community energy system adapted from Koirala et al. [36]

Perhaps ICESs give the most comprehensive view on the energy community question. They deal with the changing local energy landscape and combine sustainable energy communities, community energy systems, community micro-grids, and peer-to-peer energy. ICESs are not just about increasing energy autonomy, but also providing services and support to other connected systems. ICESs are a holistic approach to energy communities, providing local production incorporating renewable energy, energy storage solutions, electric vehicles and demand-side management. The objective is to maximize energy performance while cutting costs and minimizing environmental impact. With ICES the size of the community can vary from a block of houses to an entire district. [36] Although there are many definitions for the word "community", most have some common themes, such as a sense of place, identity, localism and shared values [37].

4.2 Classification

Energy communities are usually categorized based on location and/or grid connectivity. Communities can be grid connected or off-grid standalone systems. Koirala et al. [36] have also differentiated developed and developing countries, both having urban and rural area categories. Usually the case is that in developed countries rural and urban communities are grid connected, at least in European countries [36]. Although some remote locations such as summer cottages might be off-grid. In developing countries energy community systems aim to provide affordable energy access to rural areas that are often totally off-grid.

Rae [37] suggests that grid connection is beneficial from both technical and financial perspective. Off-grid systems have many disadvantages, such as the need to function at low capacity factors, costly and technically uncertain energy storage, and possibility of overproduction if all the excess energy cannot be stored [37].

Furthermore, energy communities can be divided into communities within a housing company, communities crossing property boundaries and distributed communities [38]. These will be discussed in chapter 4.10.

4.3 Value streams

Microgrids or energy communities face some technical problems that may prove very harmful for their profitable deployment. Such include islanding detection, relaying and protection, and power quality monitoring. To balance these challenges, there are some notable revenue streams characteristic for energy communities. These include demand response, exporting power to the grid, the value of resilience, and local energy markets. [39] Here we look at the four value streams.

In demand response (DR) the end-user's electricity consumption deviates from the normal patterns due to electricity price changes or due to incentives used to shift consumption peaks or when the stability of the grid is endangered. DR actions can be executed through load curtailment or by shifting consumption to another time, possibly utilizing local production and storage. Communities with renewables, storage and adjustable loads are well suited for DR either by reducing consumption or providing support to the grid. [39]

Exporting power back to the grid is one possible revenue stream or saving opportunity in energy communities. In net metering a bidirectional meter allows the measurement of net energy consumption when the user has an opportunity to feed his own production to the grid. This way the user pays only for the difference between consumption and own production. With feed-in-tariffs the user gets paid for all electricity exported to the grid. [39]

Local generation, storage and control can be utilized to minimize inconvenience and financial losses during planned and unplanned outages or disturbances. The proper size of the reserve may be hard to evaluate; hence the cost vs value of the resilience should be assessed. [39]

Energy communities could create value streams by forming local energy markets inside and/or between the communities. This would demand for an online auctioning platform similar to the existing electricity market platform, or it could be possibly integrated with the current system. Possible benefits include savings in electricity bill, curbing the power of utilities, facilitating renewable production, grid stability, and energy efficiency. [39]

4.4 Technologies

In the traditional power grids, there is a one-way flow of power from centralized generation to customers. However, in a smart grid, a two-way flow of power and information is used to create an automated and distributed energy delivery network. [40] Developments of smart grids create the basis for functioning ICESs. Energy management systems, also mentioned in Table 2, enable efficient control and operation of distributed generation, storage, consumption and flexible demand.

Table 2. ICES technologies adapted from Koirala et al. [36]

Categories	Technologies	
	Household level	**Community level**
Local generation	Micro-CHP Fuel cells Heat pumps Solar PV Solar thermal Micro-wind	Community CHP Fuel cells Heat pumps Biomass Geothermal Micro-hydro Community PV Solar thermal Community wind
Demand side flexibility	Smart appliances Automated meter reading (AMR) Electric vehicles Electric and heat storage Battery energy management system (BEMS) Home energy management system (HEMS)	Community electric and heat storage Community BEMS Community energy management systems (CEMS)

Forecasting the availability of solar and wind can be challenging and no matter how accurate forecasts, they aren't always available. Therefore, in addition to intermittent generation such as wind and solar PV, flexible generation and storage are needed to ensure a steady flow of power. Community level flexible generation is still largely based on generators that use traditional fossil or biofuels. These solutions must be replaced in the future and there are some promising alternatives. Fuel cell technology is developing at a fast pace and some cells already function at high levels of efficiency. Also, geothermal and other heat pumps are already in use for more efficient cooling and heating solutions. [36] They are most useful in passive houses that have very low energy consumption due to effective insulation [36], [41].

4.5 Company motives

Company motives for engaging in sustainable activities, such as energy communities, can be examined through different theoretical lenses. For this use we have chosen Corporate Social Responsibility (CSR) and Innovation Ecosystems. CSR is often used when examining sustainable businesses [42]-[45] and innovation ecosystems deal with multiple stakeholders and value creation, as do the CSR theory and energy communities. Altered version of this sub-chapter has been used earlier as a part of a conference paper [46].

Concepts of CSR and sustainability often appear together in the literature and are sometimes used synonymously, though their definitions slightly differ. Corporate sustainability is the basic framework which includes CSR. [45] Carroll and Shabana [43] define CSR as follows:

> *The social responsibility of business encompasses the economic, legal, ethical, and discretionary [later referred to as philanthropic] expectations that society has of organizations at a given point in time*

Schaltegger et al. have set three requirements for business cases for sustainability. Sustainability needs to have a proactive approach and needs to be based on voluntary activities. Motives cannot be purely economic, and the activities will have to aim at solving environmental or social problems. Second, it is still a business case, so there must be a positive effect on economic success. That success must be traceable and measurable, such as increased sales or reduced costs. Lastly, economic success must be achieved through those sustainability activities, not just alongside with them. [13]

Next, business-case arguments or business benefits for CSR are viewed. Carroll [43] divides the arguments to four sections based on arguments proposed by Kurucz [47]: cost and risk reduction, gaining competitive advantage, developing reputation and legitimacy, and seeking win-win outcomes through synergistic value creation. Also Weber [42] and Aagaard [45], for example, list business benefits for CSR and the lists are quite similar to Carroll's, with slightly different sectioning.

Cost and risk reduction. Establishing a certain level of social and environmental performance minimizes the possible threat of stakeholder demands that might endanger the economic performance of the company. Also, equal employment opportunity policies and being environmentally proactive reduce costs and risks in the long term. Costs of complying with environmental regulations can be lowered with proactive CSR and social concern is diminished. It is likely that the company faces less regulation and objection when it has positive community relationships. [43] Companies can achieve cost savings also through optimizing activities such as: increasing resource efficiency, lowering energy and water consumption and waste quantities. All these actions preserve the environment and result in economic benefits also. Lean is often part of a company's CSR strategy and has been proven efficient in resource optimization. [45]

Gaining competitive advantage. Carroll describes competitive advantage in this context as how companies differentiate themselves from other companies using CSR. In CSR, stakeholder demands are seen as opportunities and the aim is to fill those demands while also gaining benefit for the company. CSR actions can also strengthen customer relationships and increase brand loyalty. Companies with a good track record on CSR and sustainability are also more likely to attract investments. [43] Porter and Kramer discuss the concept of shared value. The most efficient way to create shared value and achieve competitive advantage is through the key areas of the company's business. In the core business lie the biggest economic benefits and long-term commitment is easier to establish. Biggest impact on societal problems is made where the company has the resources and scale of operations. [15] Weber also suggests positive effects on employee motivation, retention, and recruitment when engaging in CSR activities [42], and thus gaining competitive advantage.

Developing reputation and legitimacy. CSR actions are one way of strengthening legitimacy and enhancing reputation of the company. This means functioning according to social norms and fulfilling the expectations of different stakeholder groups. Image is the current picture of the company projected to its stakeholders and reputation is the result of "consistent performance and communication over several years." [42] Corporate social reporting provides information on the economic, environmental and social performance of the company. This is a practical way for companies to show that they are operating according to social norms and expectations. [43]

Seeking win-win outcomes through synergistic value creation. The win-win perspective also seeks to fulfill stakeholder demands while successfully pursuing operations of the company. An example of a win-win situation is when a company supports education in hope of quality human resources in the future. [43] Schaltegger et al. state that business cases for sustainability should "focus on overcoming trade-offs to create synergies". Win-win solutions try to achieve multiple goals at the same time and are a combining social, environmental, and economic aspects to achieve synergy benefits. [14]

Innovation ecosystems are also closely related to energy communities, sustainable development and CSR through value creation, innovation, networks and sustainable growth. Hence ecosystems will now be discussed in the context of business benefits.

Value creation and innovation. Competitive advantage is dependent on value creation, which in turn is dependent on successful innovation. It is rare for an innovation or a company to stand alone without suppliers or complementors. [48] In most cases external factors and innovations have major effects, as in the case of complex concept of energy communities. Energy communities require cooperation from governments, companies, aggregators, NGOs, end users etc. When functioning correctly, ecosystems foster innovation and create value that no company could produce on its own [28].

Efficiency through partnerships. Iansiti & Levien use the case of Wal-Mart and its procurement system as an example of ecosystem efficiency. Wal-Mart has an extensive network of business partners and by sharing information and by correctly managing the ecosystem, they are able to optimize supply and demand in their ecosystem. This way they increase productivity and flexibility of the whole ecosystem and gain more value for themselves and their partners. Another example is Nvidia, a graphics accelerator designer. They use manufacturing platforms of other two companies and focus on their core competences such as designing the products. This way they avoid the costs of owning and operating the manufacturing functions. [26]

Sustainable growth from sharing value. Sustainable growth and long-time survival of the ecosystem depends on the ecosystem leader or leaders sharing the value with ecosystem members. If value is not shared the benefits will be temporary, and the ecosystem will fall apart. One example is eBay, that has created a well-functioning platform that attracts new members to the ecosystem. They have also succeeded in sharing the value, charging rather small commissions but still profiting and running a successful business. [26]

4.6 Individual motives

In the literature there are several benefits and barriers listed for the development of energy communities. Some of them are listed here to create a general view of current pros and cons of energy communities. For example, Walker [49] lists incentives that might attract different actors to energy community projects. Depending on the project these actors might be such as individuals, community organizations, local government and the private sector. Based on the literature are listed some of the main incentives and benefits:

Economic benefits. Community members share the benefits from renewable generation. Members can get direct savings from self-consumption and they have a possibility to participate in the electricity market by selling some of the produced electricity or by participating to demand response. These actions provide direct financial benefits for the community. [38] Installations and maintenance of renewable energy create jobs that may result in indirect revenues for the community. Installation might require special skills, but usually at least the maintenance can be done by local workforce. [50] Also local biomass energy projects have been found useful, creating a market for agricultural waste etc. [49].

Security of supply. The threat of future energy price increases and the risk of power outages are also drivers for increasing energy self-sufficiency. Renewable generation makes the prosumer less reliant on the electricity grid and less sensitive to increases in electricity prices. In the UK there was a 45 % increase in electricity bills from 2003 to 2007. [51] Keeping the power on during outages is another benefit of self-sufficiency of energy communities. [38]

Acceptance. Energy communities help in raising the overall acceptance of renewable energy. Community members have better understanding of renewable energy technology and the energy system. There is also increase in energy saving efforts and general awareness about energy consumption and climate change. The acceptance towards renewables increases especially if community members feel involved and receive also financial benefits. [50]

Climate change. The increased awareness about climate change and renewable energy may help change behavior and societal norms, hence speeding up the transition to a low carbon society. Energy communities may help foster a more sustainable attitude, leading to ethical and environmental commitment.[50]

Social norms and trust. Kalkbrenner et al.[52] found that social norms and trust are the most determining factors in willingness to participate in community energy projects. It has been found that social norms can be driving factors when it comes to cooperative behavior and environmentally related behavior. Social norm is a perception of social pressure and expected behavior under the surveillance of significant others. Citizen participation has been found to correlate positively with high levels of trust. Especially in energy community projects trust is seen a very important component. [52]

Local control and identity. If the community is involved in an energy project, they may have a say about such things as scale, siting etc. [49]. This involvement gives more freedom of choice and builds a stronger identity for the communities [50]. There is also an interest to secure supply of energy from local sources, decreasing dependence from the markets [53]. Collective projects may help residents identify themselves as part of the community and maybe even give them a feeling of self-realization [50].

Advancing political goals. Many governments have set targets for renewable energy production and emission reductions. These targets are supported by energy community activities, such as installing renewables and influencing the attitude towards sustainability in the society. Energy communities are seen to create more favorable environment for policies and programs concerning the environment. Governments also aim for more energy independence from external markets. [50]

4.7 Challenges

The list of challenges for energy communities is quite comprehensive in the literature. Most challenges are in the categories of social, institutional and financial challenges. There are also technical challenges, but they seem less pressing than the other issues connected more to society. Next are listed some of the most common challenges connected with energy communities:

Organizational / legal issues. The voluntary basis and small size of many energy communities can form a challenge. The small size of cooperatives prevents them from producing enough profit to cover the organizational costs. There are also institutional challenges related to high planning requirements, acquiring initial funding, paperwork and required permissions. Generally, the complex legal processes connected to founding an energy community can be experienced as overwhelming. [50]

Incumbent companies. Legal frameworks and markets are built for centralized production and big energy companies, which makes it harder for small energy community initiatives to survive. It has been detected that large incumbent companies actively fight against energy startups to protect their own businesses. [50]

Lack of political support. Drastic changes to the current policies and regulations need to be executed for renewable energy to reach its full potential. Encouraging examples can be found in Denmark and Germany for example. [37] Correctly carried out support schemes and incentives for renewable energy and energy communities are needed. These can include tax benefits, subsidies, feed-in tariffs, funding programs etc. Supporting actions should be updated according to market dynamics. [36]

Lack of resources. Initiating an energy community project demands resources in funding, time and expertise. In-depth knowledge in different fields is required: knowledge about the market status, different technologies, planning knowledge and project development skills. Also, information on funding and legal issues is needed. The overall process is very complex. If experience is lacking, communities might hesitate to enter such an endeavor. It is also a long-term commitment which requires resources also after the initial phase. [50]

4.8 The connection between business model and business case for sustainability

Schaltegger et al. describe two links between business models and sustainability strategies. The first link is that developing business case drivers and implementing a sustainable strategy may inflict changes on the business model. On the other hand, the business model also has effects on corporate strategy and may constrain the business cases for sustainability. Reconfiguring the business model is therefore unavoidable when pursuing improved sustainability, and the business model can be a limiting or supporting factor. [13] In Figure 8 the ICES elements have been implemented into the business model canvas as an example of a possible business model for an energy community.

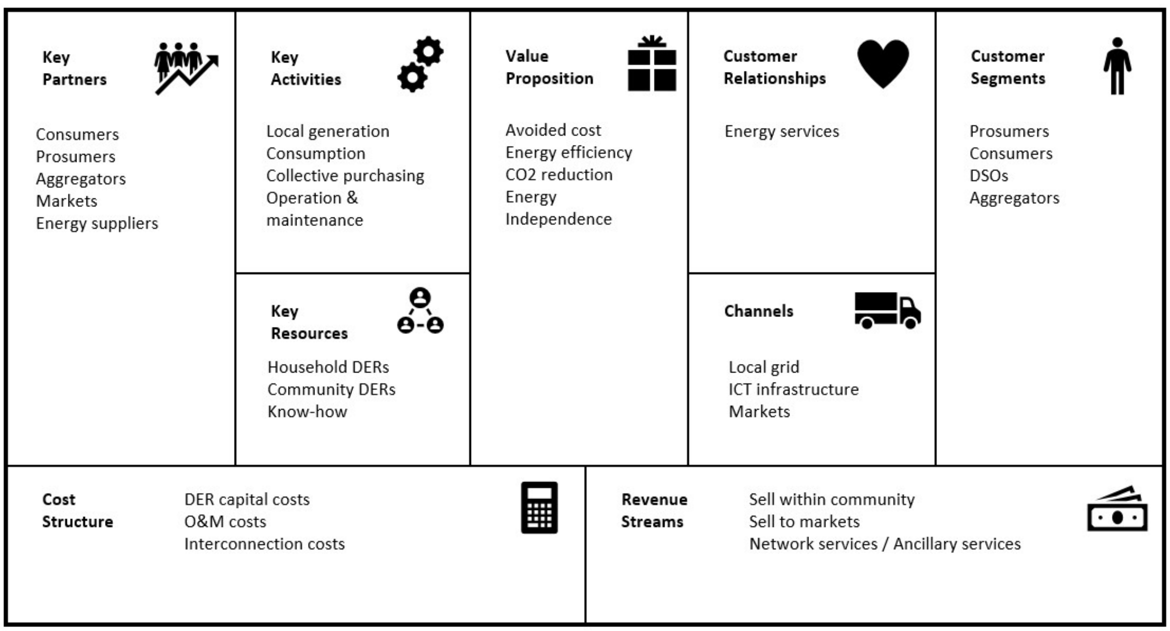

Figure 8. ICES business model canvas adapted from [7] and [36].

To show the connections between business model and business case drivers, Schaltegger et al. identify four central pillars for business models and link them to the drivers for sustainability. They form a table that shows how the generic business model pillars, as value proposition and customer relationship, are affected by the business case drivers for sustainability. [13]

4.9 Example case of an energy community

Feldheim is a village in the state of Brandenburg in Germany. In 2015 Feldheim became totally self-sufficient, producing 100 % of its own electricity and heat. Electricity is produced with a wind farm of 42 turbines. There is a biogas CHP [2] plant of 400 kW for the heating needs of the community. The CHP plant produces also electricity when the generation from the wind isn't enough. A wood-chip plant provides additional heat on the coldest days. The biogas plant is fueled by agricultural waste from local farms. Electricity and heat are supplied through separate local grids, so the community is separated from the national grid. It is connected to the national grid only to sell the overproduction to the markets. There is also a 10 MW lithium storage battery in use to balance the fluctuations of the wind power and it serves as an ancillary service for the village. [54]

This unique case might not be applicable as such elsewhere but can serve as an example to other communities of what can be achieved with renewable energy and community production. Grid defection is not practical in most cases and in large scale it is very harmful both to the DSOs that manage the grids and to the rest of the customers that must pay the grid fees of the defected communities.

4.10 Legislative changes in Finland and EU

A framework for legislation considering energy communities has been given by the European Union (EU) and is now in the process of being implemented to the legislation of member states. We will look at suggestion made in Finland and the EU directives framing energy communities.

4.10.1 Finland

The Finnish Ministry of Economic Affairs and Employment published a report on "A flexible and customer-centered electricity system" in 2018 [38]. This report is one example of policies aiming for the transition towards a sustainable energy system. The report makes high level proposals to create a smart electricity system in Finland. The working group behind the report categorizes these proposals under four main themes [38]:

1) The roles and rules in the electricity market will be clarified
2) Market-driven incentives will be enabled
3) Sufficient technical preconditions will be created

[2] Combined heat and power

4) Cooperation across sectoral boundaries will be increased

Proposals under these main themes create a framework for the smart electricity system and suggest some practical guidelines for energy communities, demand flexibility, storage etc. Here we will discuss some of the proposal related to energy communities.

If an energy community is established between parties operating or living in the same property, the working group proposes that *"no network service charge should be paid to the distribution network company for energy generated and consumed within the property if it does not cross the access point to the distribution network and consequently does not pass through the distribution network."* This allows the energy community to benefit fairly from the resources they have acquired, such as solar panels. For billing purposes, the electricity taken from the distribution company's network and the electricity generated by the community must be computationally separated. [38]

Neighboring houses might want to join forces and build small-scale renewable generation. The neighbors would have to build a mutual electricity network for the needs of their small-scale production. Currently a license is needed to construct electricity networks and to transfer electricity across property boundaries. This is to prevent the construction of parallel networks. However, it is proposed *"that the construction of a power line across the property boundary to connect a small-scale generation site to the consumption site be allowed without permission from the distribution network company and without a [!] electricity network license."* Customer will be responsible for electrical safety and the quality of the produced electricity. [38]

In distributed energy communities the production is located elsewhere than on the property or near it [38]. The production and consumption sites are connected through the existing distribution and transmission networks. Each production, storage and consumption site are separately metered, and each connection point needs its own network service contract [38]. The community then computationally uses the energy from its own generation site, even though in practice the electricity comes from nearby production. The use of the grid is billed normally and the taxation is according to current legislation [38].

Electricity storages are an important component in the smart energy system. They can be utilized in demand response, self-storage, frequency control etc. The working group proposes that *"owning and using electricity storages is competitive business activity."* This prevents network companies from using and owning them, since network companies are neutral market facilitators and possess a monopoly status. However, network companies may acquire storage services from the market, and in some exceptional cases they may also own storages for separately determined needs. EU legislation on the subject is under construction. [38]

4.10.2 EU

The European union has recently introduced new frameworks for energy communities with the "Clean energy for all Europeans" package or "Clean Energy Package" (CEP). Recasts of two energy directives, renewable energy directive (REDII) and electricity market directive (EMDII), outline the attributes of energy communities and individual/collective self-consumption. Two similar concepts for energy communities are defined in the directives: "renewable energy communities" (in REDII) and "citizen energy communities" (in EMDII). Implementation of the directives into national laws is undergoing, but the legislation concerning energy communities is still in the early stages in many countries. [55] The member states are required to implement the new EU rules regarding energy communities into their legislation by the deadline of June 30th, 2021 [56].

There are major similarities and some differences between "citizen energy community" (CEC) and "renewable energy community" (REC). REC can be considered as a subcategory for CEC. [56] Next are listed the similarities between the two: 1) open and voluntary participation, 2) must be a legal entity, 3) value driven, not focusing on financial profit, 4) require effective control by certain participants, 5) collective actions. Differences are focused on actors and activities, and these are compared in Table 3. [55]

Table 3. Differences between CEC and REC adapted from [55].

Differences between concepts

Citizen energy community	**Renewable energy community**
• No geographic limitation • Large and medium size enterprises excluded from effective control • Electricity only • Technology neutral • Create a level playing field for the CECs as a new market actor	• Proximity requirement of effective control (defined in national law) • Limited membership (shareholders or members do not include large companies) • Open to all sources of renewable energy (e.g. also heat), but renewable energy only • Promote the development and growth of RECs as a way to expand the share of renewable energy at national level

The legal form of these organizations is to be decided in the national legislation and the directives do not also exclude other formats additional to CEC and REC [55]. So, many of the details are left to be decided on the level of member states.

5. RESEARCH METHODS

This chapter starts by shortly introducing the research philosophy and the qualitative research approach. Then the course of the empirical phase of the research process is described, i.e. the data collection. Lastly, the process of how the data was analyzed is presented.

5.1 Research philosophy

There are two basic models which determine “How to bring forward knowledge about the world in research?” These models are deduction and induction, and in addition there is a combination of these two models called abduction. In deductive reasoning, theoretical information is used to formulate one or more hypothesis which are then tested through empirical study. In inductive reasoning the approach is opposite, empirical research leads to theoretical results. Abductive reasoning is somewhere between the deductive and inductive approaches, meaning that the researcher moves iteratively between the two during the study process. [57, p. 21–23]

In this research the theoretical framework was constructed before gathering the data. This was to determine what aspects are relevant to cover considering the empirical stage. The more inductive phase was gathering the data and analyzing it and then connecting it to the theory again. So, the process started as deductive and finished more on the abductive side.

5.2 Qualitative research approach

A qualitative research approach was chosen for this study. This approach was chosen because the subject under investigation is largely uncharted territory and the implications to the real world are yet to be discovered. Qualitative research strives to create a holistic understanding of the subjects under study and deals with interpretation and understanding [57, p. 5]. Ghauri and Gronhaug [58] very effectively summarize that:

> *Qualitative research is particularly relevant when prior insights about a phenomenon under scrutiny are modest, implying that qualitative research tends to be exploratory and flexible because of ‘unstructured’ problems (due to modest insights).*

Although in my case the initial theoretical framework was built before the empirical stage, the data collection and analysis stage are carried out with an abductive approach, examining the data carefully and revealing unexpected details. Important factors arise from the data through analysis, rather than the researcher deciding what is important.

5.3 Data collection

The reader should be able to evaluate the reliability of the research based on the description of the research process in the method chapter. Research methods are described in detail so that the thought process and actions of the researcher become clear to the reader and so that the same research may be carried out again if needed. [59, p. 242] This chapter creates transparency by describing in detail how the research material was gathered. The next chapter on the other hand describes the process of analyzing the gathered material. All the data, except one interview, was collected before starting the analysis.

In qualitative research the use of interviews as a data collection method is immensely popular [57, p. 78]. One major benefit of the interview approach is its flexibility, the questions can be arranged and modified according to the situation. If needed, the questions can be clarified, and the interviewer can ask additional questions. There is also more room for interpretation of the answers than in a questionnaire. Other reasons for the interview approach might be that little is known about the subject at hand and the researcher might want to place the answers into a larger context. The interviewee might have bigger insight than expected and the answers might lead to unexpected directions. [59, p. 194]

This study is based on interview data that was collected with semi-structured interviews [57, p. 82]. The semi-structured approach was chosen to guide the conversation toward relevant topics, but at the same time not being too restrictive if the conversation steered to an interesting direction. The sample base was also so diverse that exactly the same questions didn’t apply for all, although the basic structure was kept constant throughout the interviews. The semi-structured approach was successful in this study and suited the unexplored nature of the subject.

The empirical phase of the research project started with the formulation of the interview questions. The questions draw from existing studies and surveys on energy communities and sustainability of companies. Forming the interview template was an iterative process of studying the existing theory and brainstorming with my supervisor and professor. Quite few studies exist in this particular field of study and chosen approach, so forming the template was not a simple task. Despite of some difficulties, a basic template was formed, and it proved itself during the first couple interviews as the interviewees were able to give meaningful answers and contribute their insights on the subjects of the study.

The interviewed companies were selected deliberately from an industrial level energy community project, so that they had first-hand information and expertise and also the subjective company perspective to energy communities and sustainability. Two of the companies were from outside of this project, but strongly related to the subject of the study and involved in other similar projects. All in all, ten interviews were conducted with nine different companies. Interview information is listed in Table 4.

Table 4. Interview information.

Company	Industry	Execution	Length (min)
A	Technology provider	Face-to-face	47
B, consultant 1	Property management	Phone	22
B, consultant 2	Property management	Phone	20
C	Technology provider	Face-to-face	33
D, consultants 1 & 2	DSO	Skype call	43
E	DSO/Energy/Retailer	Skype call	26
F	DSO	Phone	24
G	Energy/Aggregator	Phone	26
H	Consultant/Technology provider	Phone	25
I	Technology provider/Consultant	Phone	30

The interviewee candidates were first contacted by email. In the email was a short description of the study and a request that an appointment time is reserved for the interview. It was also informed that the information gathered will be anonymous and used for the purpose of this study only. If the candidate didn't reply, further contacting was done through phone calls and messages. The appointments were supposed to be, if possible, face-to-face appointments for the maximum benefit of using the personal interview method. However, soon after starting the interviews the COVID-19 pandemic started to affect also the Finnish society. This inflicted restrictions to the meeting policies of most companies and forced the interviews to be done remotely over the phone or computer. This didn't affect the conducting of the study too badly because there was a basic structure to the questions, although there was the lack of personal contact. An unstructured interview method would have suffered much more from this turn of events, so also in this sense the method chosen was appropriate.

At the beginning of each interview I asked for permission to record the conversation in order to make transcripts of the interviews to be used later in the analysis phase. I used a separate digital recorder to record the conversations. After each interview I sent the audio file to be transcribed. The interviews were all conducted using Finnish, as it was the native language of both sides in all cases. The translated basic template of the interview questions can be found in APPENDIX A. The interviewed companies included both Finnish and international companies. Also, the size of the companies varied from five workers to hundreds of thousands of workers. The variance in the population ensured a broad range of perspectives to the subject and provided more possibilities considering analysis of the data.

5.4 Data analysis

The analysis phase of this research is mostly inductive, as I start from the data and form patterns and generalizations based on it. On the other hand, the formation of the initial theory framework and the interview questions is mostly deductive. So, in this research there is interplay between deductive and inductive approaches. The analysis phase also includes systematic coding of the data and placing the codes into subcategories and categories. These are elements visible also in grounded theory [57, p. 154]. On the other hand, this research does not have "the constant overlap and interplay between data collection and analysis phases" [57, p. 156]. So, the analysis phase of this research will have to fall under the inductive approach, although in the background there is the deductive approach.

The analysis started with coding the gathered data, i.e. going through the transcriptions and marking the relevant parts. Before coding the transcripts in ATLAS.ti, I had already pre-coded the transcripts by highlighting the relevant parts right after I had received the transcript. Anything that answered directly to the interview questions or seemed otherwise important to the themes of the interview was highlighted from the transcripts. This happened simultaneously with the interview phase. After finishing all the interviews but one, I used ATLAS.ti for reading the transcripts again and coding the pre-marked sections and also some new ones. Then sorting the created codes into categories and subcategories. The subcategories with most citations are presented in Table 5.

Table 5. Subcategories with most citations.

Subcategory	Number of codes
Energy community	35
Stakeholders	32
Meters for sustainability	23
Cooperation with other actors	22
Financial perspective	20
Legislative problems	19
Sustainability of operations	18
Renewable energy	15
Business model	13
Carbon neutrality targets	13
Pioneer status	12
Financial-social perspective	11
The role of enabler	10
Customer interest	10
Role in the ecosystem	10
Stakeholder needs	9
Power grid	8
Sustainability certificates	8
Local production	8
Demand control	7
Environmental factors	6
Circular economy	6
Energy companies	6
Reporting sustainability	6
Micro-grids	6
Automation	6
Measuring renewable production	6

Categories were created from the themes that emerged from the conversation and then subcategories were created under which the individual codes were placed. The coding in ATLAS was done so that the transcripts were read one by one, sorting the codes into categories after coding the transcript. The intention was to let the categories and subcategories emerge from the transcripts by reading through them carefully, and not to let previous conceptions guide too much in deciding what is important.

6. RESULTS

In this chapter the results from the interviews will be presented. First a framework for the findings will be introduced and then in the other subchapters the results are presented in categorized groups. Findings are supported by citations from the interviews. The original citations are in Finnish, but they will be presented here in English, translated as accurately as possible and preserving the original meaning. Finally, a summary where the common themes are recapped.

6.1 Framework for the findings

395 citations were highlighted from the interview data, related to energy communities, ecosystems and sustainability. These codes were grouped under 110 code groups, which were then grouped under seven main categories. These were Ecosystem, Challenges of Sustainability, Drivers of Sustainability, Meters of Sustainability, Sustainability Goals, Business Models, and Demands & Expectations of Stakeholders.

The population of the research is easier to handle and grasp when it is divided into smaller segments. The interviewed companies quite naturally fall into their own categories based on their line of business. Already in the early phase of the research it was intended to include as large variety of companies as possible to get as many different insights as possible. This was accomplished fairly well since there were many actors represented along the value chain and the size of the actors also varied tremendously. Based on the views represented by the interviewed companies, a simplified value network was formed to depict the larger ecosystem of electricity production and delivery, which energy communities are part of. This simplified model is presented in Figure 9.

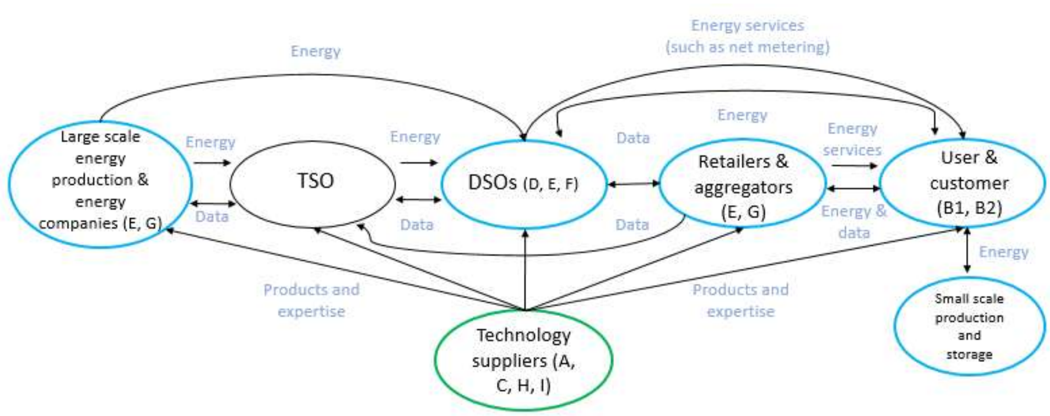

Figure 9. Value network of the interviewed companies.

Representative of the TSO level was not interviewed in this study. All the other actors in this chain are represented in the interviews, some participants belonging to multiple categories. To give further structure for the interview results, a table was created to describe the changes happening in the value network. The actor groups described in Figure 9 were placed on one the horizontal axle of the table since it was an easy and natural way to group the individual interviews.

Then it was reflected upon what would be the best way to describe the changes happening in the energy industry ecosystem or value chain, caused by the formation of energy communities and sustainability pressures. After some consideration the Ecosystem Reconfiguration framework by Adner [31] was chosen. A more detailed description of the framework can be found in chapter 3.4. The reconfiguration mechanisms described in Adner's framework were placed on the vertical axle of the table. In addition to them, rows for sustainability drivers and challenges with energy communities were included. This structuring of the data is visualized in Table 6.

Table 6. Interview findings categorized under different actors.

	Energy companies	**DSOs**	**Retailers/Aggregators**	**Technology suppliers**	**User/Customer**
Sustainability drivers	- Financial profitability - Social & environmental concern - Energy independence from the grid - Possibilities of renewable energy - Carbon neutrality	- Climate change - Customer demand - New business opportunities - Renewable energy - Social & environmental concern	- Customer demand - Environmental concern	- Financial profitability - Investments - Business opportunities - Customer demand - Renewable energy - Climate change - Local business	- Climate change - Carbon neutrality - Necessity of change - Minimizing future expenses
Challenges with energy communities	- Legislation - Scalability - No existing solutions - Top level coordination - Information sharing	- Grid defection - Legislation - Customer interest - Scalability	- Legislation - Functioning automation systems - Top level coordination - Scalability	- Scalability - Plug & play solutions - Implementing changes - Legislation - Longevity - Circular economy - Challenge of newness	- Lack of information - Dividing profits - Top level coordination - Challenge of newness
Relocation of elements	- Creating new sustainable business models with renewables and ECs	- The role of enabler in energy communities and society - Retaining the current monopoly status while also embracing ECs	- Actors offering more renewable solutions for clients and offering energy services (smart homes etc.)	- Technology suppliers in the forefront of sustainable development in cooperation with other actors - The role of technological enabler in society	- Property owners in the forefront of sustainability - Accurate measurements instead of approximation
Separation of elements					
Combination of elements	- Bringing actors together in clusters or ECs and optimizing local energy services		- Clustering the production and use of energy and optimizing that package - Synergy benefits for all actors	- Supplying plug & play type solutions instead of components or machines	
Addition of new elements	- Addition of energy communities and municipal and industrial microgrids - Addition of energy community operators	- Addition of energy communities and renewables in the distribution grid	- Addition of energy community operators and aggregators	- New startups or subsidiaries specializing in energy aggregation and smart grids for example	- Aggregators offering for example demand control services
Subtraction of existing elements		- The fear or risk of losing income and business because of independent ECs		- Actors who are not willing to invest to sustainability and longevity	

Sustainability drivers and challenges were involved in the table because they were seen as one major outcome from the interviews. These elements are answering focal questions like what the motivating factors for companies are to embrace sustainable development and join energy communities? On the other hand, what hinders this development and what could be done to overcome those obstacles? Sustainable development was the most central theme in the interviews. Hence the role of sustainability in the formation of energy communities will be reflected. Although sustainability and ECs are connected in some ways, they are still separate entities affecting each other. Following questions to this are how the changes caused by sustainability and ECs are perceived by the companies and what are those changes that are happening? These are some central questions that will be reflected in this chapter, by going through the introduced frameworks of the value chain and Adner's [31] ecosystem reconfiguration.

6.2 Technology suppliers

As seen in Figure 9, technology suppliers are located in a way beside the value chain, providing components and services to multiple actors along the chain. Some concentrating on other segments more than others. Technology suppliers represent the largest sample in this research. Technology suppliers include companies A, C, H and I, presented in Table 4.

Based on the sample of this research, technology suppliers are motivated to be on the frontlines of sustainable development, providing components and services to other actors and cooperating with them to create better solutions. One thing in common was the willingness to be the first mover and to be constantly aware of the changes happening around sustainability. Another common theme was the role of enabler in society, in this case technological enabler, providing sustainable solutions to other companies in order to help them in their own businesses. The perceived role of the enabler is strongly present also among the DSOs.

Sustainability drivers for the technology suppliers are especially the profitability of their business now and in the future, new business opportunities in renewable energy for example, customer demand, and of course the concern about the global climate change as almost with every respondent.

> *… at first this pioneering work won't be easy and maybe not so profitable, but definitely if we look at capital movements and the stock market, where money is*

being invested, then it is quite obvious that the companies developing these (sustainability) things are more profitable and that's where the money goes. There are many drivers and they are all pointing to the same direction. (Company H)

Concerning sustainability goals, such things were mentioned as pursuing the UN sustainable development goals, being a good workplace, creating new business and jobs, innovating solutions, working together with the academic institutions, creating circular economy, producing energy sustainably and securing the welfare of humans and animals.

… our baseline is that we have a good workplace where people want to be, and they can be involved in improving the society we live in. (Company I)

We try to influence so that energy production in Finland and all around the world would be carried out in a more sustainable manner. (Company H)

… innovations and helping the society, that's where we are strongly involved. (Company I)

Areas where technology providers especially saw sustainability challenges were scalability of the technological solutions, creating plug & play solutions to ease the transformation, implementing changes to current product line, longevity of business, circular economy, and the challenge of newness.

… if we think about building residential areas for example, it's like a 100 m sprint, everybody comes there, it's a big mess, everybody wants their own profit and to quickly move to the next project [– –] accomplishing the change that companies and people start seeing this differently, from a 100 m sprint to a marathon, it's more profitable in every way. It's more profitable financially, operationally, considering energy consumption and environment and so on, but it's always hard accomplishing change. (Company H)

One supplier reported certain challenges considering the commercialization of products. Customers may not know to ask for certain solutions if the company hasn't announced that it is offering that certain solution. So, the commercialization of solutions and technologies is important so that the customer knows what novel solutions can be demanded from the supplier. One problem according to the supplier is also that solutions are so decentralized and there are no comprehensive solutions that cover all areas, regarding micro-grids combining different energy sources for example.

… in certain technology aspects if we were one step further considering commercialization, and we would articulate that, then it wouldn't be the question of can we do it, instead the customers would know how to ask for these solutions with certain functionalities. (Company A)

Considering the reconfiguration of the ecosystem, there was an input to all the functions of reconfiguration except for the separation of elements, which was absent in all the other links of the value chain also. In relocation of elements, the technology providers move more and more to the production of sustainable components and solutions in cooperation with other actors to achieve the best result. The focal idea here is the role of technological enabler in society, discussed earlier.

In combination of elements the suppliers are providing more plug & play type of solutions and their expertise instead of just components or machines. Also offering services related to the technology, moving more to areas of service industry or product-service systems (PSS). One company representative stated that they are a strong technology supplier, but they are also heavily investing in offering their consultation and expert services to other actors.

There is also addition of new elements that is created by the existing technology companies or just by people with previous expertise. These are startups or subsidiaries specializing in energy aggregation or smart grids for example.

… we try to promote this innovation work in Finland, by trying to help startups in creating new innovations. (Company I)

The view among the interviewed companies seems to be that the actor that are not willing to invest in sustainability and longevity, will sooner or later be subtracted from the ecosystem. Long term profitability and sustainable actions seem to be desirable qualities among technology suppliers.

… sustainability, renewable energy, co2 emissions, and carbon neutrality related issues are a significant part of every sensible company's strategy … (Company H)

6.3 Energy companies and electricity production

Energy companies are located on the same distribution system level and are connected straight to the distribution network or through the transmission system level. Energy companies produce energy (electricity and/or heat) locally and distribute it in their area of operation, as a common example are municipal energy companies. There are always separate companies for heat and electricity distribution and electricity production, but they are part of the same corporation. In this sample there are two energy companies, companies E and G.

All in all, utilizing renewable energy in their operations and concern for the environment was present with both companies. Municipal actors and other clients were seen as the key stakeholder groups and also working with academic institutions. Also offering the municipalities and other clients a possibility to become part of a functioning energy community and microgrid was a common goal. Stiffness and tardiness of legislation concerning renewables and energy communities was also a theme present with both companies.

Main sustainability drivers for energy companies were financial profitability of their new and existing operations, concern for the carbon neutrality challenges and implementing renewable energy to their operations and reaching a certain level of energy independence.

> *And from a financial perspective we would of course want that a built community could be financially sensible and even make some profit for its owners. (Company G)*

> *… from a client perspective we try to make the clients everyday life go smoothly and that there is always an option for that renewable solution. And for us it is important that those solutions are environmentally and ethically sustainable. (Company E)*

> *… in this energy community that we're going for, it's not just about renewable production but also this self-sufficiency aspect, that if the renewable production isn't enough to cover the energy demand of the community, then we won't simply rely on the national grid but produce the energy with some alternative method or rely on electrical storages. (Company G)*

Sustainability challenges that the energy companies in the sample saw as the most pressing were the stiffness of the legislation, scalability of the solutions especially down from the industrial scale, the difficulty of creating new solutions, lack of top level coordination and the information sharing on new sustainable solutions and energy communities. Especially legislative challenges were seen as a major speedbump slowing down the progress with energy communities and the renewables. It is difficult to function when legislation hinders the current projects and it is not known what is allowed or supported in the future. Also, how to distribute some of that knowledge learnt through pilot projects to other actors to speed up the sustainable development projects elsewhere.

> *Regarding energy communities, we have concluded that we are quite a lot ahead of our time in the sense that how the legislator interprets energy communities and how an energy community can function in Finland. [– –] It creates a certain challenge for the wider deployment of renewable energy. (Company G)*

> *In wind power and solar power [– –] in a way the slowness of zoning is one problem, and in a way the low threshold for filing official complaints… (Company E)*

> *… these different models for energy communities are being developed also in Finland, so I think that it would be essential to drive this development forward somehow in a centralized manner. Whether the scale being Finland or Europe or whatever, so that we can have a working system when this becomes more common. (Company G)*

As for the ecosystem reconfiguration, at least relocation, combination and addition of elements seem to be present. In relocation of elements energy companies move more towards renewable energy production and sustainable business models from their own initiative and on basis of the demand coming from clients and other stakeholders. In combination of elements energy companies bring together different industrial and municipal actors to form energy communities and local microgrids. These communities then combine a variety of energy sources and storages to optimize the local energy services. In addition of new elements, new entities such as energy communities are formed, and the local energy companies are willing to offer their services and expertise in this area.

6.4 DSOs

DSOs are located in the value chain after the TSO, distributing electricity with a monopoly status to clients within their distribution area. Distribution companies operate in the same grid level as energy companies but have differing interests since they are not allowed to produce or store energy, only to join clients to their grid. DSOs are the second largest sample in this research with three companies, D, E and F.

All interviewed DSOs want to be on the frontlines of sustainable development and renewable production. One major theme that came up with all the distribution companies was the role of enabler that they had all adopted, enabling the creation of energy communities by connecting actors and providing tools for development. The same enabler role came up with the technology suppliers, but with a different angle. That was enabling the change from technological angle, this is more about connecting actors and providing services for communities.

Sustainability drivers for the DSOs were largely the same as for other links in the value chain. Responding to climate change and the demand of customers for sustainable operations, new business opportunities with renewables and energy communities, also ethical and societal motives.

> *… goes for both sustainable development and energy communities, if there's business and there's money to be made then that attracts players. (Company D, consultant 1)*

> *One should always remember the longevity and ethical and societal perspectives. (Company E)*

> *But for this to be a major breakthrough, there has to be clear earning possibilities for all parties. For the local producer, for the community member and for the operator controlling the whole system. (Company F)*

In sustainability goals the climate change and different surveillance systems like international certificates and quality systems are highlighted. The UN sustainable development goals are again mentioned and being a good workplace.

> *The principles of responsibility have been determined recently. There's customer experience and quality, safety and wellbeing at work, societal effectiveness and the continuity of operations and visionary status. [– –] (from UN sustainable development goals) … we have affordable and clean energy, decent work and economic growth, sustainable industry, innovation and infrastructure, sustainable cities and communities, climate actions, and partnership for the goals. (Company D, consultant 1)*

> *… we have a quality control system [– –] and in addition we have systems for environment, work safety and energy efficiency. (Company E)*

> *… as a company we make choices based on green values and strive to be active and frontrunners in that area. (Company F)*

From the challenge perspective, some themes were the fear of grid defection due to the formation of energy communities, legislative problems with energy communities, scale of the communities and whether the clients will show interest towards these communities. The legal concerns are the same as with energy companies, the current system doesn't enable energy communities and the future on legislation is still uncertain. Grid defection is harmful for DSOs as they lose income and that income is used to maintain the grid. It is also harmful for other clients who have to pay that part of the lost income.

Maybe the most relevant challenge is if energy communities are built in such places that they are not reasonable considering the whole system, so in practice detaching functioning parts from the grid, we think that is a dangerous development. (Company D, consultant 2)

Also, the scale of the communities was seen as a challenge. According to one company it is problematic if the communities or energy pools are not large enough to create an impact on the local level.

… either there is a large actor, a municipality or city or group of companies, or then pooling smaller resources to form a community. And so, that the financial profit isn't the first thing in mind, but more like ethical and renewable energy perspective, then it usually works. If there are actors seeking only financial profit, then it's usually problematic on the long run. (Company E)

One company was worried whether regular consumers will show enough interest to make the energy communities beneficial on behalf of DSOs.

… one big challenge is that is there really demand for these kinds of services and actions. Are regular consumers interested enough in this? [– –] but are consumers then again ready for change. That's a challenge and a thing to be looked into. (Company F)

Ecosystem reconfiguration on part of the DSOs includes at least relocation, addition and subtraction of elements. The role of enabler is strongly present in the relocation of elements as with the technology suppliers. DSOs move more towards enabling energy communities and offering their services related to renewables and other areas, instead of just distributing electricity. The distribution companies of course want to sustain their monopoly status in electricity distribution, but at the same time welcoming energy communities and renewable production and offering their services related to those areas.

Energy communities and both large- and small-scale renewable production are already a part of the distribution grid, but even more so in the future. These added elements offer new business opportunities and income streams for grid operators while they might lose some of their income due to consumers producing a part of their own electricity.

Subtraction of elements might occur if actors were to form independent energy communities and defect from the grid. This would be very harmful for the business of DSOs but especially for the clients left in the grid, as they would have to pay for the lost income of the DSO in their electricity bills. Therefore, DSOs do not encourage independent energy communities, although they are in favor of communities connected to the grid.

6.5 Retailers and aggregators

Retailers and aggregators in this sample are in the same corporations as the two energy companies. In the other corporation (E) there is a separate company for selling electricity, and in the other corporation (G) one company is the operator of an energy community. Retailers and aggregators sell clients electricity that is then delivered by the TSO and DSOs. In the future they can also buy back the electricity produced by the users and redistribute it or sell it to the market.

Sustainability drivers for retailers and aggregators in this sample are especially customer demand and environmental concern. Customers are demanding green energy and sustainability from the retailers and aggregators deal with energy usually produced with renewables. Company E said that they measure the amount of renewable energy in their sales.

Challenges are largely the same as with the energy companies, legislation causes the biggest trouble since it doesn't include the operation of energy communities or aggregation. This causes problems for energy community operators especially, since the law doesn't allow all the necessary operations. For example, the operator cannot buy electricity back from the users and redistribute it to other users in the community. There are legislative changes coming soon to this area in Finland also. What also came up were the challenges in balancing and managing the microgrid, since there are no readily available systems for that.

> … for this grid balancing and other things, there's no readily available automation system for that. *[– –] when all this (production and storages) is put together and the local power balance is pursued, the system that guides this, we've had some challenges there. (Company G)*

In the ecosystem reconfiguration at least relocation and combination of elements are present. In relocation, all actors move towards offering more renewable energy. Energy companies might offer their services for other companies and municipalities in their area and form an energy community. In combination of elements, other aggregators might collect the production of individual households to form a virtual powerplant for example. All these actions could bring synergy benefits to the actors and optimize the use and production of energy locally.

6.6 Users and customers

Users and customers are located at the end of the value chain, consuming energy and possibly also producing energy in small scale and maybe storing the energy. The sample of this research includes only one end user, company B with consultants 1 and 2. Although this user makes up for that with its large size, the company in question is a large property owner.

The most significant sustainability drivers for this company are acting strongly against the climate change, reaching the set carbon neutrality targets, strong pressure for actions coming from clients, and minimizing expenses by acting early and being a frontrunner in sustainability. Especially the necessity of fighting climate change was highlighted.

> *Well it's just absolutely necessary. Whatever news channel you open, each and every message just screams for the necessity of it (change). (Company B, consultant 1)*

> *… it (carbon neutrality) will become compulsory, and large real estate owners like we, this kind of property mass is really not quickly replaceable from one form to another. That's why we must anticipate in a big way so we can reach the goals and it won't become too expensive for us. (Company B, consultant 1)*

> *… main client and the main owner [– –] they have so ambitious targets, and we of course want to support them in saving the world and reaching the sustainable development goals. (Company B, consultant 1)*

Sustainability goals of the company include reaching the carbon neutrality targets, embracing circular economy and investing in biodiversity around and on the buildings. This actor is already providing accurate measurements from its operations and carbon footprint. Also, international certificates and indexes are part of the operations. They also see emissions trading as a quick way to have an effect. Circular economy and biodiversity are important themes of the near future.

> *… we have a vision that our operations will be carbon neutral by 2030. And for a quicker impact we are preparing an emissions trading program. (Company B, consultant 2)*

> *… how to better consider biodiversity in the future [– –] and maybe implement some monitoring and measurements. (Company B, consultant 2)*

> *… these kinds of planetary preconditions set a new kind of paucity, and I hope that it will become financially reasonable to use circular economy materials and solutions. (Company B, consultant 2)*

The primary challenges this company recognized in sustainable development were lack of information and the challenge of newness, the lack of top-level coordination and clarity on profit dividing models. Coordination meaning that some operator would create models for how energy communities could work. This is dealing with the same problems as energy companies seemed to be having with the unclear and lagging legislation.

> *But if we get a roof organization that could create general rules and frames for how these communities could work, and then if these smaller communities would be just created according to these rules. (Company B, consultant 1)*

> *But when there's no knowledge, no experience, then overcoming the newness is slow. (Company B, consultant 1)*

Considering the reconfiguration of the ecosystem at least relocation, addition and subtraction of new elements are involved. In relocation of elements property owners and other users move their operations to a more sustainable and conscious direction. In all real estates the importance of metering and measuring accurately will increase, and also reporting those measurements and planning future operations based on them. Accurate measurements will replace approximation. In addition of elements some new actors as aggregators will appear to offer their services. In subtraction of elements old measurement systems based on approximation will be replaced by new accurate systems.

6.7 Summary

There were many common themes and insights in this whole sample although there was quite a lot of diversity between the companies or corporations. Diversity both in size of the companies and in operations. The most common theme was climate change, carbon neutrality targets and carbon footprints. Almost all the companies had a carbon neutrality target or at least some monitoring of their carbon footprint. Clearly in this sample there is common concern about the climate change, maybe also driven by pressure from stakeholders and the society in general. This theme includes moving towards renewable production, circular economy and preservation of biodiversity.

Also, the role of enabler in society theme came up with the DSOs and technology suppliers. This enabling was done either through technologies or through offering services and connecting actors. Actually, all of the companies included in this research seem to be essential in enabling the creation of energy communities and in enabling the transfer to a sustainable society. The challenges posed by current legislation was another common theme with many of the companies. Current legislation doesn't allow the full operation of energy communities and slows down the development of these communities and the deployment of renewable energy. The future will show how the legislator sees energy communities and what is allowed and supported. Financial profitability of operations now and in the future was also one reoccurring theme. Although sustainability was emphasized, there also must be some financial benefits for the actors involved. And those benefits were seen in renewable production and sustainable development by the companies included in the research.

One key difference between some of the companies was the attitude towards independent energy communities. Energy companies and technology suppliers were more accepting towards independent energy communities that don't rely on the distribution grid. Mainly though these independent communities were seen practical in special cases such as remote locations. DSOs on the other hand had differing views on independent communities. One DSO saw the independent community as a solution only in a very limited case of remote locations. This is probably also the majority view among DSOs since detaching parts from the grid is very harmful to their business and also to the rest of the customers as they will have to pay for the lost income of the DSOs. Although one DSO reported being involved in independent communities to ensure the electrical safety. Visualization of the drivers and challenges is presented in Figure 10.

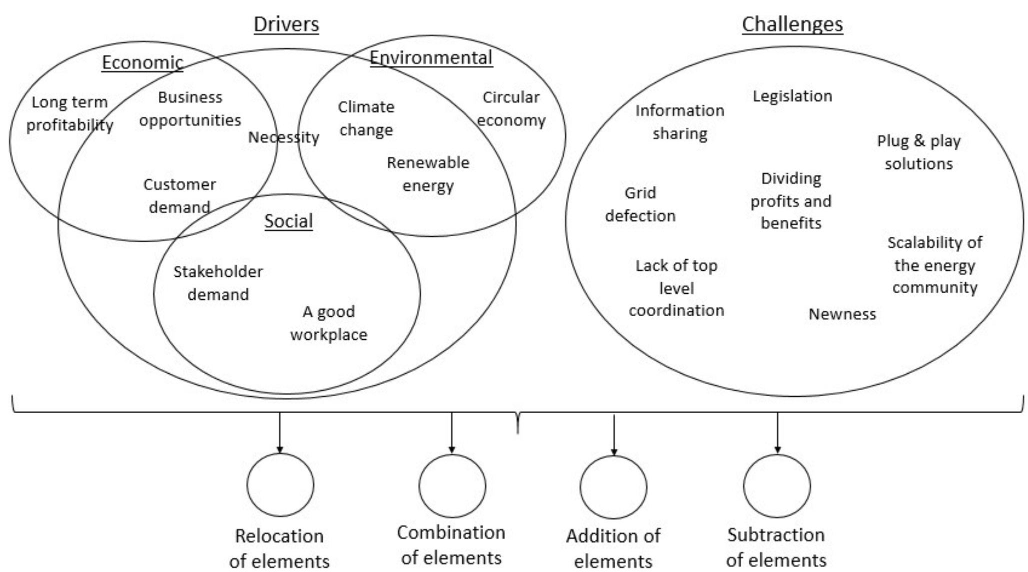

Figure 10. Visualization of the drivers and challenges.

Reconfiguration of the ecosystem examined the changes happening in the ecosystem settings of the involved companies due to sustainability development and emerging energy communities. Relocation of elements was a relevant category for all the involved companies. Also, addition of elements was relevant for all the companies. This is consistent with Dedehayir et al.'s [29] proposition that in new market disruption, where the value proposition is more tempting because of additional features for example, the reconfiguration is likely based on addition of new elements. This highlights the need for new functions and the adjustment of old functions when companies engage in renewable energy and energy communities. Visualization on the reconfiguration of elements is presented in Figure 11. Here the reconfiguration elements from Table 6 are injected to the value network in Figure 9 to visualize the changes in the value network.

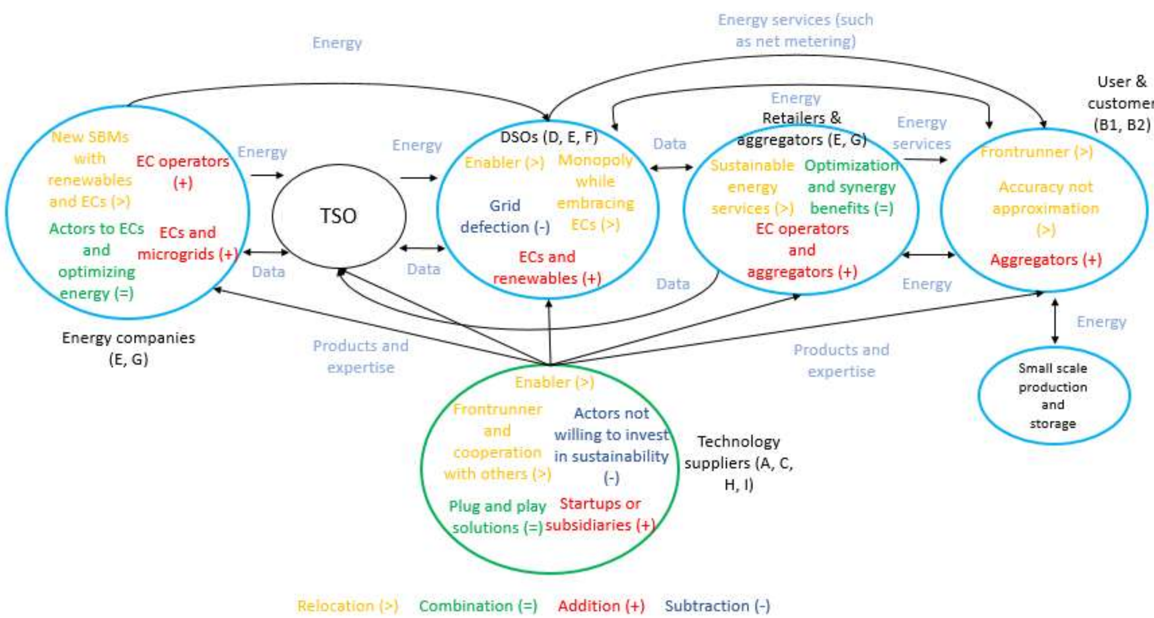

Figure 11. Visualization on the reconfiguration of ecosystem elements in the value network.

Separation of elements was a category that wasn't found relevant with any of the included companies. According to Dedehayir et al. [29] low-end disruption is more likely characterized by separation of elements. The changes happening in the sample of this study cannot really be described as a low-end disruption. Also, combination of elements is represented by clustering of actors and functions into energy communities. For technology suppliers also the combination of elements to form holistic plug & play solutions and services instead of single components. Subtraction of elements was present with DSOs as detaching parts from the grid would mean lost income to them. This grid defection would harmful for the remaining customers in the grid also since the lost income would be taken from them instead. Subtraction was also relevant for the suppliers since if they are not willing to invest in sustainable operations, they will sooner or later find themselves without business.

7. DISCUSSION

In this chapter we will link the results of the interviews to the initial theoretical framework presented in chapters two, three and four. We will discuss how the results obtained relate to the theories and do the theories seem to be in place. Finally, in the summary chapter we will link the theoretical backgrounds together and discuss the findings.

7.1 Ecosystem changes and incentives through business models

Perhaps the most relevant view to business models in consideration of the interviews is that many things in the surrounding world affect the company and its business model. This is especially well depicted in Figure 1 adapted from Osterwalder. The outside pressures presented in this picture are largely the same that came up during the interviews. Companies then must somehow adapt to these pressures by adjusting their business model or even renewing it entirely. The chosen basic business model framework in this study is the Business Model Canvas by Osterwalder [7], and it can be applied to any of the interviewed companies.

7.1.1 Osterwalder's model and external pressures

Referring to Figure 1, Social Environment represents in this study the changes driven by climate change and other societal elements. The companies in the sample expressed concern caused by the climate change and brought up such actions as carbon neutrality targets, circular economy and protecting biodiversity. Also, the role of enabler in society and societal responsibility of the companies over critical infrastructure for example came up in the interviews. These societal and social pressures clearly steer the operations of the companies included in this study, thus affecting also the business model.

The Legal Environment was also very strongly present in the study. The companies experienced that the legislation in Finland is lagging when it comes to energy communities and renewable energy. They felt that the development of energy communities and the large-scale deployment of renewable energy is hindered by the current legislation. However, the legislator is preparing new legislation in this area, based on the proposals of the Smart Grid Working Group [38] for example. In this way the legislation places constraints on companies and their business models and companies create pressure for the legislator to act as the playing field is changing.

Competitive Forces also affect the companies. The DSOs and energy companies operating with monopoly status are not affected as much as the technology suppliers for example. The companies interviewed stated that renewable technology is a very competed industry. Also, DSOs can feel threatened by the new competition from local production and energy communities, they just must adjust their business model to offer services for these new segments, which is just what they are planning to do based on the study.

Customer Demand is linked to climate change, presenting itself through demand of clean energy, sustainability goals and services related to energy communities and renewable production. Certain functions and a certain level of sustainability is already expected from companies according to this research. And in many cases the changes are not quick to implement so companies must be very farsighted to fulfill customer demands also in the future.

Technological Change offers new business opportunities for the technology suppliers. Suppliers enable the technological change happening in society and in other companies with their products and services. Sustainable development creates changes to the business models of technology suppliers and also the business models of customers. The large-scale implementation of renewable energy offers new business opportunities in many groups such as DSOs and energy companies. They can implement renewable production and energy services to their business models.

7.1.2 Sustainable business models in the ecosystem

Sustainable business models and sustainable value presented in the theoretical framework are very strongly present in the interviews. The idea of sustainable value illustrated in Figure 3 from Evans et al. fits quite well to all the companies included in the sample. Most of the companies mentioned the environmental, social and economic values that steer their operations, and that all these put together form the sustainable value. As in Figure 3, environmental values included for example renewable resources, low emissions, biodiversity and circular economy. Social values included for example the role of enabler, community development, good workplaces and health & safety. And economic values included profit and long-term viability for example. All in all, the five propositions made by Evans et al. [10] fit very well to the operations of the interviewed companies. These sustainability factors also present in the theoretical frameworks incentivize companies to join energy communities and make further investments to their sustainability operations.

The operations of the interviewed companies also seem to be in line with Schaltegger et al.'s [13], [14] business case for sustainability. The companies strive to create economic success *through* environmental and social activities as in the business case for sustainability. Activities are also measured, and sustainability is included in the management activities of the company as described in the articles. Porter and Kramer [15] revolve around the same subject in their article and the insights of the interviewed companies seem to consistent with these thought also. Adjusting business models so that they serve society's needs instead of manufacturing artificial demand is just what the DSOs and technology suppliers emphasize with their enabling role in the society. Also, the sustainable value chain and cluster thinking are relevant with the companies as the technology suppliers mentioned supporting startups and local industries as one of their functions.

Product-service systems offer possibilities especially for technology suppliers. The suppliers in the sample reported a demand for holistic plug & play solutions in the areas of renewable energy and microgrids. Technology suppliers could offer their services and expertise in addition to the equipment and thus expand their business models. For example, solar power offers many PSS possibilities like renting power plants and product life cycle management.

7.2 Innovation ecosystem changes

As the citation from de Vasconcelos Gomes et al. [22] in chapter three describes, innovation ecosystem is a group of actors joined together to produce value. The networked actors can include a company, customers, suppliers, innovators and regulators for example. This description fits the sample of this study. Although it can be argued whether it is just a network of companies or an ecosystem. But based on the innovation happening around energy communities and renewables that came up in the interviews and the close interaction between the focal companies and their stakeholders, the companies included in this study can be considered part of an innovation ecosystem. Based on the interviews the companies and their networks match the common definitions of innovation ecosystem presented in chapter three. Considering Adner's [25] ecosystem-as-affiliation and ecosystem-as-structure categorization, the ecosystem of this research falls under the affiliation category. The actors in this ecosystem are focused around the platform of the energy system, rather than some single value proposition. This is because the ecosystem revolves around the energy delivery platform more than around the users. Although this balance is shifting due to users starting to participate more actively in the energy market and having own small-scale production.

Dedehayir et al. [27] and Iansiti and Levien [26] describe an ecosystem leader. It is a central actor in the ecosystem that links other actors together around a certain platform. Based on the interviews, many companies involved match the description of the ecosystem leader. Especially DSOs and some of the technology suppliers with their perceived enabler role. They reported linking actors together and offering tools and services to enable operations in a certain area. For the DSO the ecosystem or platform could be the distribution network area where it operates. For a large technology supplier, the platform could be as broad as the Finnish society for example. Here the changes in the ecosystem offer some companies even more possibilities to serve their customers and offer additional services thus strengthening their positions.

The customers in the energy platform are offered to become an active part of the energy system and to optimize their own production and consumption through energy communities for example. Also, energy companies operating an energy community can be considered as ecosystem leaders of that community. Niche actors in this setting include smaller technology suppliers, suppliers of materials, contractors and so on. These niche actors are an important part of the ecosystem and the complement the key actors by offering their own products and services. Small niche actors are also agile in their movements and reported the willingness to be among the first movers when it comes to new developments like energy communities. Hence, the reconfiguration in the ecosystem offers opportunities for niche players also to enlarge their business and offer versatile solutions. These niche, and also other actors, can offer solutions to problems that other companies are facing with new developments like energy communities.

Adner [28] describes a set of ecosystem risks. At least the *interdependence risk* is relevant with the interviewed companies. Legislator is strongly a part the ecosystem when discussing the energy sector. Some of the interviewed companies are having trouble with current legislation which is hindering the development of energy communities and the large-scale deployment of renewable energy. This is negatively affecting their business because the interdependence risk considering the current legislation hasn't been examined carefully enough.

Initiative risks must also be considered. Some companies and municipalities are already involved in energy community pilots, but the interest of regular consumers is still a question mark according to the interviewed DSOs for example. So, whether to invest in energy communities or not when the customer interest is uncertain.

Integration risk must be considered when thinking of the intermediaries in the value chain and whether they all benefit from the innovation, in this case energy communities. Many of the interviewed companies highlighted that for energy communities to succeed, every participant must benefit somehow from the new arrangement. So, finding a profitable model for all actors is crucial to the success of energy communities. This is where companies have to realize that awaiting business opportunity and incentivize other actors to join after them.

The findings of the interviews are analyzed through the ecosystem reconfiguration framework in chapter six. The energy community context seems to fit the reconfiguration elements and the framework gives a good platform to structure the interview results. All categories but one seem relevant to the reconfiguration in this research. Separation of elements does not appear in the analysis. This is compliant with the proposition made by Dedehayir et al. that in new market disruption reconfiguration is likely based on addition [29]. That finding was made also in this research, the reconfiguration elements that were most relevant were addition and relocation. These two elements were relevant with all the interviewed segments. The reconfiguration framework gives a good overall look to changes happening in the ecosystems of the sample of this study.

7.3 Company incentives

Company motives for sustainability are discussed in chapter 4.5. These include business case arguments by Carroll [43] and Aagaard [45] for example. *Cost and risk reduction* are somewhat relevant with the interviewed companies since they're investing and rearranging their operations now so they will reach set goals in the future and the transformation to sustainable operation won't become too expensive. But from the interviews can be read that the changes are done more because they're essential and the company won't survive without these changes. They are not just to save money.

Gaining competitive advantage is a bit off the point in the case of the interviewed companies. Especially the technology providers reported that it is a very competed field. Sustainability improvements are done to stay along with the development and customer and stakeholder demands, rather than gaining advantage. Some of the companies are operating under monopoly status so competitive advantage is not relevant to them.

Developing reputation and legitimacy is in the interest of every company and sustainability development is done because it has come to the point that these companies can't function profitably if they are not complying with norms and expectations set by different stakeholders. Mostly the sample companies invest in sustainability and energy communities because they see those as necessary investments for their survival, not just to develop their reputation

Many companies mentioned the *win-win outcomes through value creation*. Especially DSOs highlighted that there must be a system where every actor involved in an energy community for example can somehow benefit from the arrangement. Only then the communities can be successful. All interviewees highlighted the value of working together with different stakeholders and creating beneficial synergies.

Some possible challenges related to energy communities were listed in chapter 4.7. Legal issues were already mentioned in 7.1.1. Incumbent companies fighting against energy startups proved to be wrong at least among the sample of this study. Quite the contrary, companies seemed accepting towards energy startups and new businesses in all. One company stated that it actively supports energy startups and innovation. Although frameworks and markets are still built for centralized production, but they too are starting to change.

Lack of political support is relative in the legislation point of view. Laws and support considering energy communities and renewables are still unclear. Lack of resources doesn't seem to be a central problem at least not on this corporate level of the study. The need for change to a more sustainable direction is so essential that the resources must be allocated somehow in order for the company to survive in the long run.

These company incentives play a significant role in the deployment of energy communities and also large-scale renewable energy. Most of the incentives presented in the theory framework seem to be in place although some proved wrong at least in the sample of this research.

7.4 Summary on ecosystem incentives and reconfiguration

The initial theoretical framework presented in the beginning of this research seems to be largely supported by the results of the interviews. Especially the model of sustainable business model seems to be adopted by the companies in their operations. The three elements of sustainability economic, social and environmental sustainability and their implementation in the actions of the company came up with almost all the interviewees. The companies seem to be executing Schaltegger et al.'s [13], [14] *business case for sustainability* approach more than the philanthropic approach of Carroll [43]. Sustainable development is for all companies in the sample included strongly in the management and operation of the company rather than it being a separate function. The sustainability actions are also measured and connected to the financial profitability of the company. Also, Porter's and Kramer's [15] *shared value* concept is supported by the interviews.

The general definitions of innovation ecosystem presented in chapter three seem to match the sample of companies in this study. The same actors are involved in the sample as the theory or they are mentioned in the interviews. Also, the ecosystem leader and niche creators mentioned in the theoretical framework are identifiable among the interviewed companies. So, based on this research the companies included are identifiable as innovation ecosystem actors that implement sustainable business models in their operations.

The size of the perceived ecosystem may vary depending on the company but on some level, they are operating in an ecosystem. In this case the innovation ecosystem could cover the whole Finnish energy sector or be divided into smaller sub-systems as energy communities or distribution grid areas. Large themes like climate change and sustainable business models with financial longevity are incentivizing companies to invest more in energy communities and renewable energy. One obvious incentive is new business opportunities and financial profit but accompanied with understanding for longevity. Investors, customers and other stakeholders are motivating companies towards more a more sustainable paradigm. These reconfigurations in the ecosystem create changes in the roles of actors and new actors form in the mix as some old ones are washed away. Giving some structure and categorization to the change helps perceiving it better.

8. CONCLUSIONS

The aim set in the introduction chapter of this thesis was to study the motivations of companies regarding energy communities and sustainability and the changes happening due to these new themes. The research questions containing these themes were formed as:

> *What incentivizes companies to join energy communities and to invest in sustainable development?*
>
> *What changes are energy communities and sustainable development causing in the operational environments of companies?*

The targets were reached, and the research question was answered on a satisfactory level. The biggest incentives in this sample for joining energy communities and investing in sustainability were climate change, carbon neutrality, new business opportunities, demand from stakeholders and the necessity and movement of capital. Biggest changes happening in companies' environments are relocation towards sustainable business models, clustering of small-scale production, new actors such as aggregators, and new business opportunities. The interview questions were formed based on the initial theoretical framework, always keeping in mind the research question. The interviews were conducted successfully despite the ongoing COVID-19 pandemic, mainly over the phone or computer. More detailed descriptions of the methods and data collection can be found in chapter five. The interviews were analyzed for example through an ecosystem lens.

This research provides new information for researchers and other actors dealing with the emergence of energy communities and the implementation of sustainability to corporate operations. Information on current sustainability practices and future plans of companies, on current conceptions of energy communities. As the language of this thesis is English, the meaning is to provide information also for actors in other countries dealing with the same subjects and challenges. This research area on energy communities is very novel and this thesis adds to that growing stream of literature. Especially the perspective of the theoretical framework combining business models, ecosystems and energy communities seems to be very novel.

8.1 Reliability, validity and generalizability of the research

According to Eriksson and Kovalainen reliability, validity and generalizability form a basic framework for evaluating business research [57, p. 291]. Reliability describes to what extent the results are the same if the research is conducted repeatedly. Meaning that how well, based on your work and description, can another researcher repeat the research and get similar results. Validity describes how accurate the conclusion made during the research are compared to what actually happened. Meaning how accurately the findings are represented and whether they are backed up by evidence. [57, p.292]

However, many sources question the applicability of traditional reliability and validity assessment when it comes to qualitative research. The literature is divided in the conclusions whether these traditional methods are reliable when it comes to qualitative research and whether they can be used at all, since they have been originally developed for quantitative research. [57, p. 292], [59, p. 217] Despite this, the reliability and validity of the qualitative research must be somehow evaluated. The reliability of qualitative research is usually enhanced by accurately describing the research and the methods used. Validity is supported by evidence such as citations from interviews, generally what the findings and arguments are based on. [59, p. 217–218]

The method chapter of a thesis is of great importance when considering reliability. In this research reliability comes from the detailed description of the used methods and the different phases of the data collection and analysis. All the phases of the data collection are described in chapter five and the basic template for the interview questions is provided in Appendix A. Just the basic information about the interviewed companies is given so that the confidentiality of the interviews is maintained. Based on these descriptions the research should be repeatable in the same setting as this research, Finnish energy industry, or perhaps in some other setting.

The results of the study are directly drawn from the interview data and presented in chapter six. The interviews themselves went mostly as planned and if there were any unclarities, the answer or statement was asked to be clarified. The research strives for validity by making the statements based on the interviews and then presenting citations from the interview transcripts to back the statements. The transcripts of the were successful because the quality of the recordings from the interviews was mostly excellent. Thus, the amount of unclarities and gaps in the transcripts was quite low. However, because the interviews were done over the phone mostly, there were some distortions etc. These segments were checked again from the original recording to clarify the meaning or just avoided if they couldn't be clarified.

The interviews and transcripts are in Finnish so the citations in the thesis have been translated to English. This poses one threat to the validity of the research, as the message in the citation might be slightly altered by the translation. The translations were done as carefully as possible and efforts were made to keep the original tone and message of the citations.

Generalizability of this research is a difficult subject. The research approach is qualitative, and the sample size of the research is only nine companies. This research might be generalizable in the setting of Finnish companies in the energy sector; however, the sample is too small to make any justifiable generalizations. Despite this fact, the research provides information for actors dealing with the emergence of energy communities and renewable energy.

8.2 Scientific and managerial implications

An author can make contributions in three areas: theory, methodology and context [60], [61]. Most papers contribute in one or two areas, best papers in all three areas. For an aspiring writer is it desirable that there is solid contribution at least in one area. [61]

This research contributes mostly in the context area. Energy communities from the company perspective are not a very researched area and this research adds to that context. Especially in the Finnish context energy communities are a novel research topic. In other countries energy communities have been researched especially from the citizen perspective. The research on energy communities from the company perspective is interesting because the legislation considering ECs is being implemented into legislations of different countries all over Europe. Companies and municipalities can form communities and the EU directives encourage especially small and medium sized companies to join ECs. That’s why it is important to generate more useful information on company incentives and operations related to ECs, as in this study.

One theoretical contribution might be the combination of using sustainable business models and innovation ecosystems to study energy communities. So, the relatively new approach of investing sustainability in an ecosystem. In the energy community analysis especially the roles of different actors and the reconfigurations in the ecosystem elements proved to be relevant. Based on the interviews most roles in the ecosystem are changing and new actors are forming to serve the developing needs of the ecosystem. As stated in chapter seven, the initial theoretical framework selected in the beginning seemed to fit the researched subject and the findings made from the interviews supported the thoughts and propositions in the theories. This combination of theoretical lenses could be used also in future studies to investigate energy communities.

The methodological contributions of this research are very slim since the used methods were very traditional and the interviews followed the basic outlines of a semi-structured approach very much. So, in the method department this study didn't introduce any new approaches.

There are also some managerial implications in this research. This research provides information for companies and other actors on why they should possibly join energy communities, network with other actors and stakeholders and market the EC concept to relevant stakeholders. Also, what are the possible challenges to be considered when participating in an EC. Possibly in what areas could have new business opportunities waiting to be discovered. When the legislation on energy communities is revealed and some sort of practices are formed considering ECs, there will be a great potential for business opportunities in implementing renewable energy and energy community solutions to the existing system. The ecosystem reconfiguration framework presented in chapter six provides an overlook to the changes happening in the energy sector and how they might affect different actors in that field. The companies in the energy sector will want to take those changes into consideration and make changes to their business models and strategies accordingly. This way they can benefit from the change and succeed in the changing markets.

8.3 Future research

More research on the subject of energy communities is needed because, as mentioned before, the subject is still relatively unexamined. Also, this thesis has some shortcomings that can be covered in future research. The sample size of this study was ten interviewees from nine companies. The sample size could have been a bit larger if the time window for the research would have been longer. It is difficult to make any justifiable generalizations based on this sample size and the qualitative nature of the study. That's why a quantitative component would've added nicely to this research. This was originally the intention and a survey were built with the same themes as in this thesis. However, there wasn't enough time to gather a notable amount of data with the survey, so it wasn't included in this thesis. This is one component that could be added in future research.

This research focused on actors in the Finnish energy sector. Future research could investigate other industries and countries as well. The same changes are happening all over Europe as countries are implementing the energy community directives into their own legislation. Changes are of course happening outside of Europe also. It would be useful to share experiences of different countries in different phases of change. The shared information could make help the transformation of the energy system go more smoothly. Also, other industries outside the energy sector and their willingness to participate in energy community activities could be investigated.

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APPENDIX A: SEMI-STRUCTURED INTERVIEW TEMPLATE

Background

Tell me shortly about yourself/your tasks and the company you're working for?

Willingness to participate

How do you see the role of your company in relation to energy communities in the future?

What role could energy communities play in the energy transition?

What drivers bring new entrants to sustainable business and energy communities?

What challenges has your company faced regarding sustainable development or energy communities?

Ecosystem view

What kind of interaction does your company's business model have with business models of other companies?

Sustainability aims

What are the sustainability aims of your company and how do they affect the business model? (Economic, social and environmental sustainability aims)

How is sustainable value or sustainability measured in the company? How is the information published?

Stakeholders

When considering sustainable development and innovation, who are the most important stakeholders and partners of the company?

What sustainability expectations or demands do company stakeholders have?

Summary

Are there any other aspects around sustainable development that we have not talked about and which you think are important?