Energy cooperatives, the distribution system operator and energy transition

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Executive summary

Research goal

This research is part of a Think Tank organised by the Distribution System Operator (DSO) Alliander and the University of Nijmegen. The focus of the Think Tank was energy cooperatives.

Energy cooperatives are defined as citizens organizing together to realise sustainable energy projects in their local community. They are a relatively new actor on the Dutch energy market and represent a growing share of sustainable energy use and generation in the Netherlands. Furthermore, energy cooperativers promote projects that generate energy locally and are involved in such projects themselves. Energy cooperatives thus contribute to a transition to a more sustainable and distributed energy system.

This research analyses the ways in which energy cooperatives relate to the Dutch energy system and how they contribute to an energy transition. Additionally, the way in which Alliander can support development of an energy transition by cooperating with energy cooperatives is investigated. This results in the following research question:

How can Alliander contribute to the energy transition by facilitating innovation in the niche of energy cooperatives?

Research approach

To address the research question four sub-questions were asked. Firstly, barriers and opportunities for the development of innovative services in energy cooperatives were identified. The framework used for this is based on the theory of Multi-Level Perspective (MLP). MLP is a theoretical framework designed to understand socio-technical transition . It identifies three levels in a soci-technical system: (1) The *landscape*, this is the wide socio-technical environment that is resistant to change. (2) The *regime*, the rules and routines that configure the dominant way of fulfilling a societal function. The regime can be described following seven different dimensions (*guiding principles, industry structure, technologies and infrastructure, user relations and markets, policy and regulations, and knowledge bases*). (3) *Niches*, innovative products or services that are protected from direct competition on the market. Energy cooperatives were compared to the seven regime dimensions of the Dutch energy regime. Deviations from the regime can indicate barriers and opportunities for innovative development.

Secondly, a look was given at the different services provided by energy cooperatives. These services were analysed to identify to what extent they can contribute to energy transition. Besides that, the ways these services can affect the operations of Alliander were investigated. This was done to reveal which services are most interesting for Alliander and energy cooperatives to cooperate on.

The third research question addresses the capabilities of energy cooperatives as a good niche environment for development on innovative energy services. This is done by investigating in what ways the cooperatives as a niche environment are interacting with the incumbent regime. When niche environments can facilitate these different processes they are considered an effective protective space for innovative development. These processes are shielding, nurturing and empowerment.

Shielding processes are those processes that protect innovative development from being rejected by the socio-technical regime. They help innovative projects get started and allow nurturing to take place.

Nurturing processes allow innovative products and services to be further developed within the niche. Important factors for the nurturing of innovation are: First, the articulation of the vision for the project should be specific and should be shared amongst relevant actors. Second, social networks should be both broad and deep, meaning that actors in the social network surrounding innovative projects should be from a diverse background (broad) as well as able to mobilise commitment and resources from within their organisation (deep). And third, learning processes of both first-order (accumulation of facts and data) and second-order (changes in cognitive frames and assumptions) should be present.

Empowerment describes processes that allow a niche innovation to compete on with other products or services on the market without the help of shielding or nurturing. Empowerment can occur in two different ways. The niche innovation can be developed to better fit to the incumbent market thereby conforming to the incumbent regime. This *fit and conform empowerment* functions to convince a wide range of actors that the innovation can survive in the incumbent regime. Alternatively, new rules and routines can be adopted into the incumbent regime transforming the regime.This *stretch and reform empowerment* functions to convince a wide range of actors that the socio-technical regime needs to change.

The last research question focusses on the vision of the energy cooperatives themselves. In investigating what would be effective ways to contribute to transition by facilitating energy cooperatives, it is important to use the vision of the cooperatives themselves. Cooperatives were asked in what way they would desire to be facilitated, their vision on their current relation with the DSO, and what services they would like to exploit themselves, which activities would be best handled by the DSO and which services they envision are best exploited by the DSO and cooperatives together.

Data collection

Three methods for data collection were used. Firstly a literature study was done based on academic articles, websites from various companies and organisations, official reports from the government, news articles, and statistical data. Secondly, a digital survey was distributed among energy cooperatives via e-mail. Twenty-two cooperatives resonded to the survey. Thirdly, three case studies were performed with three different energy cooperatives. These case studies are based on information made available by the cooperative as well as an in depth interview with an active member of each cooperative.

Conclusions

The comparison of energy cooperatives against the seven regime dimensions of the incumbent energy regime resulted in an overview of barriers and opportunities for the development of innovations in energy cooperatives. Most prominently, barriers seem to arise due to miscommunications and differing priorities. These cause projects to be developed at a slow rate or even be halted.

In investigating the different services that energy cooperatives exploit, it was found that an appreciable amount of their activities has potential to stimulate sustainable and/or distributed energy generation. Furthermore, most activities have the potenial to affect the day to day operations of a DSO such as Alliander.

The analysis of processes that a niche environment requires to effectively develop innovative products and services showed that energy cooperatives are a good environment for developing innovations. Regulatory and financial shielding processes are actively pursued by energy cooperatives. Furthermore, cooperatives have a specific *vision*, employ *social networks* to gather resources and raise support for innovative activities, and spend a lot of time *learning* about relevant topics. Empowerment processes are mostly of the fit and conform kind.

The questions about the desired facilitation led to the following: Cooperatives moslty desire financial facilitation, access to knowledge about the energy system, and to be taken more serious as an actor on the energy market. Besides that, services that energy cooperative envision to be best exploited by a collaboration of cooperative and DSO are those that involve a close relationship with the user, or both experimentation in an active community and specific knowledge and resources.

Recommendations

The conclusions of the research lead to three reccomendations for Alliander. (1) Reduce barriers the energy regime imposes on the development of services in energy cooperatives. This can most effectively be done when cooperatives and regime actors thoroughly and specifically communicate what they expect from each other. (2) Facilitate expert knowledge which is otherwise difficult for lay people to access. And (3), experiment with development of services by engaging in collaborative projects.

Contents

1. Introduction

This research is affiliated with a Think Tank which was organised by Alliander and the University of Nijmegen. The Think Tank was set up to allow five students with different backgrounds to investigate a common subject. Three Universities participated in the project, the University of Nijmegen, the University of Utrecht, and the University of Technology Eindhoven. The common subject of the five studies was dubbed “collaborative consumption” which was quickly focussed to investigate the growing phenomenon of Energy Cooperatives: Citizens organising together to realise sustainable energy projects in their local community. Other research papers in this project focus on: Barriers and motivations in organising an energy cooperative; Lifestyles and the energy cooperative; Business models in energy cooperatives; and the need and use of energy data in energy cooperatives. This research focusses on energy cooperatives as a niche for innovation and transition.

1.1 Research Framing

1.1.1 Sustainable Energy Challenge

One of the biggest challenges faced by modern society involves energy supply. It has been argued many times that the currently dominant way of generating and supplying energy is not sustainable. Fossil fuels are the world’s main source of energy, which could cause a number of problems in the future (International Energy Agency 2013).

An objection to the use of fossil fuels as an energy source is the emission of greenhouse gasses, and in particular carbon dioxide (CO2). The emission of these gasses is a probable cause of global warming. A global warming can cause the melting of polar ice leading to a rise in sea levels, it can cause fauna and flora to be unable to adapt and go extinct (IPCC 2013).

Another important concern is the depletion of these fossil fuels, it has been predicted that fossil fuels will run out. Counterarguments state that the developments in technology will make it so that currently unknown or unreachable sources of fossil fuels can be tapped into, which means the threat of the depletion of fossil fuels is not as big as some will have us believe. This does not take away however that fossil fuels are finite, and regardless of when the earth will be depleted of it, it is important to prepare for such a situation with more sustainable ways of providing society with energy (IPCC 2013).
For these reasons it is generally accepted changes have to be made in the world’s energy system.

1.1.2 Alliander

Alliander is a Dutch Distribution System Operator (DSO). A DSO is an organisation that is responsible for the management and maintenance of energy distribution systems. The gas and electricity networks in the Netherlands are governed by eight different DSO's. The main shareholders in all Dutch DSOs are municipal and provincial government. Furthermore, commercial businesses are not allowed to benefit from DSO shares. Thus, like all Dutch DSOs, Alliander operates for the benefit of the public.

Alliander is one of the three largest DSOs in the Netherlands and can therefore play a considerable role in facilitating energy savings and energy generation from renewables. Alliander has observed the growth in local sustainable energy projects, and realised that the Dutch energy system is becoming more and more complex. This is due to the increase in distributed generation of energy and due to the high number of different energy sources that are being tapped into with each their own benefits and limitations. Alliander perceives the Dutch energy system to be more integrated and locally focussed in the future.

Alliander sees energy cooperatives as a very relevant development for the future of the Dutch energy system. Alliander views them both as partners in an energy transition and as a growing and important group of clients. Alliander is collaborating with energy cooperatives in several research projects and has recently launched an information portal specifically for energy cooperatives. One of the fears of investing in these research projects is that the findings and implications of such projects will stay isolated and do not spread to other markets. For this reason Alliander is interested in the role energy cooperatives have in innovation and transition in the Dutch energy system, and how Alliander can facilitate them to improve the rate of innovation and transition.

1.1.3 Transition studies

To investigate the role of energy cooperatives in an energy transition in the Netherlands, a **Multi-Level Perspective** (MLP) on transition will be used. The MLP is a transition theory with the aim to give a good view of how socio-technical transition comes into place. The MLP separates socio-technical systems into three interacting levels.

The meso-level describes a socio-technical **regime**, the way a certain social function is organised in a society. This involves normative rules such as laws and social norms, but also cognitive routines such as the way engineers approach a certain problem or the way people are used to interacting with a certain technology.

The macro-level describes the socio-technical **landscape**, which refers to overarching developments that can influence the socio-technical regime. Two ways in which the socio-technical landscape can influence the regime can be distinguished. A slow development that builds up pressure such as the building up of environmental awareness in society; And a critical event that instantly changes opinions on a subject, this can be for instance natural disasters, critical technological failures or certain political decisions.

The micro-level is drawn up by **niches**, these are environments in which innovative technologies or services can be developed with limited influence by rules and routines from the incumbent regime. A niche can for instance be an R&D branch in a business, a small market with specific criteria, or a government program that supports a new technology.

This research is mostly interested in the interaction between energy cooperatives, which can be seen as niches, and the incumbent regime. Niche regime interactions can be divided in three categories that often, but not necessarily, happen consecutively. These categories are **Shielding, Nurturing,** and **Empowerment**.

Shielding processes limit the negative effects on niche developments imposed by regime mechanisms. An example can be a geographical location that offers specific benefits or requires specific criteria. Another example can be an exception to a certain policy that allows a project to experiment.

Nurturing involves those processes that allow an innovation to develop more successfully in a niche environment. This can include the provision of knowledge, funds, manpower and other resources. A prominent theory on the nurturing of niches is called **Strategic Niche Management** (SNM). This framework describes three types of processes as important for successful development; the articulation of **expectations and visions**, the building of **social networks**, and **learning processes**.

Empowerment of niche developments means the process of becoming less and less reliant on shielding and nurturing to survive in the mainstream market. This can be achieved if the niche innovation is fitted to conform to rules and routines present in the incumbent regime. Alternatively, developments in niches can impose new rules and routines on the regime, transforming it to better fit the innovation.

1.2 Research Objective

The goal of this study is to identify ways in which Alliander can assist in the development of innovations in energy cooperatives. In particular Alliander is interested in ways to ensure innovative developments in energy cooperatives are translated to the main public. To do this the MLP on transition will be used to draw up the incumbent electricity regime in the Netherlands. The way in which energy cooperatives deviate from this regime description will be used to identify possible barriers for niche developments in energy cooperatives. Furthermore, it will be investigated in what way energy cooperatives are interacting with the regime. This will be done by searching for processes of shielding, nurturing and empowerment. Finally, possible subjects in which Alliander can assist in shielding, nurturing and/or empowering innovations in energy cooperatives will be identified.

1.3 Research Questions

The research objective has been translated to the following research question:

How can Alliander contribute to the energy transition by facilitating innovation in the niche of energy cooperatives?

This question is divided into four sub-questions:

a. **In what way do energy cooperatives deviate from the incumbent electricity regime in The Netherlands?**

The way in which the Dutch electricity regime is constructed may clash with the vision energy cooperatives have for the future of their energy supply. These differences can pose barriers that limit the innovative possibilities that energy cooperatives aim to achieve. In answering this question, the historical development of the Dutch electricity system will be explored and the current incumbent electricity regime of the Netherlands will be drawn up using several dimensions described by the MLP. After that, the ways in which energy cooperatives deviate from these dimensions will be identified. These deviations can be used to identify important barriers for innovations in energy cooperatives to facilitate transition.

b. **What services do energy cooperatives undertake?**

Certain activities may not be interesting for Alliander to get involved in while other may not contribute to a more sustainable and distributed energy system. Therefore, it is important to identify those activities that are related to energy transition and in what way they can affect Alliander. After that, the ways in which Alliander can address barriers surrounding relevant innovations in energy cooperatives can be investigated.

c. **What processes of shielding, nurturing, and empowerment are affecting innovative developments in energy cooperatives?**

In order to see how suitable energy cooperatives are for the development of innovative energy services, the niche-regime interactions will be investigated. Processes of shielding, nurturing and empowerment will be identified. Besides that, the way these processes have affected the development of innovations in the energy cooperative will be investigated.

d. **How do energy cooperatives desire to be facilitated further?**

In investigating how Alliander can facilitate energy cooperatives, it is important to take in the opinion of the energy cooperatives themselves. They may find a certain level of involvement from their DSO helpful, but they may also have a clear view on what the DSO should not do.

By combining the information gathered answering the sub-questions the main question can be answered.

1.4 Reading Guide

An overview of the following chapters will be described here. Chapter 2 will go deeper into the theoretical frameworks. Firstly it will give a more in depth look at the MLP and the regime dimensions that will be used to draw up the Dutch electricity regime, a further explanation of the niche-regime interactions will be given, extra attention to the nurturing framework of SNM will be given, and the uses and limitations of these theoretical frameworks will be discussed.

Chapter 3 will describe the methodology of this research, explaining how data was gathered and in what way it will be used to answer the research questions.

Chapter 4 will give an overview of the information gathered from literature. Firstly a historical perspective is taken on the development of the incumbent Dutch electricity regime. After that the incumbent Dutch electricity regime will be described following seven regime dimensions. Then a look will be given at the history of cooperatives in The Netherlands. And lastly, the different case studies will be concisely described.

In Chapter 5 the theoretical frameworks, the information from literature, and the empirical data will be combined to answer the four sub-questions.

Chapter 6 will look at the analysis in chapter 5 and combine the results to address the main research question. The answer to the main research question will be discussed and recommendations for Alliander will be made.

2. Theory

Alliander has pronounced its perception of changes in the Dutch electricity regime and wishes to prepare for a potential role change that a transition may imply for the company. To better understand a transition in this electricity regime, transition studies literature will be explored and evaluated. After that service innovation literature will be explored to gain better understanding for the action Alliander may have to take in order to fit into a new role.

2.1 Transition studies

2.1.1 Multi-Level Perspective

Transition studies investigate how socio-technical changes come about. These changes are slow processes that can be systematically observed throughout history. Via these investigations transition scholars try to derive certain frameworks and identify specific dimensions for investigating transitions. One of these frameworks is the Multi-Level Perspective (MLP), which illustrates interactions between three different levels of a socio-technical system as important mechanisms for innovation and socio-technical transition (Geels 2002; Verbong & Geels 2007).

The macro level is called the socio-technical landscape; it refers to a wide socio-technical environment that is sometimes called exogenous and is robust to change. A distinction can be made between two important types of Landscape factors. The first being the slowly changing values that build up importance over time, this includes the economic environment, societal trends, and environmental awareness. The second type is critical events that can instantly change the public point of view on a subject; examples are natural disasters, political decisions and critical technological failures (Geels 2002; Geels 2005; Verbong & Geels 2007; Raven & Verbong 2007)

The meso-level in the MLP illustrates a socio-technical regime. Geels (2002) introduced this term as an expansion on Nelson & Winter's (1982) concept of a technological regime. Their concept of technological regime stood for the cognitive routines in minds of engineers; the standard way engineers realise their operations and research. The socio-technical regime added to this concept by not only including the cognitive routines of engineers, but also the cognitive routines of other social groups. Another notion is that the routines embedded in the actions of these social groups can be institutionalised into normative rules such as laws and social norms and values (Geels 2004; Raven & Verbong 2007). Together these rules and routines configure the dominant way of realising a societal function. Each societal function can be described by its own regime; a society is thus constructed by many regimes, for instance an energy regime, a political regime, an agricultural regime. Socio-technical regimes are often characterised as being very rigid, and will not change easily. This is partly due to the path dependent nature of the development of the regimes. Since routines have been institutionalised into regulatory rules, these same rules influence the development or changes of new

rules and routines (Kay 2005). This means that the way an incumbent regime is constructed, constrains the development for innovations that are not compliant with the incumbent regime. Engineers can be oblivious to developments that are outside their focus areas, regulations and standards can limit possibilities for new technologies, people have difficulty with adapting their lifestyle to new technical systems and sunk investments in machines, infrastructures and competencies can pose barriers for the implication of new systems (Geels & Schot 2007).

The micro-level is drawn up by niches. Niches are environments in which radically new technologies can develop while being less affected by the regular market selection environment (Geels 2002). This protection ensures that innovations can be further developed even if they cannot compete with products that have an established market share. An example of a niche can be a government program that supports new technologies, making them more financially viable to compete with established products. Another can be a small market with very specific selection criteria (Geels 2004).

The division of these levels on its own does not give a good view on the way socio-technological changes comes into place. What makes MLP more interesting is de described interaction between these different levels. One point MLP attempts to make is the importance of developments in all three levels in the success of new technologies (Geels 2002). Most of the time socio-technical regime represents a stable situation in which different rules from different dimensions of the regime are aligned. Seven different dimensions are defined by Geels (2002): Technology, user practices and application domains (markets), symbolic meaning of technology, infrastructure, industry structure, policy, and techno-scientific knowledge. These dimensions are dynamic and will thus vary from time to time. The variation in dimensions is influenced by changes in the landscape; a certain dimension of the regime can be more susceptible to a development in the landscape. This can lead to tensions within the regime due to miss-matches in rules. Due to tensions in a regime a radical innovation (developed in niches) can gain an advantage in its introduction to the mass markets. These innovations can compete with technologies of the old regime and can eventually replace them causing wider changes in other parts of the regime (Geels 2004) (see figure 1).

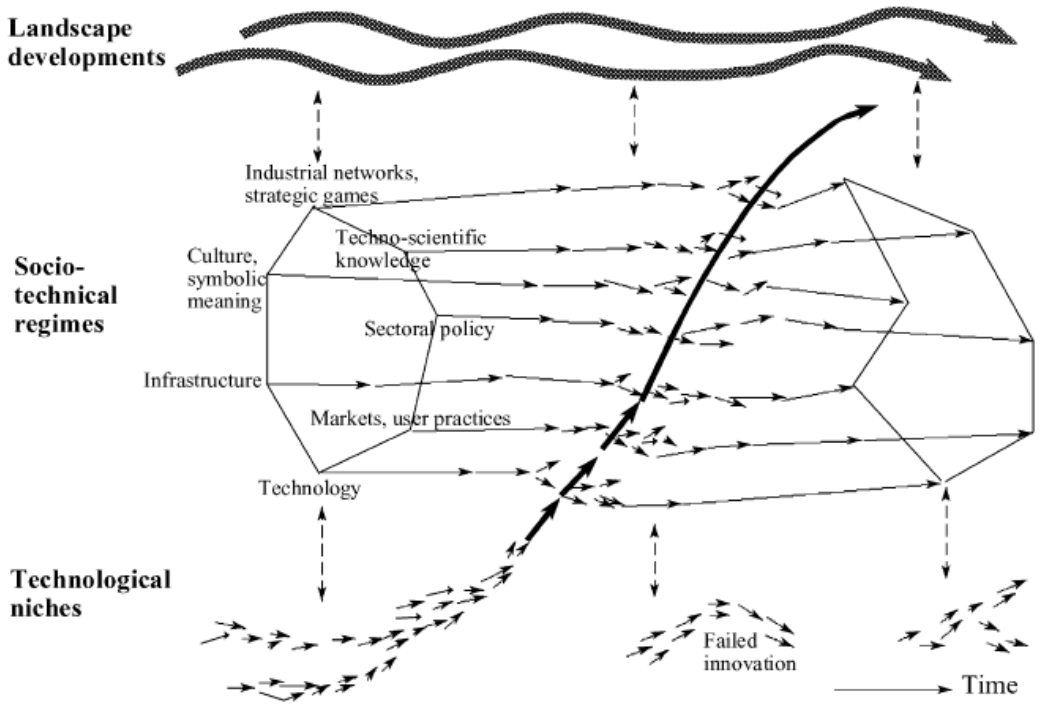

Figure 1 – Multi Level Perspective Model (Geels 2002)

2.1.2 Regime dimensions

The regime dimensions as given by Geels (2002) each represent a part of the cognitive and normative rules that define the selection environment for innovations. Generally, new technologies or innovative ideas are subject to this selection environment. Much like in biological evolution theory, external factors (selection environment) also determine the success of different variations of entities in that environment. The regime dimensions have been reorganised by Smith (2007) and can be explained as following:

- *Guiding principles* represent certain characteristics or practices that define the success of a certain sector in fulfilling a social function; its evaluation criteria.
- *Industry structure* defines the way the industry is organised, it involves established network relations, shared routines, existing resource allocation procedures, etc.
- *Technologies and infrastructures* form an environment through technological artefacts, technological standards and infrastructural arrangements.
- *User relations and markets* describe established market institutions and price mechanisms, but also user preferences and routines.
- *Policy and regulations* define the political environment social functions are subject to; it includes laws, taxes, policy networks, etc.
- *Knowledge bases* involve the level of scientific knowledge and amount of public knowledge about a certain area.

- *Cultural, symbolic meanings* can be given to certain parts of a socio-technical regime. This can mean that a certain technology can represent an ideology; a car represents independence, for instance.

Together these dimensions draw up the selection environment of the regime.

2.1.3 Niche-Regime interaction

The way in which niche developments influence or are influenced by the incumbent socio-technical regime has been studied extensively. Niche developments can be hindered by regime rules that do not connect well with the particular innovation. Niches can offer protection to these hindrances and assist novel developments in various ways. Smith and Raven (2012) discuss three types of functions which niches can fulfil with regard to the incumbent regime rules: Shielding, nurturing and empowerment. Shielding processes limit the effects mainstream selection environments have on the niche development. Smith and Raven distinguish between passive and active shielding niches. Passive shielding occurs when selection pressures are not as present for contingent rather than strategic reasons, such as geographically isolated niches. Active shielding occurs though constructed niches; instead of waiting or searching for the right selection environment, policies can strategically create a protective environment.

Nurturing becomes available when innovations are being developed in a shielding environment. It involves those processes that assist in the successful development of an innovation. Smith & Raven discuss two theoretical frameworks that describe the nurturing of innovations, Strategic Niche Management (SNM) and Technological Innovation Systems (TIS). A more in depth look into SNM will be given in a later section. A third function which niches can have in the development of innovations, Smith and Raven introduce the concept of empowering.

Empowerment entails the concept that at some point a niche innovation no longer requires shielding or nurturing in order to compete with other technologies in the selection environment. This can occur in two different ways. The niche innovation can try to fit into the selection environment by conforming to regime rules and thereby being able to compete with other technologies in the incumbent regime. This is called '*fit and conform empowerment'* and its goal is to convince a wide range of actors that the innovation can become competitive in the incumbent regime. Another form of empowerment occurs when niche innovations impose new rules or routines on the incumbent regime. This is called '*stretch and transform empowerment*' and its goal is to convince a wide range of actors that the socio-technical regime needs to change.

2.1.4 Strategic Niche Management

Strategic Niche Management is a perspective closely related to the MLP, it focuses on understanding how technologies develop from niches towards mainstream adoption (Schot & Geels 2008). It

originates from evolutionary ideas in the sense that there is variation in technology and that the selection environment of the market determines which technologies survive. It deviates from this though, resembling a more quasi evolutionary perspective. One assumption is that variation is not blind. Actors actively try to anticipate the selection environment and try to shape it to better fit their technology. This shaping of the selection environment creates protected spaces for technologies to mature, niches. Niches can be created by technology actors, governments or other societal groups. Another assumption associated with SNM is the belief that for many innovations, market niches are not readily available. This is because many innovations are radically different from the mainstream set of technologies. The purpose of SNM was therefore: To manage the development of socially desirable innovations as well as radical innovations that mismatch the incumbent regime (Schot & Geels 2008).

As mentioned earlier Strategic Niche Management is a framework that focuses on the nurturing of niches in order for them to develop. The main question of early SNM work was: How and under what circumstances is the successful emergence of a technological niche possible? Based on various studies the following internal processes in niche development were summarised by Schot & Geels (2008) as being important for success:

(1) The articulation of expectations and visions.
(2) The building of social networks.
(3) Learning processes at multiple dimensions:
    (a) technical aspects and design specifications
    (b) market and user preferences
    (c) cultural and symbolic meaning
    (d) infrastructure and maintenance networks
    (e) industry and production networks
    (f) regulations and government policy
    (g) societal and environmental effects

Expectations contribute more to niche building if they are: more robust, more specific and substantiated by ongoing projects and experiments. Expectations and visions should be shared amongst actors who are involved in the experimental projects.

Social networks are more likely to contribute to niche development if they are broad and deep. The broadness of social networks indicates the variety of different actors connected to the project. Actors from many different industries and societal background should be in the social network surrounding an experimental project. The deepness of a social network indicates the amount of agency that can be exerted through the social network contacts. This means that, if actors involved in an experimental

project are able to pull resources from or make decisions in their organisation, experimental projects are more likely to succeed.

Learning processes are more likely to contribute to niche development if they are not only directed at the accumulation of data (1st order learning), but also enable changes in cognitive frames and assumptions (2nd order learning).

2.1.5 Uses and limitations

The MLP is useful since it structures and simplifies the complex analysis of large scale societal changes. It divides socio-technological transition into more abstract and easy to grasp terminology of landscape, regime and niche (Smith et al. 2010). It is not meant to describe reality perfectly but to give an analytical framework that can be used to understand socio-technological transitions (Geels 2002). Cooke (2011) notes that the MLP approach shows a model of smooth, slow transition processes and thereby lacks the concept of 'creative destruction' for innovation. Where other transition theories show a shock or crisis as motivator for radical innovation, MLP advocates a gradual growing consciousness of indicators of the need to change. Cooke further states that MLP is often criticised for emphasising that actor networks raise awareness for 'windows of opportunity' for change. The criticism here is that this emphasis underplays the role of actor agency in creating these opportunities.

Strategic niche management emphasises the importance of experimentation in a transition process. It has also generated useful insights into the policy challenge of nurturing niche innovations. These insights have been confirmed by many *ex-post* case studies. Herein lies a challenge for SNM research, it has not been proven to be useful for prescriptive application in experiments (Schot & Geels 2008). Hegger & van Vliet (2007) criticise the SNM approach for seeing social developments as a derivative of technological innovation, despite the co-evolutionary principles of SNM. They state that many experiments and studies take technological developments as a starting point, while the social networking preceding the technological experiment may be more important. Hegger & van Vliet go on, pointing out that the idea that forms the basis for an experiment is most important since several technological alternatives can be just as feasible in realising the same concept.

3. Methodology

To explore the position of energy cooperatives as niches for innovation and transition in the Dutch energy system two theoretical frameworks have been selected. One, an exploration of differences in regime dimensions between the incumbent electricity regime, and energy cooperatives. The regime dimensions as described by Smith (2007) will be used for this 'regime dimension comparison'. And two, an investigation into energy cooperatives as a niche for innovative development. The important internal processes in niche development which Schot & Geels (2008) have summarised as being important for success will be used to explore the potential of energy cooperatives for successful niche innovation development. Furthermore, the three different niche-regime interactions as described by Smith and Raven (2012) will be used to investigate the way energy cooperatives are affected by the incumbent regime, and how energy cooperatives affect the incumbent regime. The following section will explain the ways in which information was gathered to provide useful information for the two theoretical frameworks.

3.1 Data collection

Three methods for the collection of information were used. Firstly A literature study based on: academic articles, websites from various companies and organisations, official reports from the government, news articles, and statistical data.

Secondly, a digital survey (Appendix VI) was distributed among energy cooperatives via e-mail. A list of approximately one hundred cooperatives was derived from websites documenting energy cooperatives (Hieropgewekt.nl & P-nuts.nu). These cooperatives were contacted via e-mail asking to fill out a survey, as compensation the responding cooperatives received the results of this study. A total of twenty-two cooperatives responded to the survey. A note that has to be made here is that the cooperatives that were approached for this survey only represent initiatives that have been founded. This could result in a bias as the initiatives that faced the most difficulties (and thus failed) are not represented by the survey respondents.

Lastly, three energy cooperatives were selected for a case study to get a more in depth view of the cooperative, its activities and opinions. For each case study a representative was interviewed using a semi-structured interview method (Appendix V). These interviews were transcribed and the transcript was sent to the representative for approval. From these transcripts descriptions of the three cooperatives were made (Appendix II, III, and IV), and quotes from the transcripts were used for the analysis. Case study 1 was about *LochemEnergie*, an energy cooperative situated in the municipality of Lochem. The representative who was interviewed (Interview 1) is a founding member of the energy cooperative LochemEnergie and is currently LochemEnergie's research coordinator. Case

study 2 was about *De Groene Reus*, an energy cooperative in the municipality of Almere. The representative who was interviewed (Interview 2) is a founding member and currently chairman of the cooperative. Lastly, case study 3 was about *TexelEnergie*, an energy cooperative on the island Texel. The representative who was interviewed is a founding member of the cooperative and currently chairman of the supervisory board of the cooperative.

3.2 Regime dimension comparison

To find out where potential barriers and opportunities lay for innovative services developed in energy cooperatives, it is important to investigate in what way energy cooperatives differ from the incumbent energy system. These differences will analysed using the seven regime dimensions as mentioned by Smith (2007). Firstly, the incumbent regime dimensions will be drawn up using relevant literature. Following this description, the digital survey and the interviews will be used to determine how much and in what way energy cooperatives deviate from the incumbent regime. For every dimension specific questions were asked. (1) *Guiding principles:* Participants will be asked to explain the goals, visions and beliefs their energy cooperative is based on; (2) *Technologies and infrastructure:* Questions will be asked about the activities of the energy cooperative, which technologies are used, and what problems or barriers were encountered regarding technology and infrastructure. Additionally, participants will be asked if specific technologies should be governed by cooperatives or by other energy actors*;* (3) *Industrial structure:* This dimension will be covered by questions regarding the social network of the cooperative. Which other players were involved in the founding of the cooperative and which parties are currently collaborated with in the provision of services and products.; (4) *User relations and markets:* Interviewees will be asked about the coverage of the cooperative, (how many members, in what areas do they live, how involved are they, etc.), questions about the activities of the cooperative will provide insight into the markets they are involved in.; (5) *Policy and regulations:* This dimension is addressed by asking questions about the cooperative's experiences with policies and regulations. In what way they are hindered and in what way they are assisted.; (6) *Knowledge bases*: Participants will be questioned about the sources that were used to acquire knowledge about relevant subjects, furthermore they will be asked in what way knowledge has caused problems in the cooperative; and (7) *Cultural, symbolic meanings:* This dimension will attended to in questions about the values that are at the roots of the cooperative.

During the interviews all the dimensions were covered by using relevant follow-up questions for each dimension. The survey uses less open ended questions and may therefore not cover all dimensions as well as the interviews. Where needed additional information was gathered by studying the cooperatives' website.

3.3 Niche development

After the investigation of regime deviations, a second step involves exploring the potential for innovations to have an effect on the regime when developed in a cooperative. The important internal processes in niche development which Schot & Geels (2008) have summarised as being important for success will be used to explore this potential. The articulation of vision, actor networks, and learning processes are investigated in interviews by asking the participants about the ambitions, and values associated with their cooperative; the way in which these ambitions and values are conveyed to members and partners; Which actors were/are involved in what stage of the development of the cooperative; and how encountered problems were addressed in order to solve them and to avoid them in the future. Questions regarding these subjects seemed to be too open ended to be answered with sufficient relevance and detail if they were included in the survey, and were therefore included in the survey in limited form.

Secondly, the niche-regime interactions as described by Smith and Raven (2012) will be used to investigate the way energy cooperatives are affected by the incumbent regime, and how energy cooperatives affect the incumbent regime. In the interviews questions will be asked to explore in what way the cooperatives have experienced the concepts of shielding, nurturing and empowerment. These questions will be about encountered barriers, methods used for overcoming these barriers, and in what way the cooperative has had assistance or resistance from regime actors. Just like in the first part of the niche development analysis, these questions are rather open ended, and were included in the survey in limited form.

4. Context

In order to investigate the way energy cooperatives can function as niche environments for the development of (service) innovation, it is important to understand the context surrounding this topic. In the following section relevant trends in the development of the Dutch electricity regime will be described. The regime will then be analysed following the regime dimensions as described by Smith. Finally it is important to see how cooperatives gained ground in the Netherlands, for that reason a historical perspective on cooperatives in the Netherlands will be given.

4.1 Development of the Dutch Electricity Regime

An important trend in the development of the electricity regime of the Netherlands was the liberalisation of the energy industry. The origins of which lay with the Electricity Law of 1989; the goals of this law were to create competition in the supply of electricity and to stimulate efficient generation by means of coordinated production. This created competition by allowing distribution companies to buy electricity from sources other than the local ones. On top of that the law allowed self-generation by industrial firms, but also by joint ventures involving distribution companies. This decentralized generation was very attractive because the electricity law forced distribution companies to take in all locally generated electricity and pay a set feed-in tariff. The increase in decentralized capacity decreased the demand for central generation, thereby raising the system peak price and raising the feed-in tariff, making investments in decentralized generation even more attractive. As a result decentralized generation doubled between 1990 and 1995. This eventually led to overcapacity and inefficiency (van Damme 2005).

The Maastricht Treaty of 1992 planted a seed for further liberalisation of the energy market, not only in the Netherlands but in all EU member states. The Netherlands played the role of frontrunner with the establishment of a new electricity law in 1998 (Verbong & Geels 2007). The law mainly dealt with liberalisation of the consumer side of the energy market and the regulation of the network parts. The liberalisation of the retail market was done in three steps; the first one third of the market were the 350 largest users who were free to choose their energy supplier right away (1998), the middle section as of 2002 and the smallest users as of 2004. The generous feed-in tariffs for decentralized generation were removed and large scale producers no longer ‘pooled’ their input in the system.

Another important implication of the 1998 Law was the legal unbundling of networks. Network owners, distribution companies, had to set up independent organisations that were responsible for network management. Distribution companies were allowed to remain owner of the network, but their independence from the management of the network had to be proven to the minister (van Damme 2005).

Dutch regulations went further than the European requirement for unbundling in 2006 when an alteration to the electricity law of 1998 was made. Electricity generation, trading and retailing were no longer allowed to be part of the same holding as the distribution network management. This resulted in a new independent actor who solely operates their distribution network. Ownership of these new Distribution System Operators (DSO) was held by Dutch municipalities and provinces, tariffs for connection to the grid are regulated by a governmental institution. The Office of Energy Regulation calculates the tariffs based on the revenues of the previous year, the efficiency of the individual DSO, and the quality of the individual DSO. Efficiency is measured by increased productivity and technological improvements. Quality is determined by the reliability of the network, which is measured by the amount of interruption minutes experienced by network users (Niesten 2010).

4.2 Dimensions of Electricity Regime in the Netherlands

4.2.1 Guiding principles

Guiding principles in the incumbent electricity regime in the Netherlands are efficiency and reliability. Reliability is important and expected by all users of the electricity grid, it is for example not accepted if power were to suddenly go down. If an area or a consumer were to lose their access to electricity the DSO is expected to resolve the problem as soon as possible. Reliability is also in the interest of the DSO since it is one of the criteria on which they are evaluated, the tariffs they are allowed to ask for connection to the grid depends on their reliability score. Efficiency is another evaluation criterion of the DSO; they are expected to make use of technological improvement to increase the efficiency of their networks. Efficiency of the networks is also important from a societal viewpoint, the less power is lost due to distribution the more is available for society and that means lower costs of electricity. The same goes for the use of the network; managing and maintaining the networks efficiently will reduce costs for repairs and replacements.

4.2.2 Industry structure

The industry structure of the electricity regime in the Netherlands mainly consists of four parts: Generation, transmission, distribution and network operation.

The electricity used in Netherlands a couple of different sources. Firstly, large scale production of electricity; this is performed by a few market actors who together generate about half of the total electricity used in the Netherlands; this was around 70 million MWh in 2010.The second largest acquisition of electricity is due to CHP systems, this makes up about forty percent of Electricity in the Netherlands. The remaining 10 percent is either generated by distributed wind and solar systems, or is imported from foreign suppliers (Energie Nederland 2011).

Dutch Energy production and distribution companies used to be fully owned by Dutch provinces and municipalities, but this ownership has been disbanded during the process of liberalisation of the

sector. As a result, a number of energy companies have been taken over by foreign companies and new energy companies have made their way onto the market (Energie Nederland 2011).

High voltage transmission of electricity is managed by a single actor, the Transmission System Operator (TSO), the TSO in the Netherlands is called TenneT. TenneT owns most of the high voltage lines in the country and is responsible for management and operation of all the lines that transmit with a voltage of 110 kV or higher. The lines that transmit these voltages but are owned by DSO's are also under management of TenneT. The TSO is also responsible for the interaction with foreign grids (Energie Nederland 2011). This interaction with foreign grids shows another characteristic of the energy industry, namely the fact that it is embedded in an international system.

Since the unbundling implications of the law change in 2006, energy producers/distributors are no longer allowed to own the electricity network. The ownership responsibility for the energy networks lies with the DSOs. There are seven DSOs active in the Netherlands, The DSOs are independent organisations, and the main shareholders of DSOs are municipalities and provinces.
Government is not directly involved in the industry but has installed a regulator to govern the electricity distribution system operators (Energie Nederland 2011).

Important routines in the industry revolve around the supply and demand predictions. A prediction about supply and demand of electricity is made for each day. Energy suppliers do this to prevent under or overloading of the grid. They communicate their predictions to the DSOs who facilitate the transportation and to the TSO who can correct for imbalances in the system (Energie Nederland 2011).

4.2.3 Technologies and infrastructures

Technology and infrastructure plays an important part in various stages of the electricity. The generation of electricity is done in several different ways, using different technologies and different energy sources. The main type of generation in the Netherlands is done in central generation plants. These plants burn mostly natural gas or coal and make up about fifty percent of electricity in the Netherlands. A large part of the renewable generation in the Netherlands is also done in central facilities. Since 1990 experiments with co-firing of coal with biomass have been performed, in 2011 this was 3.1 million MWh which is approximately 4.5% of total central generation (CBS 2013).

Decentralised production also makes up a large part of the Dutch electricity portfolio, about 40% in 2011 (CBS 2013). Compared to neighbouring countries, this amount is quite formidable. Most of the decentralised production is generated by Combined Heat and Power systems, 84% in 2011. The main

industries responsible for electricity production through decentralised CHP are the chemical industry and horticulture industry, which each make up a third of all Dutch CHP (CBS 2013).

The transmission and distribution of electricity in the Netherlands is done via mostly underground cable networks, this way the cables are better protected from extreme weather, generate less potentially harmful electrical fields and are less of an eyesore. Underground cable are more expensive and more complicated to lay out and maintain, meaning that changes to the network have larger costs associated with them.

The electricity network in the Netherlands is very dense, meaning a large area of the Netherlands is fully covered. In total there is 309.502 km of electricity cable in the transmission and distribution grid. This density helps achieve high reliability rates. The network is organised in branches for top down usage. The National high voltage grid connects regional networks to power plants, this grid uses voltages between 360 and 220 kV. Regional transmission networks operate at 150, 110 or 50 kV, these voltages are used for bulk supply to heavy users and connect to regional distribution networks. These regional distribution networks use between 3 and 25 kV and transmit to the smallest local networks that operate at 230/400 volts, which are connected to households. The Dutch grid is connected to the international grid via 12 different cross border electricity lines. The layout of the network is shown in figure 2 (Energie Nederland 2011).

According to Energie Nederland (2011), the Netherlands statistically has the most reliable grid in Europe with an average electricity downtime per client of 32 minutes in the year 2010. The main causes for electricity interruption in the Netherlands are excavations or wear and tear.

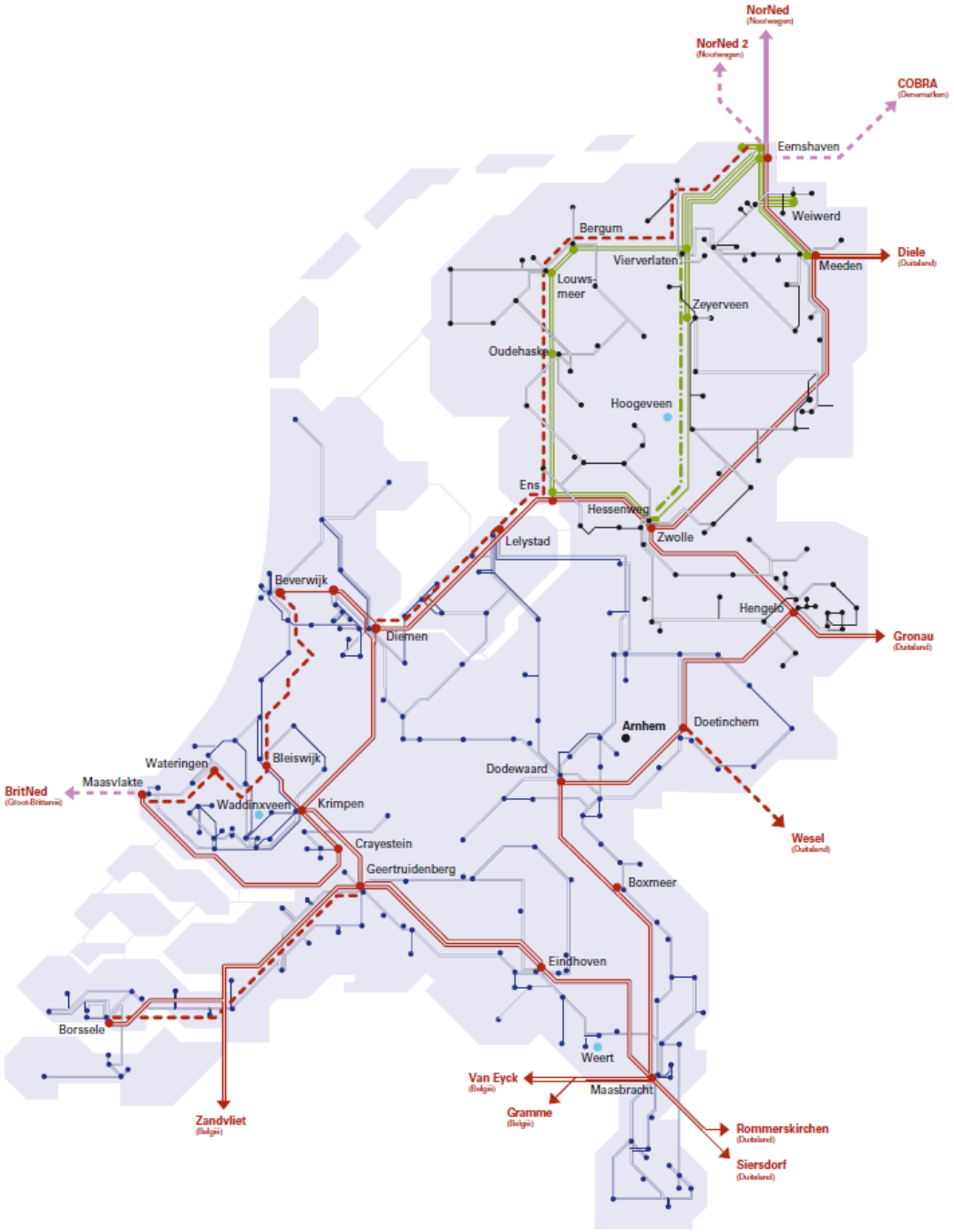
NorNed
(Noorwegen)
NorNed 2
(Noorwegen)
COBRA
(Denemarken)
Eemshaven
Weiwerd
Bergum
Vierverlaten
Diele
(Duitsland)
Meeden
Louwsmeer
Zeyerveen
Oudehaske
Hoogeveen
Ens
Hessenweg
Zwolle
Lelystad
Beverwijk
Hengelo
Gronau
(Duitsland)
Diemen
Arnhem
Doetinchem
Wateringen
Bleiswijk
Dodewaard
BritNed
(Groot-Brittannië)
Maasvlakte
Waddinxveen
Krimpen
Wesel
(Duitsland)
Crayestein
Geertruidenberg
Boxmeer
Eindhoven
Borssele
Weert
Van Eyck
(België)
Maasbracht
Gramme
(België)
Rommerskirchen
(Duitsland)
Siersdorf
(Duitsland)
Zandvliet
(België)

Figure 2 - electricity Grid in the Netherlands (Energie Nederland 2011)

Nearly all households in the Netherlands have a connection to the electricity grid. Electricity usage per household has been increasing up until 2008, since than it has stayed almost the same. The growth in electricity usage up until 2008 is mostly explained by increased usage of household appliances such as a freezer, dishwasher, washing machine and dryer. On top of that the increase in usage of personal computers played a significant role. The stagnation since 2008 is explained by the steady, household penetration level of home appliances. The percentage of households using these technologies is not increasing anymore. New appliances are more energy conserving than older ones, but this leads to increased usage thereby keeping the energy usage approximately the same. A probable cause of the decrease in appliance purchases as well as a contributor to energy savings is the economic crisis of 2008.

4.2.4 User relations and markets

Since 2004, customers are free to choose which supplier they want. This determines the price they will pay for their electricity as well as whether or not their portion of energy use was generated by using renewable energy sources. Here a distinction is made between green and grey energy.

Other than the selection of supplier and the choice between green and grey energy, users have a very passive role in energy industry. When clients demand electricity, the contracted supplier checks the energy trading market and determines the cheapest source of energy for the customer; this can be import or local production and green or grey energy. The imported or produced energy is delivered to the national (high voltage) grid, the balancing and maintenance of this grid lies with TenneT. From the national grid, electricity is delivered to the regional grid, which is balanced by the responsible DSO for that area. The current that passes through the front door meter at the client's residence is measured and can be used (Energie Nederland 2011).

Feedback to the user is limited to the numbers on local energy meters and the energy bill presented by their supplier. The energy bill is made up of three different parts, the cost of energy transport, the cost for delivery, and energy taxes. Energy transport costs are independent of the chosen energy supplier, they are determined by the energy chamber of the Dutch competition authority. Delivery costs are determined by a contract the user has with a supplier. A large proportion of the energy bill are taxes, for an average household taxes are about half of the bill (Energie Nederland 2011).

The energy industry is reliant on a number of different markets. First of all is the global market for fossil fuels. The main driver of this is the oil price. The oil price is linked to price for natural gas and natural gas is the main source of Dutch electricity. This means that if the oil prices rise, so does the price for electricity in the Netherlands.

Besides the fossil fuel markets, energy companies are subject to two markets that are created to help achieve political goals of sustainability. Firstly, companies are subject to CO2-emission rights. When a company produces more CO2 than it has emission rights, these rights have to be bought on the CO2-market. By using more renewable fuels a company can have more emission rights than it needs. These can be sold on the CO2-market (Energie Nederland 2011).

A second tool used to achieve goals for sustainability is the pursuit of green energy. The Dutch government uses a green certificate system to ensure consumers they receive green energy when they request this. Energy suppliers can receive these green certificates from CertiQ (daughter company of TenneT) if they provide users with green energy (also imported energy counts). Government pays subsidies for the awarding and payment of green certificates to suppliers. CertiQ checks if electricity is really green and awards certificates, these certificates can be traded among market players. Consumers can choose to only receive green electricity, the certificates guarantee that their portion of electricity was generated in a sustainable way (Energie Nederland 2011).

4.2.5 Policy and regulations

The government has retreated from direct involvement in the energy industry. This means however that policy and regulations are set in place to influence the energy industry. The Dutch ministry of economic affairs, agriculture and Innovation presented an energy report in 2011. The core of this energy policy is described as:

1. Transition to a cleaner energy environment, reduction of CO2 emissions
2. Economic growth in the energy sector, increase the strength of the energy sector by cooperating with entrepreneurs and researchers on new energy technologies.
3. Ensure a reliable energy supply, search for a reliable balance between green and grey energy. Europe will be reliant on fossil fuels for quite some time, fossil fuels can become cleaner by

investing in Carbon Capture and Storage (CCS). Nuclear energy is also needed to further diversify the energy portfolio.

This translates to three principles that are central in the Dutch energy policy: Energy should be *reliable*, *affordable* and *clean*.

Short term goals are 14% renewable energy in 2020 and 20% CO2 emission reduction compared to 1990.

The Dutch government supports the renewable generation of energy with subsidies. A subsidy can be obtained for the generation of green energy using biomass, waterpower, solar power, geothermal power and wind power. (Agentschap NL 2013)

In a document presenting solar energy generation and Dutch law, *Zonnestroom en de Nederlandse wetgeving*, Agentschap NL presents implications Dutch law has on decentralised generation. A distinction is made between decentralised generation systems that connect after the meter and those that connect in before the meter. Connection behind the meter means that for instance a household connects an energy generation system directly to their house network. The generated power only enters the national grid when it is not fully used locally. The amount power that is fed back into the grid can later be consumed by the household without a fee. When the generation does not take place where it is being used, all the generated power will enter the national grid and will be delivered to its owner. In this last situation the owner has to pay energy taxes over the self-generated power.

The feed-in in the situation of generation after the meter is limited by certain regulations. If the feed-in is larger than 5000 kWh, then the energy delivered will be bought by the energy company at a reduced tariff. The reduced tariff only affects the energy price, the energy taxes on production are still paid in full.

The payment of energy taxes over energy that is generated before the meter is not explicitly laid down in a law. Some articles do explicitly allow self-supply of energy, but the ministry of economic affairs sticks with the rules described because for technical and administrative reasons only 1 energy supplier per client connection is allowed.

4.2.6 Knowledge bases

The energy market is mainly populated by big companies who rely on internal knowledge. These companies do not benefit in opening up their knowledge bases to other actors, making them fairly closed sources of knowledge. Other actors that possess knowledge of the energy system are knowledge institutions, these do not tend to have values that cause them to limit the accessibility of their knowledge. However a second factor that makes knowledge of the energy system less available

for lay people is it complicated nature. Thus, since the energy market is such a closed market and knowledge is not easy to grasp, knowledge mostly stays with the experts.

4.2.7 Cultural, symbolic meanings

People view electricity as a basic need, it stands for modern technology. As stated earlier the increase in electricity usage up until 2008 is mostly explained in the increased usage of household appliances involved in cooking and cleaning, as well as increased usage of personal computers. People do not view electricity as an amazing service but as a requirement to enjoy other services and technologies. This means people are dependent on the availability of electricity to enjoy daily life. Since the distribution companies and DSOs deliver this basic need, people are also dependent on them. The current electricity regime can therefore represent modern standards, but also dependency.

The main characteristics of the incumbent energy regime per dimension are show in table 1 (p. 44).

4.3 Emergence and Development of Cooperatives in the Netherlands

Dutch history on cooperatives started in the second half of the 19th century. The first industry in which cooperatives developed successfully in the Netherlands was the agricultural industry (Gutierrez 2005). The first agricultural cooperative dates back to 1877 and was set up by farmers from Zeeland to cooperatively purchase high quality chemical fertilizers at lower prices. The economic benefits of the organisational form spread amongst the farming community, with the first dairy cooperative founded in 1886, the first cooperative for public crop sales in 1887 and the first agricultural bank in 1896 (Gutierrez 2005). All these early cooperatives were focussed on a single task, which makes sense since they were founded by already specialised farmers. The common task all these cooperatives had was to make a strike at commercial monopolies (Gutierrez 2005). Being part of a cooperative, individual farmers were able to strengthen their market position. Supply and demand could be coordinated and benefits of economies of scale could be accessed. This allowed cooperatives to achieve a notable market share. These early Dutch cooperatives thus had a purely economic function for farmers.

A second wave of cooperatives in the agricultural sector emerged in the early 1990's; the so called environmental cooperatives were a response to national policy on the rural environment (Glasbergen 2000). Agriculture at that time had grown to be a very successful industry, but it had also grown to be a major source of pollution in the Netherlands. National government stimulated activities by nature conservation organisations to manage the rural environment and reduce environmental pollution. At that time it was argued that farmers would be able to do this same work more efficiently by getting involved in nature management. Environmental cooperatives were created to tackle environmental problems in the rural area for pay. An important notion here is that a market for environmental projects existed because governments were actively trying to stimulate a more sustainable rural environment (Glasbergen 2000). Economic benefits were thus a large part of the emergence of environmental cooperatives as well. What was different about the environmental cooperatives, is the scope of the pursued projects. Agricultural cooperatives were focussed on expanding the reach and productivity of a specific agricultural sector as a whole. Environmental cooperatives on the other hand, focussed on the interests of individual members as well as collective interest (Glasbergen 2000). Because the focus of environmental cooperatives was not solely the expansion of the agricultural sector but also on the execution of local projects, the focus of its members was not solely based on their own economic benefits, but also on the local impact of the projects. Because of this local, individual focus the environmental cooperatives were also smaller in organisational size, between 25 and 200 members.

While environmental cooperatives continued to develop in throughout the 1990's, the cooperative principle had also sprung up in the energy sector. An important actor in diffusing the cooperative thinking to sustainable energy projects was the organisation ODE. ODE is an association founded in 1979 by the coming together of people that opposed nuclear energy generation. Instead of fighting nuclear energy generation ODE has focused on stimulating other means of generation, wind and solar in particular. They educated the public about the power of community in achieving energy generation using sustainable energy sources. After a couple of years of promotion and education, the first Dutch wind cooperatives were founded in 1986. The aim of these cooperatives was the unification of citizens with a common interest in building and exploiting windmills for the generation of electricity. The first cooperative wind turbine was placed in 1987 by the cooperative Noordenwind on the terrain of the Delft University of Technology (Verbong et al. 2001). The belief of sustainability and environmental protection were the driving force behind the ODE's stimulation of communities to get involved in wind. This means that the wind cooperatives had these beliefs at the core of the organisation. Compared to other cooperatives, this is a deviation. The main driving forces of agricultural cooperatives were the economic benefits and the later environmental cooperatives were also driven by economic incentives. However, the ideological roots of wind cooperatives do not take away that economic viability was an important part of these organisations. The initial aim of wind cooperatives was to supply renewable electricity to its members, thereby saving on their energy bills. Due to the ruling energy laws however, the only viable business model was the sale of electricity to energy companies, and paying out the returns to the members that invested in the project (Schwencke 2012). The importance of the sustainability and environmentalist beliefs of the wind cooperatives can also be observed in their other activities. Early wind cooperatives were active in informing local population and politics about renewable energy (and often rallied against nuclear power). Besides demonstrations, lectures, fairs and newsletters, in local governance the cooperatives were heavily involved in the promotion for policies on wind energy. Another display of the importance of values is the investment of proceeds from sale of electricity in financially unfeasible projects. These projects also included other forms of renewable energy such as solar panels or heat pumps (Agterbosch 2006). After an initial surge in wind-cooperatives the development halted, wind power was facing resistance. It became clear that people believed renewable energy to be important but people were not willing to make sacrifices in order to achieve more green electricity. Wind turbines were seen as, ugly, ruining the natural landscape and as bird killers.

A new wave of cooperatives emerged with the technological innovations in the field of solar power. Photovoltaic (PV) panels started to become financially viable for the public. Calling these cooperatives solar cooperatives would not be sufficient; these cooperatives are diverse in the activities they are involved in. Their focus tends to be on the provision of green energy to its members and the

promotion for and assistance in the saving of energy. These more recent cooperatives can thus better be referred to as energy cooperatives. The main goal of the energy cooperatives is the generation of their own local energy, this can be done by many different means. It is not unusual for these cooperatives to get involved in many projects at once. Another main goal is the stimulation of energy savings either by distributing information or by offering energy savings services. Besides energy generation and savings, energy cooperatives can be connected to an energy distribution company from which they purchase green energy for their members.

As a response to the growing numbers of energy cooperatives, overarching organisations aimed to help starting cooperatives to become successful. An example is 'Hieropgewekt'. Hieropgewekt is a platform created by the climate bureau 'Hier'. The organisation characterises itself as a knowledge source for local sustainable energy initiatives, this includes energy cooperatives but also other ventures. The goals of this overarching organisation is to inform, inspire and connect citizens that are interested in generating sustainable energy. This is done by the availability of information on a variety of different subjects on their website, the organisation of network opportunities, competitions and other events related to sustainable energy generation.

4.4 Case descriptions

The three energy cooperative that were used as a case study will be briefly described here. The full case descriptions can be found in appendix II, III, and IV.

The first case describes Lochemenergie, which is located in the municipality Lochem, in the province Gelderland. It was created after an information meeting about local solar energy which was set up by six people, among which the councillor of Lochem and the local chairman of his political party. This meeting attracted over 60 people, which was much more than expected. This new group drew up a business plan, a communication plan and organised further recruitment activities.
Currently Lochemenergie has approximately 360 members, these members have access to all information services, on for instance energy savings or energy generation systems, the cooperatives has to offer. Furthermore they have a vote in the general meeting of the cooperative and can thus help make decisions about the future of the cooperative.
Around a 130 of these members are active customers of Lochemenergie, which means they receive green electricity from Lochemenergie. However, since Lochemenergie does not hold a suppliers licence, this electricity is supplied by the energy company Eneco.
Lastly Lochemenergie is active in a number of innovative projects, among which smart meters, energy storage in a water lock, energy generation systems on public buildings, the creation of a local solar park, and setting up a so called 'energy shop' as an incubator for sustainable energy companies.

The second case describes De Groene Reus, which is located in the municipality of Almere, in the province of Flevoland. It was created from a former foundation that aimed to mobilise people to invest in solar panels and energy saving measures. Three members of the foundation decided to establish a cooperative in order to more actively stimulate sustainable energy generation and energy savings. However, two out of three founders opted out of the board of the cooperative because it was too much work. The remaining founder continued and has hired people to take care of different tasks, for instance finances or legal research. De Groene Reus started out as a mediator between consumers and solar panel suppliers. People who would purchase solar panels via De Groene Reus, would get a free membership for 1 year. This proved a successful service and the cooperative quickly grew to over

100 members. De Groene Reus is involved in a couple of pilot projects, one of these focuses on the profiling of energy usage of a company and offer directed measures to ensure effective energy savings.

The third case describes the energy cooperative TexelEnergie, which is located on the island of Texel, which is part of the province Noord-Holland. A conversation between two inhabitants of Texel with experience in sustainable energy projects, sparked the idea of starting an energy cooperative on Texel. After a strategic selection process, ten more people joined to found Texelenergie. The cooperative started off supplying energy from a garbage incineration plant, but switched energy supplier two times for varying reasons. Among other services provided are the supply of solar panels, test projects with smart meters, test projects with electric vehicles, and an energy savings contest between the villages on Texel.

5. Analysis

This chapter will use the theoretical framework and empirical data to answer the four sub-questions.

5.1 Deviations from electricity regime

The first sub-question was asked to find out what barriers and opportunities can present themselves when developing innovative energy services in cooperatives. By analysing in what way cooperatives deviate from the incumbent regime, these barriers and opportunities can be revealed.

The first sub question of this research is: **In what ways do energy cooperatives deviate from the incumbent electricity regime in The Netherlands?**

To answer this question, the representation of the Dutch electricity regime that has been drawn up in chapter 4 will be used. The empirical information displayed in appendices I-IV, will then be used to find notable deviations from the incumbent regime for each regime dimension. Finally, these deviations can uncover the barriers and opportunities for innovative development in energy cooperatives. Table 1 gives an overview of the differences between the incumbent regime and the energy cooperatives.

Table 1 – Regime characteristics per regime dimension; and Characteristics of cooperatives that deviate from the regime

Regime dimension	Characteristics of the incumbent Regime	Characteristics of Cooperatives
Guiding Principles	Efficiency; Reliability;	Sustainability; Self-sufficiency;
Industry Structure	Mostly Central generation and industrial CHP; one actor (Tennet) governs the high voltage network; seven DSOs govern the lower voltage networks; Tennet, DSOs, and energy supply companies work together to balance energy supply and demand; Embedded in international system;	Small scale distributed generation; Electricity is used where it is generated; Consumers are relevant for supply and demand balancing;
Technologies and Infrastructure	Central generation with coal or gas; Co-firing coal & biomass; CHP; Dense underground cable network; above ground high voltage network; International connection with high voltage grid; Increase in energy usage due to increased amount of household appliances and computers;	Generation from sustainable sources; Distributed generation;
User Relations and Markets	Consumer chooses one energy supplier; green and grey energy; limited feedback. Oil market effects electricity prices; CO2 emission rights; green energy certificates. User is passive;	Cooperative as supplier (representative); Cooperative as consumer representative; Strong user relation; Users are active; Market for electricity supply and demand data;
Policy and Regulations	Reliable; Affordable; Clean;	Government policy is vague; Local policy is not uniform; Subsidies do not represent policy; Net metering in front of the meter should not be limited;
Knowledge Bases	Technical knowldge; Managerial knowledge;	Some cooperatives are populated by volunteers, with little; knowledge on the energy system; Some cooperatives are founded on a wide range of experts;
Cultural, Symbolic Meanings	Since electricity is needed to enjoy other technologies, energy supply is seen as a need instead of a service. This resonates to a feeling of dependency on energy companies.	Energy generation can improve the local economy;

The following paragraphs will elaborate upon the found regime deviations for each regime dimension. This will reveal barriers and opportunities for development of innovative services in energy cooperatives. After the analysis of the seven regime dimensions, the results will be summarised (see table 3).

5.1.1 Guiding principles

As established in chapter 4, notable guiding principles in the Dutch electricity regime are efficiency and reliability. Efficiency meaning the making use of technologies and management strategies to realise a minimal loss of energy during its generation and transportation as well as high energy returns on financial investments. The other guiding principle, reliability, displays the importance for electricity to be available at all times. Power outages or other reasons for electricity to be unavailable in households/businesses, negatively influence the reliability of the electricity system.

Results from the survey show that the most important values associated with starting an energy cooperative are fossil fuel independence, independence from energy companies, and environmental values. Furthermore, open answers provided by respondents indicate value in the *local* production of energy, energy savings, and 'sustainable energy'. Common principles that envelop these values are sustainability (energy saving, utilising renewable sources, environmental values) and self-sufficiency (local production, independence from energy companies/fossil fuels).

Sustainability and self-sufficiency were also recurring topics in the case studies of the three energy cooperatives. LochemEnergie, De Groene Reus, and TexelEnergie all address the importance of sustainability. In interview 3 it is for instance noted that members are often more 'sustainability minded' than others.

"A survey performed on the inhabitants of Texel asked participants about the need for sustainable energy generation, what becomes clear is that members of the cooperative are stronger proponents of this development than non-members." Interview 3

The notions of independence, localness and self-sufficiency are also present during case study interviews. For instance:

"*Independence and 'localness' are driving forces behind energy cooperatives."* Interview 2

The prevalence of sustainability and self-sufficiency as guiding principles in energy cooperatives does not relate to the incumbent regime. Furthermore during the interview with LochemEnergie a remark was made that goes against the efficiency principle embedded in the incumbent regime.

"*LochemEnergie is not a price fighter, we do not see aiming to offer the lowest prices as sustainable."* Interview 1

The differences in guiding principles between regime actors and energy cooperatives can lead to tensions or misunderstandings. These tensions or misunderstandings can create barriers for the innovative development of energy services in energy cooperatives.

Sustainability and costs efficiency and reliability

A regime that focusses on efficiency and reliability will not be easily drawn to the usage of renewable energy sources. Renewable energy sources are more sustainable, but on large scale not as cost efficient as the exploitation of fossil fuels. Barriers that can be felt by cooperatives due to this difference in guiding principles can be the not getting as much support for the cooperative as is expected. Since regime actors are focused on efficiency and reliability, renewable energy generation is not as attractive for regime actors. This slow response to the value of sustainable energy has been felt by energy cooperatives:

"When we heard the legislative organisation state that 'sustainable energy is also important', our reaction was 'Finally, it is about time they realised it'." Interview 1

This relative disinterest in sustainable energy is not only present with regime businesses or government, the public also tends to view this as a lower priority principle.

"The public views the sustainable part as less important than the independence part. Most inhabitants of Texel do not really care that we call the cooperative 'green', but they do value the fact that TexelEnergie is theirs. The fact that sustainability is involved is merely accepted." Interview 3

"*Some people have closely observed energy prices all the energy companies offer ever since the market was liberalised. Since out prices are a bit higher, LochemEnergie is not as attractive for those people."* Interview 1

These conflicts of interest are important issues that can cause energy cooperatives to have to delay their endeavours or even be unable to operate in the way they envisioned.

Self-sufficiency and reliability

The principles of self-sufficiency and reliability are in disagreement. Energy cooperatives want to supply their own electricity thereby reducing their dependence on the electricity grid. The reliability of the national grid is one of its greatest advantages over local/private generation. In fact, since reliability is the primary value on which a DSO's performance is evaluated, reliability can be seen as the main function of the national grid. The more self-sufficient consumers become the less dependent they will be on the reliability of the national grid. This could mean that the more cooperatives believe they can be self-sufficient, the lower they view the usefulness of the national grid. Energy cooperatives do talk about self-sufficiency and independence, however the benefits a connection to the national grid can bring are often viewed as essential.

"*I am sure we can maintain our own network on a local scale, if such a local network is connected to the national system."* Interview 3

The division of the responsibility for the network between DSO and energy cooperative can be an interesting subject to further explore, paragraph 6.4 will address this issue a little further.

5.1.2 Industry structure

The structure of the incumbent regime relies heavily on large scale production of electricity by a few actors, and industrial CHP. Production and supply actors are commercial actors that operate on a liberal market. DSOs and the TSO are responsible for the maintenance and management of the electricity infrastructure and communicate with energy suppliers for supply and demand predictions.

Energy cooperatives want to locally generate as much energy as possible. This is mostly done by small amounts of generation on many different. This can be seen in the types of projects in which energy cooperatives are involved as well as the number of different projects they undertake. A preference energy cooperatives have is the local supply of electricity, or in other words the generation of electricity in the same area as where it will be used. This poses two deviations from the incumbent industry structure.

Distributed Generation

Firstly, energy cooperatives promote a much more distributed generation portfolio than the incumbent industry structure. This would create a larger amount of connections to the grid that not only demand electricity, but also supply it.

The national electricity grid is designed to fit the incumbent industry structure, the described deviation may thus lead to technical difficulties in the infrastructure (see 5.1.3).

Local consumption

The preference to consume energy on the location it is generated can also create a conflict with the incumbent regime, since transmission and distribution of electricity are an integral part of the incumbent electricity industry.

The transmission and distribution of electricity as a service is challenged by the notion that energy cooperative wish to use electricity where it is generated. Developments in this generation and use structure could cause major inefficiencies in the infrastructure as parts of the transportation infrastructure could become obsolete.

Supply and demand balancing

Both the increase in distributed generation and the local consumption of electricity can contribute to some difficulties in incumbent system of supply and demand balancing. Increases in distributed generation will make this form of electricity generation a larger share in the electricity market. This means DSOs will have to take distributed generation more and more into account. Furthermore if energy cooperatives become active in the supply and demand of electricity, they will have to get involved in the system that balances supply and demand. This will require a certain degree of professionalization and expert knowledge in cooperatives (see 6.1.6). On top of that, since the energy generation in cooperatives is heavily reliant on sustainable energy sources and less focussed on reliability, supply predictions will become more variable and inaccurate. This means the growth of the share of energy cooperatives in the electricity industry threatens the incumbent routines of the system. As a result regime actors, in this case DSOs and energy companies, could try to resist the growth of energy cooperatives. In the case-study of the Groene Reus this fear was also expressed:

"*There may exist a danger of DSOs trying to slow down the development because they are unable to keep up with it. This would be a shame since the smart development of distributed generation is necessary. Germany for example faces the problem of overcapacity, causing them to have to slow or shut down wind turbines or coal plants."* Interview 1

5.1.3 Technologies and infrastructure

Centralised large scale energy production is mostly done by burning coal or natural gas. Co-firing of coal and biomass holds a small account of central production. Decentralised production is mainly

done by using Combined Heat and Power systems in large industrial firms such as chemicals and horticulture. Transmission and distribution mostly use underground cables. Household appliances make up a large account of electricity usage in households.

Sustainable energy generation systems

All the energy generated by energy cooperatives has been generated using sustainable energy sources. The technologies used to generate electricity from these sources is relatively new compared to the traditional methods. For instance, the first coal plant in the Netherlands was built in 1884 (Hermsen 2012), while the first wind turbines used to generate electricity arrived in the Netherlands in the 1970's (van Roekel 2012). The relative newness and unfamiliarity of these sustainable generation systems causes lay people to hesitate when they are about to be implemented. During the case-study interviews two energy cooperatives address this issue by naming the NIMBY effect:

"Wind energy would be a good addition, but it has its own problems. The Not In My Back Yard principle makes it hard to get sufficient support for wind turbines." Interview 1

"A problem is the Not in My Back Yard principle. People worry about everything and nothing and need to be absolutely certain that the local environment is not threatened by the technology." Interview 3

Another characteristic of (most) sustainable energy generation systems is its dependence on environmental conditions. Solar panels need the sun to work and wind turbines need the wind to work. The availability of these conditions is far from as reliable as the supply of fossil fuels.

"*As you know, there is no sun at night. This creates a mismatch between supply and demand of electricity."* Interview 1

Technologies that are used by energy cooperatives that are not energy generation systems are related to energy savings. These energy savings measure include passive energy savings such as house insulation, but also more active measures such as smart meters.

All these technologies have their impacts on and are impacted by the electricity infrastructure of the Netherlands.

Infrastructure

The incumbent infrastructure was designed with the current electricity system in mind. It is a safe, reliable, efficient, dense and rigid system of (mostly) underground cables. However the uses of the technologies described above do not simply fit into existing infrastructure without consequences. The growing exploitation of the relatively unreliable sustainable energy sources creates a need for higher capacity of the grid during peaks in electricity generation, due to for instance a very sunny day. A solution that would fit into the incumbent regime is to increase capacity by making large investments to implement bigger cables.

However, a downside to this is that other technological developments seem to reduce the need for more capacity. Passive and active energy savings measure reduce the amount of electricity that is used. On top of that, smart meter systems assist users in using up as much of the locally produced energy as possible, by for instance doing laundry when the sun is brightest. Cooperatives are aware of these developments and agree that a better energy grid is a smarter energy grid.

"Instead of putting more copper cabling in the ground, we try to take wind and water energy into account. We also do calculations for winters, and day and night cycles. The most steady energy profiles are achieved when consumers behave in such a way that is compatible with the supply of energy. To make this behaviour happen we need many people to use their smart meters." Interview 1

The incumbent electricity infrastructure is thus suboptimal for implementation of technologies preferred in energy cooperatives. Since the infrastructure was designed to fit a system of reliable energy sources, it could create barriers for innovations in energy cooperatives.

5.1.4 User relations and markets

Citizens are free to choose their energy supplier, but every connection is only allowed to have a single supplier. The user can demand energy to be green, usually resulting in a more expensive rate. The supplier then chooses whether to use locally produced electricity or to import it. The TSO and DSO are then responsible for balancing the electricity on the grid. The electricity used by a household is measured by the meter at their front door connection. The user's only feedback is the energy bill, which covers rates for electricity transport, delivery and taxes. Markets tied to the electricity market are, oil and gas prices, CO2-emission rights, and green electricity certificates.

Energy cooperatives are a new actor in this system. They can supply energy to their members, however they are not energy suppliers. They are connected to an energy supplier, however they are not consumers.

Supply of energy

One issue that has been expressed multiple times during the case studies is the relation between the cooperative and the energy supplier. The energy cooperatives desire to supply locally produced energy to their members. Since a household is only allowed to have one energy supplier, cooperatives can do one of two things. Either connect to an existing energy supplier, or undertake the steps to become a supplier themselves. Cooperatives generally choose to connect to an existing supplier since the steps to become an official energy supplier themselves cost a lot of effort and money.

"*It is possible to officially become an energy supplier yourself, but that is difficult. There are numerous requirements that must be met in order to get a license. It is much easier to sell your electricity to an actor that already has a supply license. That way, the cooperative does not have to worry about net metering, which takes a lot of time and is not the core business of the cooperative.*" Interview 2

TexelEnergie partnered up with an energy producer who desired to become a supplier. However, this transition to energy supplier proved to beyond the capabilities of the producer.

"*The domestic garbage plant seemed like a good partner, they desired to officially become an energy supplier on top of being a producer. They offered to help us and handle all the back-office for us. This seemed like a great offer, until a year later when we realised they lacked the capabilities to do all that extra work.*" Interview 3

The difficulties in becoming a supplier for members of an energy cooperatives create a necessity for energy cooperatives to connect to an existing energy supplier. This has led to some problems in the past.

"*Trianel [the energy supplier we were in contract with] went bankrupt. We had paid them a sum in advance and were unable to get that money back.*" Interview 1

"Greenchoice has helped us very well in the beginning. But after one and a half years we found out that they had been messing with the price margins. This caused us to abandon them as a partner." Interview 3

"People generally dislike switching supplier: 'Why can't I just join LochemEnergie? Why do I have to Eneco as my energy supplier?" Interview 1

The limitation of consumer to be contracted with only one energy supplier thus causes energy cooperatives to become dependent on one energy supplier. This means that if anything goes wrong with that supplier, the only option for the cooperative is to switch suppliers with all the difficulties that entails.

Representation

Energie cooperatives are not direct consumers of electricity, however they are often contracted under an energy supplier. In this relation between cooperative and supplier the cooperative is often a representative of its members. This representation is not limited to the relation between consumer and energy supplier, it is also present in the relation between consumers and other parties.

"Customer access is an opening we protect. We say to Alliander, or to the University of Twente: 'We like cooperating with research, but communication has to go via LochemEnergie.' We must make sure our members are not put into intrusive experiments and don't get overwhelmed with questionnaires." Interview 1

"We used to be a re-seller for [PV-panel] companies, which is advantageous because we do not carry much of the risk. Now however, we are making contracts in which we are named as the supplier, this is helpful for the consumer because they now have 1 actor to communicate with." Interview 2

This middle ground the cooperatives are taking up can pose great opportunities for businesses or research institutions that aim to address a group of people.

Two way user relation

Cooperatives have a strong 2 way relation with its users (or members). Users have a say in the operations of the energy cooperative.

"In the end we are still a democratic organisation, which means all information is shared." Interview 1

"Since a cooperative is very democratic and transparent without much hierarchy, I found it to be a very interesting organisational form." Interview 2

The fact that most decisions must be made democratically via the general meetings of the organisation, means the cooperative is not able to act as quickly as businesses and government may expect them to. This could further create tensions between the cooperative and the regime actors.

"*The cooperative is an association, its activities depend on the activity of its members. We have approximately 3000 members of which 100 come to the general meetings, which makes that a big*

meeting. The decision-making of the cooperative is therefore much slower and less efficient than that of a company." Interview 3

Supply and demand of electricity

Due to the fact that users will become producers, they will become interested in the supply and demand curves for electricity. This creates a market for accurate and prompt representations of electricity demand to consumers. The data required for this is generated by consumers themselves, meaning this market also becomes a clear 2-way interaction between the consumers (cooperatives) and those responsible for the balancing of electricity.

"*We have been awarded research funding to investigate customer behaviour with smart meters and related technologies.*" Interview 1

5.1.5 Policy and regulation

Government has no direct involvement in the electricity industry, and thus has imposed more regulations to guide the market in the desired direction. Policy aims are cleaner energy environment (reduction in CO2 emission), economic growth in energy sector, and the search for a reliable balance between green and grey energy. Energy taxes are lower for bulk users. Taxes and transportation costs have to be paid over all electricity that uses the national grid, with the exception of net-metering after the meter. In such a situation, excess electricity (up to 5000 kWh) that is fed back into the grid can later be used without extra costs.

Policy scope

National Policies are rather vague and long term, changes are slow, and the scope is large. On top of that, municipal (local) policy regarding energy and sustainability is not strongly influenced by national government, this means that different municipalities have different stances on the same issues. Some cooperatives benefit from this, as they operate in municipalities that are very open for distributed generation of sustainable energy.

"*I have not experienced any problems in working together with the municipality. I join a meeting every two weeks, they welcome me pleasantly and share a lot of information.*" Interview 2

In some cases local government is even limited by national policy.

"*Local government wants to help, but are often halted by provincial or national government. These need to define a clear vision and keep to that vision.*" Survey

On the other side, some cooperatives have to fend for themselves and are limited by local government.

"In our municipality opinions are divided, some are willing to cooperate, but others are not. Even when they agree on an issue and we deliver a proposal, a common answer is 'This is not what we meant.' Local government creates a lot of resistance." Interview 3

Cooperatives feel that clear national policy is needed, this will reduce uncertainties for beginning cooperatives and create a more level playing field.

Subsidies

The acquisition of subsidies is uncertain. It is unclear if and which subsidies are applicable to energy cooperatives. Cooperatives believe they are working towards achieving policy goals laid out by government and therefore should get some financial aid. A concern is expressed about government subsidies for electricity generation as a large part of subsidies is reserved for the use of fossil fuels, cooperatives feel this contradicts policy for sustainable energy.

"*We have some nice project ideas, but we need to receive SDE+ subsidy to make it work. Most of that subsidy is already awarded to large wind parks. In Drenthe there are a hundred wind turbines that have claimed all the SDE+ subsidy for the next five years.*" Interview 1

"There is a lack of consistent policy, sustainable energy is getting subsidised less than fossil fuel energy." Survey

Net metering

A central problem in national regulation comes into existence because a distinction is made between decentralised generation systems that connect behind the meter and those that connect in in front of the meter. Connections behind the meter connect an energy generation system directly to a local network. The generated power only enters the national grid when it is not fully used locally. The amount power that is fed back into the grid can later be consumed by the household without a fee. When the generation does not take place where it is being used, all the generated power will enter the national grid and will be delivered to its owner. In this situation the owner has to pay energy taxes over the self-generated power. This creates an inequality between people who own a suitable area for decentralised generation and people who do not.

Cooperatives believe national regulation creating and inequality should be changed.

"*One barrier to distributed generation are regulations and the lobby of suppliers and producers. I am not allowed to supply my neighbour with electricity because I have to use the national grid for that. This contradicts the logic of organising distributed generation on street or neighbourhood levels.*" Interview 3

According to energy cooperatives, changes in energy taxes for net metering in front of the meter could create many more opportunities for sustainable energy generation projects.

"*We have a big project in mind for a solar electricity park on a local cleaned up garbage deposit. That project could supply one to two thousand households with green electricity. However due to the current energy laws and energy taxes we are unable to start that project, it's simply too expensive.*" Interview 1

5.1.6 Knowledge bases

Knowledge about the electricity system lies mainly with experts. Engineers and scientists in energy companies, consultancy firms and research organisations are the ones who understand how it works and what the possibilities are.

Different cooperatives relate to the knowledge system in different ways. In some cases the cooperative is founded on the expert knowledge of the members themselves, and in other cases the cooperative is governed by lay people who volunteer a lot of time to get familiar with the knowledge required to execute the projects they envision.

Time constraint / volunteers

Many cooperative are founded by idealists with visions of a more sustainable future, often these founders do not have a background in energy technology or policy. Cases like this will soon notice their lack of knowledge on energy subjects and find that the energy world is not as transparent as they had hoped.

"*There exist a lot of opportunities if you know how the market works and how to play along with it. Often though, the knowledge required for this is lacking, this is because it is very complex and it will take a lot of time to figure out.*" Interview 2

The survey revealed the requirement for specific knowledge and/or necessary time investments to be a barrier in numerous energy cooperatives. One respondent stated:

"*Citizens, good-minded volunteers have a limited amount of time available. This is not so much a problem during the starting phase of a cooperative, but it will cause difficulties when plans have to be further developed. Lack of time and knowledge are strong barriers that have to be overcome.*" Bergen Energie

This shows that the way knowledge bases are distributed in the incumbent electricity regime can pose barriers for energy cooperatives. In this case a barrier can be observed with the knowledge base of the energy cooperative. In order to overcome these barriers the energy cooperatives will have to invest both time and money into acquiring specific knowledge. The people who were interviewed during the case studies illustrated this as well.

"Everything took more time than initially expected. But much is learned with experience, a cooperative really needs to have a lot of patience. It is important to immediately hire professional help for projects when the cooperative is able to." Interview 3

"*Professionalization meant that some board members had to leave the board in order to perform the tasks they were set out to do. For instance research, finances and funding. This quickly becomes serious business, which is impossible to do as a volunteer.*" Interview 1

The survey revealed however that topics regarding energy were the ones energy cooperatives researched the least. This could mean the complexity of knowledge that causes barriers for cooperatives does not lay with the energy system, or alternatively that it is hardest to find/understand information on those topics.

Expert cooperatives

As opposed to situations in which energy cooperatives consider themselves lacking in expert knowledge, some cooperatives reveal they are actually becoming experts themselves.

When a cooperative is founded on active members that have expert knowledge, projects can be approached in an integral way. In the case of LochemEnergie, many of the citizens who were interested in forming an energy cooperative were experts is a range of different fields. The local project brought them together creating a pool of knowledge from different parts of society.

Cooperatives can thus form an expert knowledge base themselves, but even here a deviation from the incumbent regime can be found. Experience and knowledge from existing cooperatives is often shared

very freely. Starting cooperatives contact experienced cooperatives for advice, and overarching organisations attempt to make required knowledge as accessible as possible. The expertise of cooperatives does not go unnoticed by other actors. Cooperatives are often invited to take part in discussions and decision-making regarding renewable energy in the municipality or province.

"*We are often mobilised in the early stages of projects, LochemEnergie has the strength of having a lot of different knowledge in one place. Some can create websites, some are communication experts, some innovation experts, some energy experts, others have knowledge on law and regulations. A project team at the municipal government cannot contain all this expert knowledge. That is why they see us as a platform of experts, they address us instead of hiring consultants.* " Interview 1

5.1.7 Cultural, symbolic meanings

Electricity is viewed as a basic need, it represents modern technology. Electricity, for instance in electric vehicles, is viewed as "cleaner" energy, as the use of electricity does not produce negative externalities (externalities during the generation of the electricity tend to be overlooked). Furthermore since the provision of electricity is not seen as a service but as a need, people feel dependent on energy supply and distribution companies.

Local benefits

A cultural meaning energy cooperatives see in energy is the opportunity of it to benefit their local environment. This benefit takes many different forms such as: Energy savings, cost savings, creation of community, creation of employment, and boosts for local businesses.

"*One of the underlying goals of the cooperative is the reduction of unemployment on Texel.*"... "*Our message is fully focused on Texel, experimentation on Texel, energy production on Texel, energy supply on Texel."* Interview 3

5.1.8 Barriers and opportunities

The discrepancies in regime dimensions give insight into barriers and opportunities for energy cooperatives to successfully introduce innovations.

Table 2 – Barriers and Opportunities found by regime dimension comparison

Regimedimension	Characteristics of the incumbent Regime	Characteristics of Cooperatives	Barriers	Opportunities
Guiding Principles	Efficiency; Reliability;	Sustainability; Self-sufficiency;	Conflicts of interests when cooperating with regime actors can cause projects to develop slower than expected.	The focus of DSOs on a changing energy system shows that the DSO is a good actor for cooperatives to cooperate with
Industry Structure	Mostly Central generation and industrial CHP; one actor (Tennet) governs the high voltage network; seven DSOs govern the lower voltage networks; Tennet, DSOs, and energy supply companies work together to balance energy supply and demand; Embedded in international system;	Small scale distributed generation; Electricity is used where it is generated; Consumers are relevant for supply and demand balancing;	Regime actors may try to slow down development of distributed generation and local consumption of electricity.	
Tech. and Infra-structure	Central generation with coal or gas; Co-firing coal & biomass; CHP; Dense underground cable network; above ground high voltage network; International connection with high voltage grid; Increase in energy usage due to increased amount of household appliances and computers;	Generation from sustainable sources; Distributed generation;	Incumbent infrastructure is perfect for current situation. Developments caused in part by cooperatives can not be solved by conventional improvements to infrastructure.	Ongoing Implementation and experimentation with smarter electricity infrastructure
User Relations and Markets	Consumer chooses one energy supplier; green and grey energy; limited feedback. Oil market effects electricity prices; CO2 emission rights; green energy certificates. User is passive;	Cooperative as supplier (representative); Cooperative as consumer representative; Strong user relation; Users are active; Market for electricity supply and demand data;	Consumers are limited to a single energy supplier causing energy cooperatives to have to connect to a supplier, which makes the cooperative reliant on that supplier. Or the cooperative can apply for a suppliers license which is often too costly or complicated; Cooperatives use a democratic model, causing decision-making to be slower than what is expected by regime actors.	Cooperatives form a middle ground between businesses and citizens, and are therefore an interesting actor for research institutions and businesses to address; Supply and demand data will become interesting for cooperatives and citizens. This creates a market for data.
Policy and Regulation	Reliable; Affordable; Clean;	Government policy is vague; Local policy is not uniform; Subsidies do not represent policy; Net metering in front of the meter should not be limited;	National policy is very broad and vague, local policies are only slightly influenced by national policy. Different cooperatives are subject to different regulations, making decisions of local government unpredictable; The division of subsidies is seen as unfair and difficult to apply for; Prohibition of net metering in front of the meter causes inequality and creates barriers for renewable energy generation.	
Knowledge Bases	Technical knowldge; Managerial knowledge;	Some cooperatives are populated by volunteers, with little; knowledge on the energy system; Some cooperatives are founded on a wide range of experts;	Technical and managerial knowledge is embedded in industry actors and knowledge institutions. This knowledge is very inaccessible for lay-people in an energy cooperative.	
Cultural, Symbolic Meanings	Since electricity is needed to enjoy other technologies, energy supply is seen as a need instead of a service. This resonates to a feeling of dependency on energy companies.	Energy generation can improve the local economy;		

5.2 Services of energy cooperatives

The second sub-question is: What services are energy cooperatives involved in?

This question was asked in the survey as well as in the case study interviews. The different services mentioned by survey respondents and/or in an interview have been summarised in table 4. Furthermore a look was given at the amount in which these can contribute to an energy transition towards more sustainable and distributed energy generation. After that, the way these services can affect Alliander in the future was assessed.

Table 3 – Observed activities of energy cooperatives; the way these activities can affect Alliander; and the potential these activities have to stimulate a more sustainable and/or distributed energy system

Services	Potential for stimulation of sustainable and/or distributed energy	Reason services can affect Alliander
Information supply	By supplying information on energy savings, renewable resources, and self-generation; will create more support for a transition to a more sustainable energy system.	Alliander is also knowledgeable and able to provide this service.
Electricity supply	Cooperatives supply electricity from renewables.	DSOs need communication with suppliers about supply and demand predictions in order to balance the power on the grid.
Electricity generation	Generation uses renewable sources. Local consumption of locally generated electricity can reduce electricity losses in transport.	Electricity feed-in to the grid needs to be accounted for in the balancing of the power on the grid. The local grid has to be connected to the generation site with suitable cabling.
Supply of generation systems	Stimulates renewable generation and local use of electricity	Buyers of generation systems may have questions/requests regarding the grid connection; If more energy is used where it is generated, energy demand will be reduced.
Collective purchasing of generation system	Stimulates renewable generation and local use of electricity	Buyers of generation systems may have questions/requests regarding the grid connection; If more energy is used where it is generated, energy demand will be reduced.
Assistance in purchase of generation system	Stimulates renewable generation and local use of electricity	Buyers of generation systems may have questions/requests regarding the grid connection; If more energy is used where it is generated, energy demand will be reduced.
Energy savings advice	Stimulates energy saving. (sustainable energy system)	Increased energy savings cause reduction in energy demand.
Energy savings measures	Stimulates energy saving. (sustainable energy system)	Increased energy savings cause reduction in energy demand.
Smart meters	Makes users aware of their energy usage enabling energy savings. provides energy usage data allowing more efficient power distribution	Provide data which allows for more accurate and acute predictions of supply and demand. This can help with power balancing on the grid.
Energy storage	Absorbs the inflexibility of sustainable energy generation systems. (storage of surplus electricity, and generation in scarcity)	Prevents the shutting down of electricity generation when a surplus of electricity exists. Creating a more flexible grid in which power balancing has to be approached in a different way.
Smart grids	More efficient electricity grid, reduction of transportation losses (costs).	Enables smart distribution of electricity, reducing losses due to transportation.
Electric vehicles	Reduce demand for gasoline and diesel (reduce oil dependence). Reduce carbon emissions. Can function as energy storage.	Can cause electricity demand to rise, resulting in higher use of the electricity grid. Can function as energy storage.
Heat supply	Heat supply reduces need for local heat generation using for instance gas.	Little relation. Alliander is not a DSO for heat networks (Liander 2013).
Gas supply	Cooperatives supply renewable bio-gas.	The DSO has to communicate with suppliers regarding supply and demand.
Bio-Gas generation	Renewable source of gas, reducing dependence on natural gas.	Gas feed-in to the grid needs to be accounted for in the management of the transport system. Gas generation has to be

		connected to the current transport system.

The ways these services can affect Alliander are a couple of different kinds.

The first involves services for which collaboration with the cooperative can benefit the DSO by reducing the number of individuals who contact the DSO for information. These include: information supply, energy savings advice, energy savings measures, supply of generation system, collective purchasing of generation system, and assistance in purchase of generation system. These services can affect the DSO in a small way. Energy cooperatives exploiting these services are spreading information that involves information about their DSO. An important way for a DSO to cooperate on these services is to make sure that the cooperatives are spreading information that is true.

Secondly, there are services exploited by cooperatives for which collaboration with Alliander would be beneficial, but this collaboration would merely involve activities that are standard operation for a DSO. These services are: Electricity supply, electricity generation, gas supply, and bio-gas generation.

Third, services that may require a more intimate collaboration to realise a good development of the service. These are: Smart meters, energy storage, smart grids, and electric vehicles. These services have the least predictable outcome for a future energy system, but it is clear that increased adoption of these services will change the way a DSO will operate. This is why these are interesting for a DSO to actively develop together with an energy cooperative.

5.3 Niche-Regime interactions

The third sub-question is: What processes of shielding, nurturing, and empowerment are affecting innovative developments in energy cooperatives?

This question addresses the capabilities of energy cooperatives for development of innovative energy services. The way in which cooperatives as a niche are interacting with the incumbent regime will be illustrated using examples of the three different functions of niches: Shielding, nurturing and empowerment. These examples can give insights into to potential energy cooperatives have to further develop innovative services.

5.3.1 Shielding

Shielding involves those processes that protect an innovative development from being rejected by the socio-technical regime. Shielding processes function to allow projects to get started and allow nurturing to take place.

Regulation

Regulation and policy can be used to actively shield, government programs and policy can fulfil this function on a local or national scale. The survey results suggest energy cooperatives do not experience much regulation shielding, two survey respondents indicate that local / temporary changes in regulations were made for them. Five other respondents somewhat agree with this, but the great majority, 15 respondents indicate this was not done. This seems to show that energy cooperatives are not actively being shielded from certain regulatory limitations. However, addressing shielding processes in regulation during the case studies did reveal some examples:

"*A lot more is allowed when participating in a pilot project, that's why we believe research is so important. We are a group that participates in a lot of research, that is the reason for us being able to try out systems that are not allowed elsewhere."* Interview 1

"We try to get involved in test projects for which government realises a pilot project would need some wiggle room in certain regulations. This is possible in these government test projects." Interview 3

It seems like active regulative shielding processes exist in the form of these government test projects, allowing cooperatives to try out systems that are not allowed to be implemented freely. These are not regulation exempts that are automatically applied or tailored for energy cooperatives specifically, but require some participation effort from the cooperative themselves. Energy cooperatives can thus offer innovative developments shielding from regulatory limitations if the cooperative actively participates in acquiring this protection.

Additionally, some cooperatives enjoy passive shielding due to the policies of local government. Since local energy policy is not directly governed by national policy, cooperatives in different municipalities are affected by different policies. Certain municipalities who have developing sustainable energy projects as a priority provide a much better environment for cooperatives to develop their services.

Financial

Financial pressures from the incumbent regime can be shielded in many different ways. Financial aid, for instance subsidies, can help a project get started by shielding it from high start-up costs. Innovative business models can be set up to gain scale advantages or avoid certain costs.

The survey results show that financial aid is not only strongly sought after. However since many respondents indicate receiving financial aid, this could explain why cooperatives do not invest excessive effort into seeking financial aid. Five cooperatives indicated having received considerable financial support from government sources, and another eight indicate have received some. The remaining nine state not having received financial aid at all. This lack of financial aid from government does not seem to lead to financial problems per se, as only three respondents indicate having a lot of trouble gathering sufficient funds.

During the three case studies financial shielding processes were also discussed. All three cooperatives interviewed have received subsidies and other forms of financial aid.

"*Through the IPIN project we received a subsidy to reduce our costs on investment, so we able to pay energy taxes instead of start-up investments.*" Interview 1

"When you are in such a test project and something goes wrong, Qurrent will feel the consequences instead of our members. When we help them with their research, they take care of our energy taxes for a year." Interview 1

"*The acquisition of funding for projects is a very present barrier" … "investments are usually either small or very large, the moderate sized investments an energy cooperative is looking for are hard to come by. That is why we are so glad the government makes funding available, since government programs are less bound by the size of the investment*." Interview 3

"*Problems are mainly financial, initially I funded from my own pocket but that is not sustainable obviously. It is vital to search for financial means, we were able to get a small sum of money for marketing, and later we were able to get a bigger subsidy. It is still a small amount compared to all the things we need to have, find out, and develop.*" Interview 2

Subsidies and other measures to create more financial security for energy cooperatives seem to be very present. The fact that nearly all investigated cooperatives has experienced some financial shielding allows projects that are not yet financially viable to still come to fruition.

5.3.2 Nurturing

Nurturing processes are important for the further development of an innovation in a niche. This involves the making available of different resources for instance. The SNM framework offers three types of nurturing processes that are important for successful development of an innovative project. In this section a look will be given at the nurturing processes deemed as important by the SNM framework and give insight in the potential of energy cooperatives to develop innovative services.

Articulation of vision

The survey provides a mixed view regarding the articulation of vision. All respondents give a clear vision, but some are much more specific than others. Where some cooperatives (16) filled out "*Generate clean local energy for local use."* others (6) specified clean energy to be for instance a windmill or PV panels. Also 'local use' can be considered a vague term, some respondents elaborated this to be a certain municipality, or other specific area.

The three cooperatives in the case studies each showed different interesting points when examining their articulation of vision. In the case of LochemEnergie the vision was defined very definitively and very specific.

"*LochemEnergie stands for the generation of local energy for and by inhabitants of the Lochem municipality. We do not want to export our energy, and most importantly we want to eventually stop passing on energy from Eneco. For that we will have to start producing more.*" – Interview 1

De Groene Reus also seems to have a clear vision and brings this forward in many different ways.

"*'The energy neutral city' is the slogan we try to express in as many ways as possible.*" Interview 2

"*When translating our ideals for the regular man on the street, we quickly arrived to the level of a solar panels and the benefits they bring.*" – Interview 2

"*If it is possible to be energy neutral on a small scale, then it should be possible to have an energy neutral city, which causes CO2 emissions to be reduced close to zero. That is my main goal the reduction of CO2 emissions.*" – Interview 2

"*Energy neutral is more the abstract mission of the cooperative. The vision that is expressed more is assisting in the reduction of people's energy bills.*" – Interview 2

These different statements elaborate on each other and show that the vision is well grounded. However, the reason the articulation of a specific vision is included in nurturing processes has to do with the different actors involved working towards a common goal, or vision. As is stated in interview 2, the vision of the cooperative is translated to a slogan that is better fitted for 'the man on the street'.

This can be a detriment when trying to develop innovative technologies or services as different members and actors may have different expectations of the cooperative.

TexelEnergie shares this characteristic with De Groene Reus. During interview 3 it was explained that what was important for the founders is not necessarily what's important for the rest of the members.

"*When expressing our vision outwards the independence was more important than the sustainability part. In fact, the 'green' part of TexelEnergie is not important for many inhabitants of Texel, but it is very important to ourselves.*" – Interview 3

"*Our message is fully focussed on Texel. If you read about it, all focus is on Texel. Test projects on Texel, production on Texel, energy supply on Texel."* Interview 3

The message to take from this is that even though cooperatives express a strong vision on what they expect of the future, there exists a tendency to sell this vision in the way that is most compatible with the specific audience. This is not to say any cooperative deviates from its goal, but it is important to acknowledge that different actors can be involved in the cooperative for different reasons and that this could have a delaying effect on the development of innovation.

Building of social networks

The building of social networks is seen as an important process because the social network surrounding an innovative project is indicative of interaction between relevant stakeholders and indicative of the pool from which necessary resources (money, knowledge, people) can be extracted. Furthermore, social networks should be both broad (multiple kinds of stakeholders) and deep (contacts should be able to mobilise commitment and resources within their own organisation and networks) (Schot & Geels 2008).

In the survey participants were asked which actors were involved in both the founding of their cooperative and which were involved in the implementation of services they offered. On average 2.6 different kinds of actors were involved in the founding of the cooperative and 3.1 different actors were involved in the execution of projects. These numbers can not show whether or not energy cooperatives have a broad and deep social network surrounding them. The case studies however, did give valuable insights in the breadth and depth of their social networks.

During the interviews with the different energy cooperatives it became very clear that these organisations consider their social network to be an important part of their endeavour. They see great value in their relations with government, business and other actors.

"*We do not desire to exploit projects on our own. In relation to the province or the municipality it is desired to work together.*" Interview 1

"We have had a lot of contact with overarching organisations for cooperatives, Hieropgewekt and e-decentraal for instance." Interview 2

Most projects were described as collaborations between them and business and/or government. They see the value in these collaborations and are looking to broaden the pool of actor with which to collaborate even further.

"We are involved in national test projects with many partners, Siemens, Capgemini, Alliander en many more." Interview 3

"*In larger projects, Lochemenergie sits around the table with professional actors like Alliander, Mpare, University of Twente, Locamation and others.*" Interview 1

"*We are exploiting sustainable renovation projects with municipality and province. But I do believe we need to get more businesses involved in our projects.*" Interview 1

LochemEnergie was even founded on the idea that the cooperative would provide the vision and opinions of citizens into projects normally developed by government and/or business. This specific positioning of the cooperative was also pronounced by De Groene Reus.

"*Councillor [C] had been communicating with businesses to find ways of increasing the adoption of solar energy in the municipality.*"*...* "*... these two parties were discussing what the citizens were supposed to be thinking and desiring, which [C] did not feel was right."... "[C] Then asked me to investigate if the public of Lochem was interested in getting involved in energy."* Interview 1

"The power of the cooperative, for innovation, is that they are in the middle of a lot of actors. They act as a sort of broker, connecting important actors." Interview 2

More than once it was mentioned that local governments desire representatives of a cooperation to take part in discussions regarding sustainability. This shows that not only do cooperatives value their social network, they are also very much valued by other actors.

"We have been in contact with local government since the beginning. It was a good collaboration, especially in the positioning of the cooperative. Now, five years later, we are presented by local government as being on the top in sustainable energy projects. We are seen as an actor that cannot be done without." Interview 3

The importance of a social network is mentioned several times, cooperatives see this as an important part of their success.

"We started off with twelve people, who were selected on their mind-set, but also on the social network they could bring with them." Interview 3

Depth of social networks can be observed as cooperatives are often invited to be a part of important discussion in government circles. Another compelling example of depth in social networks is the relation between Alliander and TexelEnergie.

"A lot stands or falls with the right contacts. Someone within TexelEnergie knows [P], CEO of Alliander well. An entrepreneur that was member of TexelEnergie at some point had some problems with costs surrounding the replacement of a cable. Those problems were resolved by employing the social network of TexelEnergie and addressing Alliander in a different way, via [P]." Interview 3

It seems that social networks stand at the core of energy cooperatives. The three case studies show that they are actively expanding and maintaining their social networks. Especially the broadness of the social networks surrounding energy cooperatives seems to be very high. This broadness may come from the fact that cooperatives are often founded on the knowledge and connections of its members, many of which have very different backgrounds and thus different kinds of network connections. Not

much can definitively be said about the deepness of the social networks surrounding energy cooperatives. Although there are examples of influence exerted through social network connections, this was not observed as a regularity. All in all the importance of social networks is clearly acknowledged by the energy cooperatives, this means they are likely able to employ their social network to ensure a more successful development of innovative services.

Learning processes

Learning involves many different processes, from the acquisition of knowledge on regulations to the way setbacks are handled and actions undertaken to avoid similar problems in the future. Learning processes are especially likely to contribute to developments in innovations when, besides first-order learning (the accumulation of facts and data), second-order learning (changes in cognitive frames and assumptions) is also present (Schot & Geels 2008).

The survey results indicate cooperatives to be organisations that are keen on learning. Respondents indicated on average 4 topics that have been actively researched by the cooperative. They survey did not reveal any information regarding second-order learning.

The focus on learning and research was also observed in the case studies. The cooperatives are eager to take part in pilot projects and other learning opportunities. LochemEnergie realises they are a source of knowledge for businesses, government, and knowledge institutions and actively make sure that research they participate also leads to useful information for the cooperative.

"*The process of learning things ourselves we find very important. We are happy to collaborate with businesses that approach us, but we want to learn from the experience equally.*" Interview 1

A further interesting development surrounding learning in energy cooperatives is the way cooperatives help each other acquire knowledge. Survey respondent indicate to have turned to other cooperatives and/or overarching organisations in order to acquire needed knowledge.

The two cooperatives investigated in the case studies that have existed the longest, TexelEnergie and LochemEnergie, both express their initial excitement in helping out other starting cooperatives. Both, however, come to the same conclusion, which is that these starting cooperatives are often looking for a quick answer to an issue in their organisation. Both cooperatives seem to have the same ideas on how to handle this.

TexelEnergie used to make their documents, such as statures, available to the public with the intention that this could be used by others to learn and inspire them to make good statures themselves. However, TexelEnergie learned that other organisation almost literally copied their statures, some even selling them to other parties. This caused TexelEnergie to become more closed about their information.

"*This is what I see too often, people who want to tap into our information but are not willing to give anything in return*". Interview 3

The way TexelEnergie handles this now is offering other cooperatives help, but either for financial compensation or if the cooperative shows their willingness to learn.

"*If a cooperative is willing to make the time-investment of visiting Texel, then we are willing to show them around. Cooperatives are full of stubborn people who like to do things themselves, that is one of the reasons they should manage their own situation themselves as much as possible."* – Interview 3

LochemEnergie shares this attitude towards helping other cooperatives, but has a more clearly pronounced way of handling those requests.

"*A cooperative wants to be able to make their own calculations for energy generation. That is why they ask us if they can use our calculation model, but I don't want to carry responsibility for the model so I say no. Instead I offer to visit them and enable them to create their own model.*" Interview 1

These interactions between cooperatives, show potential of second order learning processes. Both LochemEnergie and TexelEnergie attempt to convince start-up cooperatives to not become reliant on first order knowledge, but instead create their own systems based on their own needs. Whether or not this leads to changes in the way the start-up cooperatives involved approach problems in the future is not investigated in this research.

Overarching organisations are viewed in a couple of different ways. Some cooperatives find these organisations to be a welcome source of knowledge, others believe the overarching organisations to be a detriment to their development. However, what can be said with certainty is that these organisations facilitate learning on a larger level than local projects only.

Learning seems to be very present in energy cooperatives. They are active organisations looking to better themselves. However knowledge acquisition seems to be mostly limited to first order learning. Only the interactions between cooperatives indicate some possibilities for second order learning effects, but this cannot be confirmed by this study. Opinions on overarching organisations vary, some believe them to be helpful for first-order learning, others view them as merely providing standardised information that does not really help anyone.

5.3.3 Empowerment

Empowerment processes are those processes that allow niche innovations to become less dependent on shielding and nurturing processes.

The survey results did not reveal much insight in empowerment processes, only the two respondents whose cooperative was founded before 2010 provided examples of empowerment processes. It is possible that the younger cooperatives are still very much developing and are not yet ready to become more independent.

Fit and conform empowerment

Empowerment processes that are categorised as 'fit-and-conform' processes involve those processes that allow niche innovations to become competitive while leaving the incumbent regime unchanged. Both the survey and the case studies provided examples of fit and conform empowerment processes.

The cooperatives that were interviewed in the case studies regularly mentioned having to conform to regulations in order to achieve sustainable projects. They indicate having to have to reorient their initial plans to better fit the current situation.

"It can be hard to inspire people to partake in our vision and ideals. We do not want to use commercials like other energy companies, we are different. We are owned by our members and want to spread only via word of mouth, but that has proven to be difficult." Interview 1

"*We have had to reorient our policy and vision many times in order to adapt problems we were facing*." Interview 3

The services developed by cooperatives have been influenced by the regulations on net metering. In interview 2 it is explicitly mentioned that the fact that the business plan for solar generation on public buildings follows the current regulations.

"*In the Municipality we are currently placing solar panels, we employ net metering after the meter which is permitted by regulations, and provide the solar energy to the gymnasium*." Interview 2

What this implies is that the business plan for these solar panels deployed on public places has been developed to fit into current regulations.

Another type of fit and conform empowerment relates to the financial side of the cooperative. Survey respondents and cooperatives in the case studies indicate completing more financially profitable projects first. These profits can then be used to support other projects that may need some additional funding in order to become viable.

"*In 1991 we were building our first turbine. Which was relatively easy back then. This gave the cooperative a source of income, which was an essential first step. Al profits were reinvested which led to more turbines. It was not until 2002 that we hired our first employee and started getting more fixed costs.*" Survey

"*At the moment we are focussing on the sales of solar panels, that is our source of revenues. People who buy panels through De Groene Reus, get a free membership for the cooperative for a year. This will allow us to provide solar energy and energy saving services in the future*." Interview 2

"*The purchasing of energy generates revenues for us. This income can then be used to start different projects. We have had to be patient, but it worked out in the end*." Interview 3

Steady income generated by business models that fit well into the existing market is used in order to develop more novel projects without the need for subsidies or other external funding. Thus, by conforming to the incumbent market the cooperatives are able to become more independent.

Stretch and reform empowerment

Empowerment processes that stretch and reform the incumbent regime involve activities that cooperatives undertake in order to change certain aspects of the regime. These changes in the regime should allow cooperatives to be more successful in exploiting their business plans.

LochemEnergie shows that they are very active in trying to change regime regulations. Members and contacts of LochemEnergie have participated in official deliberations to make changes to the incumbent energy law. Some of these changes are directly addressing problems faced by energy cooperatives.

"*The energy agreement by SER, indirectly we have someone representing us. Not under the name of LochemEnergie but via the VNG (Association of Dutch Municipalities). It is involved in one of the workgroups there and has pleaded in favour of cooperatives multiple times."* Interview 1

"*Energy cooperatives will get a separate status. If we are going to generate energy outside of our own house, generating collectively in before the meter, then our energy taxes for that should be reduced. It seems like this will be implemented in the new energy agreement*." Interview 1

TexelEnergie has also pronounced their activity in trying to change regulations and policy.

"I believe it is important to lobby in The Hague. We join discussions about sustainable energy where the aim is to make national changes." Interview 3

But also local government is influenced by cooperatives. When TexelEnergie became interested in building bio-fermentation facilities to generate energy, the local government initially did not support this project. TexelEnergie then rallied the local farming community to generate a larger support base for the project. This caused the local government to be persuaded into allowing the project.

"Another project currently running is bio fermentation, that has had to go through a big process regarding politics. Local government did not want us to start this project; until we created support by approaching local farmers." Interview 3

Cooperatives are active in the reformation of perceived regime limitations. Here it is important to think about the reasons for certain regulations to be specifically fitted for energy cooperatives. As stated by Smith & Raven (2012), this niche empowerment can be problematic when forms of protection are institutionalised instead of removing redundant protections. This means the active seeking of cooperatives for more 'fair' regulations regarding energy taxes may result in protectionism of cooperatives.

Cooperatives are able to fulfil all three niche functions. Tables 4, 5 and 6 display the most important ways in which these functions effect the development of services.

Table 4 – Shielding processes and effects on innovative development

Process	Shielding Type	Effect on service development
Participation in government test programs	Active Shielding	Services that would otherwise be prohibited by regulation can be experimented with when participating.
Geographic location of cooperative / local energy policy	Passive Shielding	Cooperatives in certain municipalities will develop services more easily.
Subsidies	Active shielding	Subsidies makes experimenting with financially uncertain services more viable.

Table 5 – Nurturing processes and effects on innovative development

Nurturing process	Characteristics of Cooperatives	Effect on service development
Specific vision shared by project partners	Vision is usually expresses in a specific way; Articulation of vision can differ when expressing it to different actors;	Specific vision helps project development in the desired direction. Different actors with different views on the project can limit smooth development.
Broad and deep social network	Social networks are broad; Examples of deep social network relations can be found; Cooperatives view social networks as essential, and are active in improving them;	Broad and deep social networks help cooperatives raise support and acquire needed resources for developing services more successfully.
First and second order learning	Learning and research are central subjects in energy cooperatives; First order learning processes are very present;	Learning processes between cooperatives and activities of overarching organisations can help niche wide learning. This

	Second order learning exists in a smaller way; Cooperatives learn from each other, additionally overarching organisation try to facilitate niche wide learning.	contributes to more efficient development.

Table 6 – empowerment processes and effects on innovative development

Empowerment process	Type of empowerment	Effect on service development
Adapt business plans to fit to regulations	Fit and conform	Innovative services can be practised under regular circumstances. Proving viability and inspiring further development.
Exploit profitable projects first, then profits can be used to back up more risky projects.	Fit and conform	Innovative services can be experimented with without having to worry much about financial success. Value of the services can be proven, thus creating more support.
Activate farming community to create support and change local policy	Stretch and reform	Changes in local policy makes future local projects more viable. Additionally it can function as an example for other municipal governments.
Partake in deliberations regarding national energy policy	Stretch and reform	Changes in national policy is beneficial for all similar projects, now and in the future.

5.4 Energy cooperatives' vision on further facilitation

This section will address the last sub-question:

How do energy cooperatives desire to be facilitated further?

Firstly, responses cooperatives have given to the question of how they wish to be facilitated in the future will be presented. Further insights will be given by investigating the vision cooperatives have for a future system, and how they see their relationship with a DSO now and in the future.

5.4.1 Desired facilitation

Recurring subjects in which facilitation is desired revealed by the survey are financial support, access to knowledge and support and cooperation from government and business and, changes in energy policy. Cooperatives feel these subjects are important for them to be able to better experiment with their business models.

The most mentioned facilitation that is desired is financial in nature. Many cooperatives are still having trouble getting enough funding to make projects viable. The desire for better regulations for instance regarding energy taxes and virtual net metering go alongside financial assistance.

Besides the need for changes to make projects more financially competitive, the current stance of government and businesses towards cooperatives is seen as a detriment. The desire exists for government and business to start taking cooperatives serious, create a clear national policy, and start cooperating instead of competing with the energy cooperatives.

Furthermore knowledge is seen as an important factor in the success of a cooperative. Opinions on sharing knowledge differ however. On the one side, cooperatives who desire to learn from the further developed cooperatives. These cooperatives are often dissatisfied by the fact that they have to acquire a lot of plain information. They feel like this information should be more readily available since so many cooperatives before them have already done this research. The other side consists of cooperatives who do not believe a strong roll for knowledge sharing platforms such as the overarching organisations exists. They believe the acquisition of social network contacts that go along with the search for required knowledge is much more valuable than the information itself. On top of that there exists a strong view that most cooperatives are very different from one another, therefore standardised information would not be as effective as desired. In interview 2 an idea is coined that would provide standardised information but at the same time bring cooperatives in contact with valuable actors.

"A small cooperative tries her hardest to understand everything, but some help is required for that. Energy College in which the structure of the energy world, regulations, threats and opportunities are covered in a couple of days." Interview 2

Desire for facilitation and support is very present. A few times it is mentioned that a cooperative wants to be left to their business and not be hindered by interferences. But the major consensus is that support is definitely needed in one way or another.

5.4.2 DSO relation

Survey respondents are very neutral in the rating of the relation with the DSO. Further open ended questions reveal that most cooperatives have little communication or even knowledge about the DSOs. De Groene Reus expresses an opinion similar to the respondents of the cooperatives.

"I do not feel like Liander finds us very interesting, and I do not find them very interesting yet. Things we ask of them are always possible so Liander takes care of it. Those are standard services, business as usual." Interview 2

The one thing some respondents of the survey do ask for is better communication. The DSO seems to only communicate by offering what they can do, cooperatives feel the communication could benefit if the DSO takes more time to ask the cooperatives individually what they desire.

5.4.3 Division of services

Cooperatives realise that the activities they are involved in are relevant for the DSO. The cooperatives interviewed in the case studies expressed their awareness of the uncertainty of the future roles of cooperatives and DSOs.

"*[The border between DSO responsibilities and cooperatives] is a question we are struggling with at the moment."* Interview 1

They also believe it is important for DSOs to become more active in figuring out how different services regarding distributed generation should be divided.

"A DSO should think and act as soon as possible. They should approach cooperatives and discuss the plans and expectations. The conversation on how we can help each other is still lacking." Interview 2

The survey asked participants to indicate which services were better of performed by the cooperative and which services were viewed as better handled by the DSO. These results can be grouped into three categories: Services that should be handled by the cooperative only, Services that should be handled by the DSO only, and services for which cooperative and DSO should work together. Figure 15 shows the grouped services with the survey results. Each group of services will be further discussed.

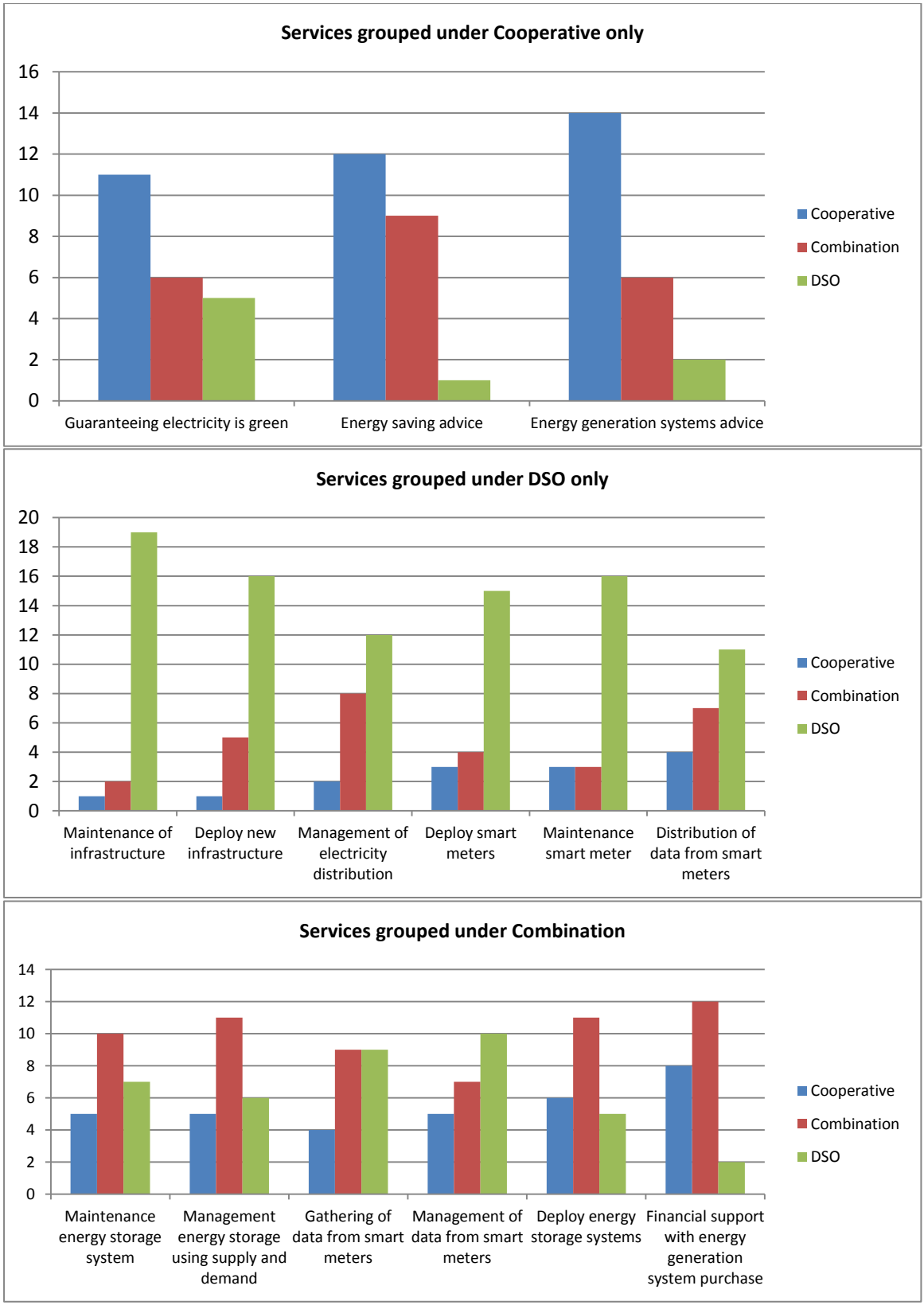

Figure 3 - Number of responses indicating which party should be responsible for which service in the future

Cooperative only

Services that survey participants indicated to be best suited to be exploited by the cooperative only are advice services regarding a sustainable energy system. Following the survey results, advice on savings measures, advice on purchasing local energy generation systems, and guaranteeing electricity is green are found to be best performed by the cooperative only. Common factor in these services is the fact that they are all about the promotion of sustainability. Furthermore, they all involve direct communication with the consumers. Even though DSOs are seen as knowledgeable and reliable actors, cooperative would rather perform these services by themselves. There can be a number of possible reasons for this, an interesting reason has to do with trust and privacy. During the interview with LochemEnergie the following was said:

"I think a DSO should let cooperatives be responsible for savings advice and supply and demand data. It does not inspire much faith if the DSO knows that much about the consumers. But if LochemEnergie knows all this, which we are ourselves, that is our own organisation which we do trust." Interview 1

These trust and privacy issues may have to do with the differences in guiding principles between cooperatives and DSOs. Cooperatives are clearly guided by sustainability, whereas regime actors are not perceived to do so. This means that when the DSO is seen as a regime actor, cooperatives believe they do not have the sustainability aspect as their main priority.

DSO only

Services cooperatives see as best reserved for the DSO to can be divided into two groups. The first group consists of the tasks that are already performed by DSOs. These are: the maintenance of infrastructure, the deployment of new infrastructure, and the management of electricity distribution. The second group are all services concerning smart meters with the exception of the gathering and management of the data from smart meters: The deployment of smart meters, the maintenance of smart meter, and distribution of data from smart meters.

The survey shows that the responding cooperatives are not interested in taking over services that have traditionally been performed by DSOs. These are tasks that require very specific knowledge of the energy system and may therefore be too much for cooperatives to handle. During the case studies, this view was confirmed.

"*Strictly seeing, Liander has the task of managing infrastructure and transport, and the measuring of energy. The rest is not as important.*" Interview 1

"Maintaining reliability of the net really is an inherent task of the DSO." Interview 3

One slightly opposing remark was made during the interview with TexelEnergie:

"It depends on the kind of people that are running the cooperative. In some cases it would be possible for Liander to hand over control of the network. If they support that with sufficient people, knowledge and resources they can figure out a good model. But I think there are only a few cooperatives that could handle such a task." Interview 3

Even though TexelEnergie believes certain cooperatives are able to handle the traditional DSO tasks, the need for specific knowledge and resources is recognised. For this reason it still seems unlikely that cooperatives will exploit these services in the future.

The division on smart meter services show some interesting results. Two of the five smart meter services are clearly preferred to be done by the DSO. The other three are a little more ambiguous. A majority of the answers still prefer the DSO as responsible for these services, but the number of answers for DSO is less than half of the total answers. Furthermore, these three services are about the data from smart meters while the other two are about the hardware.

It seems logical to have the DSO be responsible for the hardware services since they are also similar to the core DSO services. DSOs are already owners of the energy meters in the houses of consumers, therefore it could make sense that they would also be responsible for smart meters in homes.

Data gathering is also already a DSO activity, therefore this might also be a good service for them to exploit. This feeling was also expressed in a case study.

"[The DSOs] have a good position regarding the distribution of data. They already collect a lot of data, including data that only they can generate." Interview 3

However the survey respondents do feel that cooperatives should also be partly responsible for data services regarding smart meters. This may once again have to do with lack of trust in the DSO as a regime actor. Furthermore, the smart meter data services can be divided one more time. The distribution of data service was filled out by exactly half of the responding cooperatives as mostly suitable for the DSO only. This service is different from the other two as it does not involve the DSO gaining knowledge on consumers. Therefore the distribution of data is seen as probable for a DSO service while the gathering and management of smart meter data are more preferred to be exploited by the DSO and cooperation together.

It seems like cooperatives prefer the DSO to exploit services that are already closely related to the core competencies of the DSO. Furthermore, cooperatives prefer to take part in services when consumer rights, like privacy, are involved.

Combination

The remaining services are indicated to be best exploited by a combination of the DSO and the cooperative. In other words, these are services with which cooperatives want to collaborate with the DSO. Three different groups of services can be distinguished. Firstly services that have to do with energy storage: Deployment of energy storage systems, maintenance energy storage systems, and management of energy storage using supply and demand. Secondly, the privacy sensitive smart meter data services: Gathering data from smart meters, and management of data from smart meters. And lastly financial support for energy generation systems.

Energy storage is the only technology for which the survey respondents desire a collaboration between DSO and cooperative for all the activities involved. The reason for this is unclear, especially since the cooperatives in the case studies seem to think that the maintenance and deployment of energy storage hardware should not be under the tasks of the cooperative:

"*I would like to do a project regarding energy storage, provided a university or business gives us batteries with which to try things out. Large batteries to ease the day/night cycle, and electric mobility would also be a part of that.*" Interview 1

"I believe the scope of the cooperative should be as large as possible, but commons goods such as transformers or local energy storage should be facilitated by of the DSO. The cooperative can then be a guide for the DSO." Interview 2

Furthermore none of the survey respondents elaborated on energy storage in any of the open ended questions. It is possible that cooperatives see the possible benefits of energy storage and want to be a part of that innovation, but the newness and lack of knowledge about energy storage causes them to believe they need the DSO to effectively pursuit the innovation.

The issue of smart meter data services have already been addressed in the DSO only section. To reiterate, smart meter services are seen as fitting for the DSO as they are related to the core competencies of the DSO. However, when consumer rights like privacy are involved, cooperatives could play a role since the cooperative is trusted more than the DSO.

The results for the financial support for energy generation system purchase are a little different than the other services in this group. Most survey respondents see this services as best exploited by a combination of DSO and cooperative. What is different is that the amount of answers for cooperative only is also substantial while only two answers for DSO only were given. Perhaps this is because the description of the service is ambiguous. It could involve many different kinds of services, from collective purchasing benefits to money injections. Another problem with this question is made clear by LochemEnergie:

"*Financial services are a responsibility of the DSO, but even more for the province. The province is a revolving fund from which we can lend, but the interest on that is still rather high, we pay 8% interest on those loans*." Interview 1

So besides many different possible services that could be interpreted under this question, it is a service that is very probable to be performed by actors besides the cooperative and the DSO.

In conclusion, cooperatives see the most potential for collaboration in services that are very new, such as energy storage. Cooperatives are very interested in exploring these innovative systems, but often require specific knowledge or other resources from another party. The DSO seems to be able to facilitate this interest. Other services in which cooperatives see a collaboration between DSO and cooperative as most desirable, are services that seem logical to be exploited by the DSO but require trust from consumers. Cooperatives believe they can handle the services in which these trust issues arise and collaborate with the DSO to further process and distribute the results. These role divisions are displayed in table 7.

Table 7 – Envisioned roles for cooperatives and DSOs for different energy services

Service	Envisioned Role Cooperative	Envisioned Role DSO
Guarantee Electricity is green; Energy savings advice; and Energy generation systems advice;	Provide service.	Leave services that require direct user communication to the Cooperatives
Deployment and maintenance of electricity infrastructure; Management of electricity distribution;	Leave services traditionally performed by DSOs to the DSOs.	Provide service.
Deployment and maintenance of smart meters;	Leave services regarding hardware to the DSO.	Provide service.
Gathering, management, and distribution of smart meter data.	Collect and anonymise user data from members;	Manage and distribute anonymised data from cooperative
Deployment, maintenance and management of energy storage systems	Provide participants and feedback;	Provide knowledge and resources;
Financial support for energy generation systems	Provide collective purchasing services;	Leave these services for cooperatives or other actors.

6. Conclusions

This chapter will take the information from the analysis chapter and combine the results to answer the main research question of this study. After that the uses and limitations of this study will be discussed and recommendations for Alliander will be made.

6.1 Research questions

The main research question of this study is:

How can Alliander contribute to the energy transition by facilitating innovation in the niche of energy cooperatives?

Four sub-questions were devised to help in answering the main research question. These four sub-questions have been addressed in chapters 5.1 - 5.4. These results will be concisely iterated below before addressing the main research question.

a. **In what way do energy cooperatives deviate from the incumbent electricity regime in The Netherlands?**

Table 8 shows a comprehensive overview of the answer to this question. The most important results this question revealed are the different barriers and opportunities for the development of innovative services.

The most important barriers are due to differences in guiding principles, industry structure, and policies cause projects in energy cooperatives to be developed at a slower rate or even halted. This is due to miscommunication and differing priorities.

Table 8 – Barriers and Opportunities found by regime dimension comparison

Regimedimension	Characteristics of the incumbent Regime	Characteristics of Cooperatives	Barriers	Opportunities
Guiding Principles	Efficiency; Reliability;	Sustainability; Self-sufficiency;	Conflicts of interests when cooperating with regime actors can cause projects to develop slower than expected.	The focus of DSOs on a changing energy system shows that the DSO is a good actor for cooperatives to cooperate with
Industry Structure	Mostly Central generation and industrial CHP; one actor (Tennet) governs the high voltage network; seven DSOs govern the lower voltage networks; Tennet, DSOs, and energy supply companies work together to balance energy supply and demand; Embedded in international system;	Small scale distributed generation; Electricity is used where it is generated; Consumers are relevant for supply and demand balancing;	Regime actors may try to slow down development of distributed generation and local consumption of electricity.	
Tech. and Infra-structure	Central generation with coal or gas; Co-firing coal & biomass; CHP; Dense underground cable network; above ground high voltage network; International connection with high voltage grid; Increase in energy usage due to increased amount of household appliances and computers;	Generation from sustainable sources; Distributed generation;	Incumbent infrastructure is perfect for current situation. Developments caused in part by cooperatives can not be solved by conventional improvements to infrastructure.	Ongoing Implementation and experimentation with smarter electricity infrastructure
User Relations and Markets	Consumer chooses one energy supplier; green and grey energy; limited feedback. Oil market effects electricity prices; CO2 emission rights; green energy certificates. User is passive;	Cooperative as supplier (representative); Cooperative as consumer representative; Strong user relation; Users are active; Market for electricity supply and demand data;	Consumers are limited to a single energy supplier causing energy cooperatives to have to connect to a supplier, which makes the cooperative reliant on that supplier. Or the cooperative can apply for a suppliers license which is often too costly or complicated; Cooperatives use a democratic model, causing decision-making to be slower than what is expected by regime actors.	Cooperatives form a middle ground between businesses and citizens, and are therefore an interesting actor for research institutions and businesses to address; Supply and demand data will become interesting for cooperatives and citizens. This creates a market for data.
Policy and Regulation	Reliable; Affordable; Clean;	Government policy is vague; Local policy is not uniform; Subsidies do not represent policy; Net metering in front of the meter should not be limited;	National policy is very broad and vague, local policies are only slightly influenced by national policy. Different cooperatives are subject to different regulations, making decisions of local government unpredictable; The division of subsidies is seen as unfair and difficult to apply for; Prohibition of net metering in front of the meter causes inequality and creates barriers for renewable energy generation.	
Knowledge Bases	Technical knowldge; Managerial knowledge;	Some cooperatives are populated by volunteers, with little; knowledge on the energy system; Some cooperatives are founded on a wide range of experts;	Technical and managerial knowledge is embedded in industry actors and knowledge institutions. This knowledge is very inaccessible for lay-people in an energy cooperative.	
Cultural, Symbolic Meanings	Since electricity is needed to enjoy other technologies, energy supply is seen as a need instead of a service. This resonates to a feeling of dependency on energy companies.	Energy generation can improve the local economy;		

b. What services do energy cooperatives undertake?

Table 9 shows the different services cooperatives undertake. Most activities are relevant for transition to a more sustainable and distributed energy system. The different services show different potential for collaboration between DSO and cooperative.

Table 9 – Observed activities of energy cooperatives; the way these activities can affect Alliander; and the potential these activities have to stimulate a more sustainable and/or distributed energy system

Services	Potential for stimulation of sustainable and/or distributed energy	Reason services can affect Alliander
Information supply	By supplying information on energy savings, renewable resources, and self-generation; will create more support for a transition to a more sustainable energy system.	Alliander is also knowledgeable and able to provide this service.
Electricity supply	Cooperatives supply electricity from renewables.	DSOs need communication with suppliers about supply and demand predictions in order to balance the power on the grid.
Electricity generation	Generation uses renewable sources. Local consumption of locally generated electricity can reduce electricity losses in transport.	Electricity feed-in to the grid needs to be accounted for in the balancing of the power on the grid. The local grid has to be connected to the generation site with suitable cabling.
Supply of generation systems	Stimulates renewable generation and local use of electricity	Buyers of generation systems may have questions/requests regarding the grid connection; If more energy is used where it is generated, energy demand will be reduced.
Collective purchasing of generation system	Stimulates renewable generation and local use of electricity	Buyers of generation systems may have questions/requests regarding the grid connection; If more energy is used where it is generated, energy demand will be reduced.
Assistance in purchase of generation system	Stimulates renewable generation and local use of electricity	Buyers of generation systems may have questions/requests regarding the grid connection; If more energy is used where it is generated, energy demand will be reduced.
Energy savings advice	Stimulates energy saving. (sustainable energy system)	Increased energy savings cause reduction in energy demand.
Energy savings measures	Stimulates energy saving. (sustainable energy system)	Increased energy savings cause reduction in energy demand.
Smart meters	Makes users aware of their energy usage enabling energy savings. provides energy usage data allowing more efficient power distribution	Provide data which allows for more accurate and acute predictions of supply and demand. This can help with power balancing on the grid.
Energy storage	Absorbs the inflexibility of sustainable energy generation systems. (storage of surplus electricity, and generation in scarcity)	Prevents the shutting down of electricity generation when a surplus of electricity exists. Creating a more flexible grid in which power balancing has to be approached in a different way.
Smart grids	More efficient electricity grid, reduction of transportation losses (costs).	Enables smart distribution of electricity, reducing losses due to transportation.
Electric vehicles	Reduce demand for gasoline and diesel (reduce oil dependence). Reduce carbon emissions. Can function as energy storage.	Can cause electricity demand to rise, resulting in higher use of the electricity grid. Can function as energy storage.
Heat supply	Heat supply reduces need for local heat generation using for instance gas.	Little relation. Alliander is not a DSO for heat networks (Liander 2013).
Gas supply	Cooperatives supply renewable bio-gas.	The DSO has to communicate with suppliers regarding supply and demand.
Bio-Gas generation	Renewable source of gas, reducing dependence on natural gas.	Gas feed-in to the grid needs to be accounted for in the management of the transport system. Gas generation has to be connected to the current transport system.

c. What processes of shielding, nurturing, and empowerment are affecting innovative developments in energy cooperatives?

Energy cooperatives actively pursue both regulatory and financial *shielding*, this means cooperatives as a niche can minimise limitations for innovative development. Furthermore, cooperatives express their *vision* in a specific way, employ *Social networks* to gather resources and raise support for innovative activities, and spend a lot of time *learning* about relevant topics. These characteristics are indicative of a good environment for developing innovations.

Lastly, processes of *empowerment* are mostly of the fit and conform kind. This means that cooperatives have trouble overcoming limitations imposed by the incumbent regime, and mostly choose to avoid problems by adapting to the regime. This could mean that innovations would also be adapted to better complement the incumbent regime. Table 10, 11 and 12 give an overview of the different processes mentioned.

Table 10 – Shielding processes and effects on innovative development

Process	Shielding Type	Effect on service development
Participation in government test programs	Active Shielding	Services that would otherwise be prohibited by regulation can be experimented with when participating.
Geographic location of cooperative / local energy policy	Passive Shielding	Cooperatives in certain municipalities will develop services more easily.
Subsidies	Active shielding	Subsidies makes experimenting with financially uncertain services more viable.

Table 11 – Nurturing processes and effects on innovative development

Nurturing process	Characteristics of Cooperatives	Effect on service development
Specific vision shared by project partners	Vision is usually expresses in a specific way; Articulation of vision can differ when expressing it to different actors;	Specific vision helps project development in the desired direction. Different actors with different views on the project can limit smooth development.
Broad and deep social network	Social networks are broad; Examples of deep social network relations can be found; Cooperatives view social networks as essential, and are active in improving them;	Broad and deep social networks help cooperatives raise support and acquire needed resources for developing services more successfully.
First and second order learning	Learning and research are central subjects in energy cooperatives; First order learning processes are very present; Second order learning exists in a smaller way; Cooperatives learn from each other, additionally overarching organisation try to facilitate niche wide learning.	Learning processes between cooperatives and activities of overarching organisations can help niche wide learning. This contributes to more efficient development.

Table 12 – empowerment processes and effects on innovative development

Empowerment process	Type of empowerment	Effect on service development
Adapt business plans to fit to regulations	Fit and conform	Innovative services can be practised under regular circumstances. Proving viability and inspiring further development.
Exploit profitable projects first, then profits can be used to back up more risky projects.	Fit and conform	Innovative services can be experimented with without having to worry much about financial success. Value of the services can be proven, thus creating more support.
Activate farming community to create support and change local policy	Stretch and reform	Changes in local policy makes future local projects more viable. Additionally it can function as an example for other municipal governments.
Partake in deliberations regarding national energy policy	Stretch and reform	Changes in national policy is beneficial for all similar projects, now and in the future.

d. How do energy cooperatives desire to be facilitated further?

Cooperatives mostly desire more facilitation in three areas: Financial facilitation, access to knowledge about the energy system, and to be taken more serious as an actor on the energy market. Currently, the majority of energy cooperatives do not feel their DSO is facilitating them in these areas, but at the same time feel like the DSO should stick to their core business.

Services cooperatives believe are best exploited by a collaboration between DSO and cooperative are services that either involve a close relationship with users, or innovations that require both experimentation within an active community, and specific knowledge and other resources. The services in which collaboration is envisioned the most are related to smart meter data and energy storage systems. The envisioned roles for cooperatives and DSOs are displayed in table 13.

Table 13 – Envisioned roles for cooperatives and DSOs for different energy services

Service	Envisioned Role Cooperative	Envisioned Role DSO
Guarantee Electricity is green; Energy savings advice; and Energy generation systems advice;	Provide service.	Leave services that require direct user communication to the Cooperatives
Deployment and maintenance of electricity infrastructure; Management of electricity distribution;	Leave services traditionally performed by DSOs to the DSOs.	Provide service.
Deployment and maintenance of smart meters;	Leave services regarding hardware to the DSO.	Provide service.
Gathering, management, and distribution of smart meter data.	Collect and anonymise user data from members;	Manage and distribute anonymised data from cooperative
Deployment, maintenance and management of energy storage systems	Provide participants and feedback;	Provide knowledge and resources;
Financial support for energy generation systems	Provide collective purchasing services;	Leave these services for cooperatives or other actors.

6.2 Recommendations

This leads us back to the main research question of this study:

How can Alliander contribute to the energy transition by facilitating innovation in the niche of energy cooperatives?

Since (a) The most prevalent barriers seem to be related to communication, (b) cooperatives are active in various services in which a DSO can collaborate, (c) cooperatives are a good environment for developing innovation, and (d) cooperative require more facilitation in finances, knowledge, and positioning in the energy market; the following recommendations can be made for Alliander:

1. **Reduce barriers the energy regime imposes on the development of services in energy cooperatives.**

Regime barriers arise mostly due to differing of expectations and priorities. Differing guiding principles can make it hard for cooperatives to work together with regime actors since differing parties expect different results from a project. Furthermore, the democratic nature of energy cooperatives leads to slower decision-making than is expected of them by regime actors. A solution for these barriers is for cooperatives and regime actors to thoroughly and specifically communicate what they expect from each other. This communication is also recommended when looking to improve the innovation nurturing function of the cooperative as a niche. This will improve the position of energy cooperatives on the energy market.

2. **Facilitate expert knowledge which is difficult for lay people to access**

Cooperatives are often run by volunteers who do not have a strong connection to the energy industry. The knowledge that is important for developing energy services can be tough to access for these volunteers. The DSO is viewed as a knowledgeable actor in the energy industry and can help cooperatives develop their services more effectively.

3. **Experiment with development of services by engaging in collaborative projects.**

Innovative activity in energy cooperatives have the potential to inspire changes in the Dutch energy system. It is in the DSO's best interest to be fully aware of innovative energy services such as those offered by energy cooperatives. For both parties to efficiently learn about innovations in the energy industry is to get involved in experimentation. Cooperatives have the ambition and the support from members to be able to perform these experiments. However, as the cooperatives indicate themselves, they often lack in knowledge, finances and other resources. A mutually beneficial collaboration would be for the DSO to engage in niche experiments with energy cooperatives by facilitating these resources.

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Appendix I: Digital Survey results

The survey was split in three parts, the description of the results is also divided in these three parts: The cooperative, Innovations, and The DSO.

The cooperative

The questions in this section ask about simple information on the cooperative, and the process and idea behind the founding of the cooperative. 22 different cooperatives responded to the survey. Twenty of them were founded in 2010 or later, but the other two were founded in 1989 and 1985.

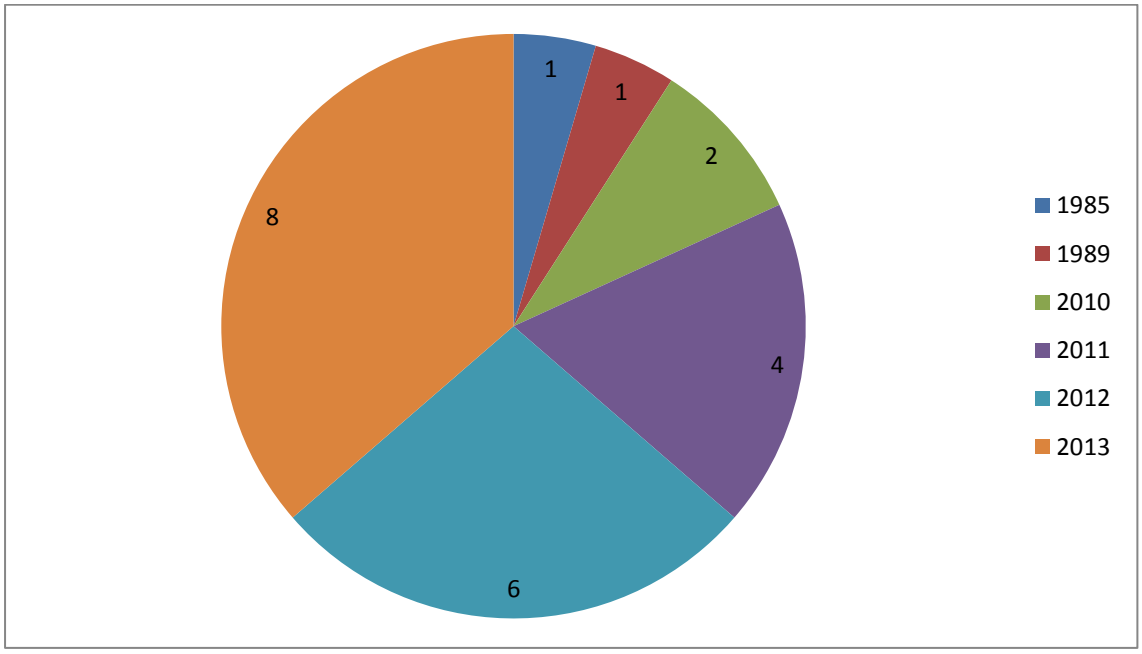


Figure 1 – Years in which responding cooperatives were founded

The results show that nearly all (21 out of 22) energy cooperatives that responded, were initiated by citizens. Three of these cooperatives indicated the initiative raised in collaboration with a municipality or business. One cooperative was initiated solely by a business actor.
After the initiative, all cooperatives indicated collaborating with other parties before founding the cooperative. All respondents involved citizens during the founding process and 19 included at least one more party.

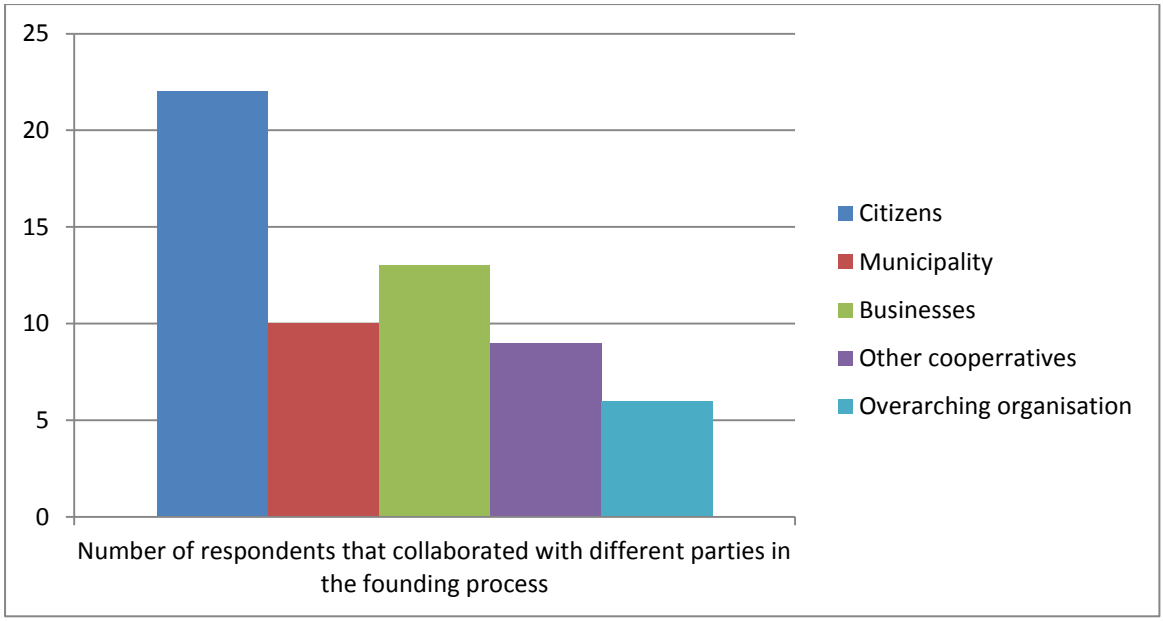


Figure 2 - Parties involved in the founding process of cooperatives

Half of the respondents indicated not having encountered problems in the process of founding the cooperatives. However this means that the other half did encounter problems. Problems indicated (Figure 3) were provided as an option in the survey except for the time investment problem, which was brought forth by three cooperatives.

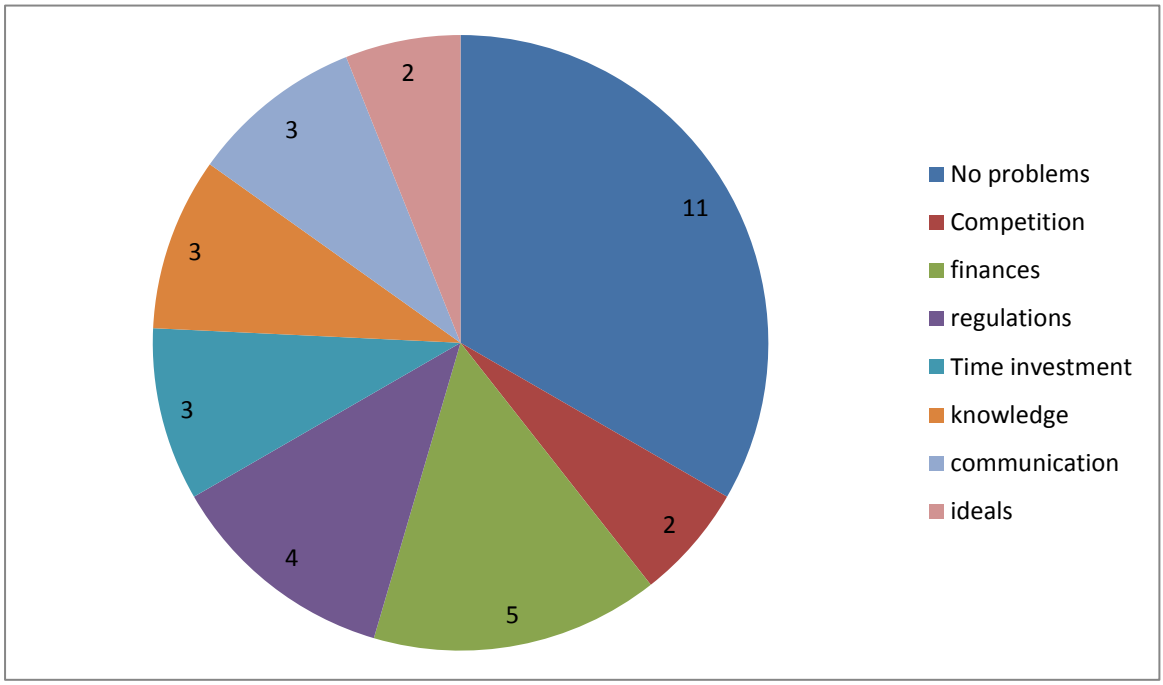


Figure 3 – Number of respondents that encountered different problems during the process of founding the cooperative

Respondents were asked to elaborate on the problems during the founding process, several responses and the type of barriers they describe are shown in table 1.

Quote	Barriers
"Due to competition with the 'large scale market' and the inability of local as well as national government to clearly give direction, decentralized energy projects such as energy savings and generation can be considered laborious."	Competition, regulation
"*With regard to competition: Local government has created a similar initiative to ours , although now there is talk of a fusion, and interferes by organizing separate activities regarding sustainability. Enexis (a DSO) is also organizing meetings for environmentally minded citizens, but with their own agenda in mind. This makes the whole situation rather confusing for citizens."*	Competition, communication
"Current regulations are not compliant with the sustainable ambitions of local as well as national government."	Regulation
"Volunteers learn pretty quick, but find it hard to make the mind switch towards being part of a business as opposed to a friendly green organization."	Ideals
"A cooperative is usually not founded with profit in mind, startup funds are needed and funds exist that are meant for initiatives like these. Still, these funds are quite hard to actually acquire. There is a belief that large energy companies lobby to slow down the process of new parties acquiring those funds."	Ideals, Finances, (competition)
"*Besides regulations being one step behind the developments, the energy world and its regulations are very knowledge intensive. This together with the fact that cooperatives are still a very new concept to a lot of people, makes it tough for cooperatives to get enough support."*	Regulations, knowledge, communication
"Citizens, goodhearted volunteers, have limited time available. During early phases this does not cause many problems; but when projects need to get fully designed, the lack of time an knowledge become large barriers that have to be overcome."	Knowledge, lack of time

Table 1 – description of barriers during the founding process

To investigate what kinds of information are important to cooperatives, how much external help they require for this, and where this external help is mostly found, questions were asked about the gathering of knowledge in the early phases of the cooperative. When asked about the amount of effort needed to acquire additional knowledge, none of the respondents claimed to find it very difficult. Only three responded with an answer above intermediate (see figure 4).

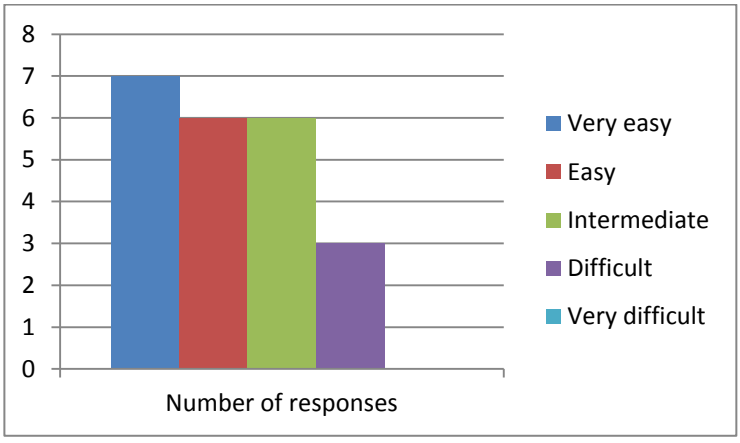


Figure 4 – difficulty of gathering needed knowledge in the early phases of the cooperative.

The sources which the respondents indicated to rely the most on for knowledge can be seen in figure 5. Internal knowledge is an important source of knowledge for most respondents, all cooperatives used it in some way and 14 cooperatives marked internal knowledge as 5 out of 5 for importance. "Other cooperatives" were pointed out to be an important knowledge source as well with 14 respondents scoring it as 4 out of 5 or higher. A mixed result was obtained for literature as a source of knowledge, an almost equal amount of respondents found it important as those who did not rely on it much. Overarching organizations were considered important by 5 respondents, and consultants were deemed the least useful with 15 respondents not having used them at all.

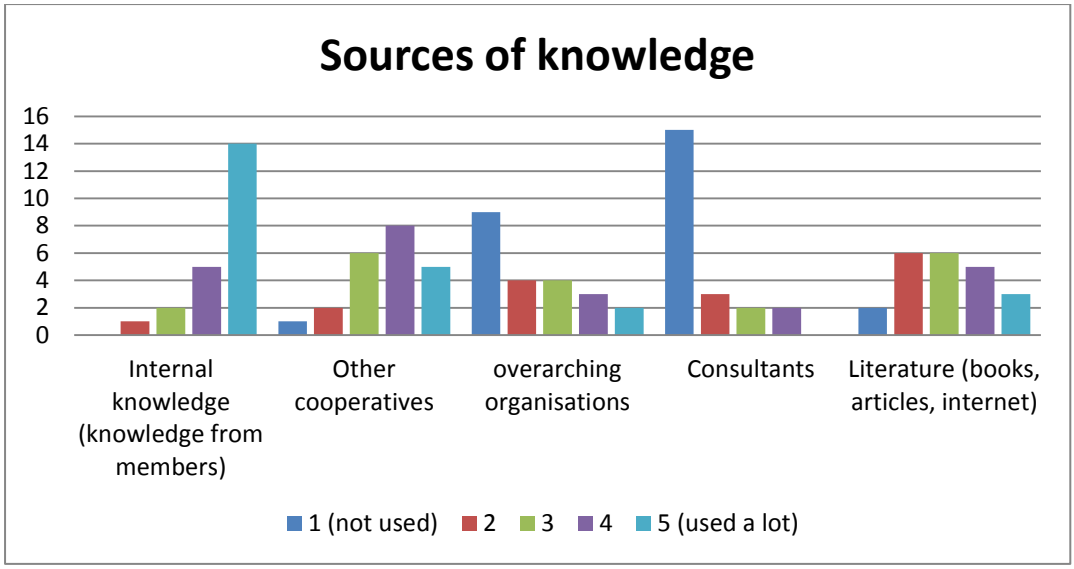


Figure 5 – Number of respondents that indicated how much they relied on a certain knowledge source

The subjects in which the respondents actively searched for additional knowledge are displayed in figure 6. This shows that nearly all subjects provided were further researched by half the respondents. In total 95 subjects were selected which comes to an average of approximately 4 subjects researched per respondent.

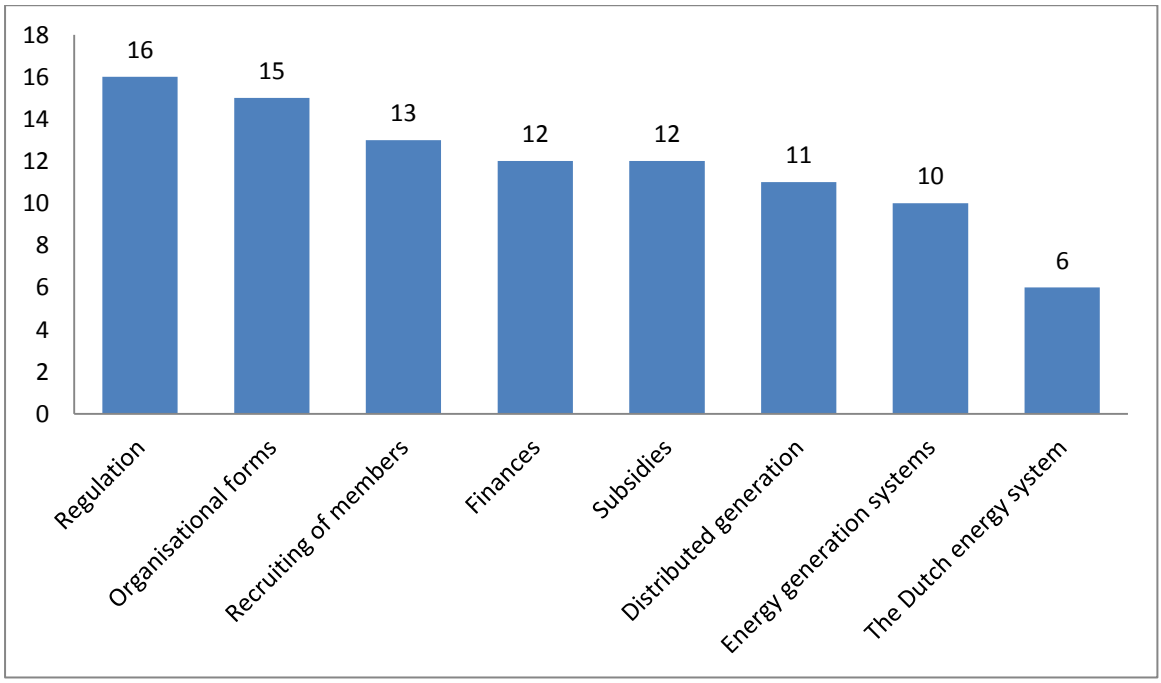


Figure 6 - Number of respondents which actively gathered more knowledge on different subjects

The final questions of this section are about the goals and values of the cooperative. These questions aim to get some insight into the guiding principles and cultural values cooperative have. Cooperatives indicated to what degree, six different values were important in the founding of the cooperative. Figure 7 shows the importance of six values in the founding of energy cooperatives that responded. A couple of interesting results can be found. The first value, curiosity for technology, was quite spread out; some indicated it as being very important and others did not find it important at all. When asked

to describe the purpose of the cooperative, only one respondent explicitly indicated the exploitation of a certain technology. The results of the next three values, Fossil fuel independence, independence of energy companies, and environmental values, were quite similar. All of the respondents indicated them to be important to some degree. Moreover, the majority of respondents marked each of these values as very important. The results for the fifth value, unification of locals, are also similar to the previous three. The great majority indicated it to be an important to very important value for their cooperative, and only one rated it as less than fairly important. The last value, financial savings, was mostly labeled as fairly important to important.

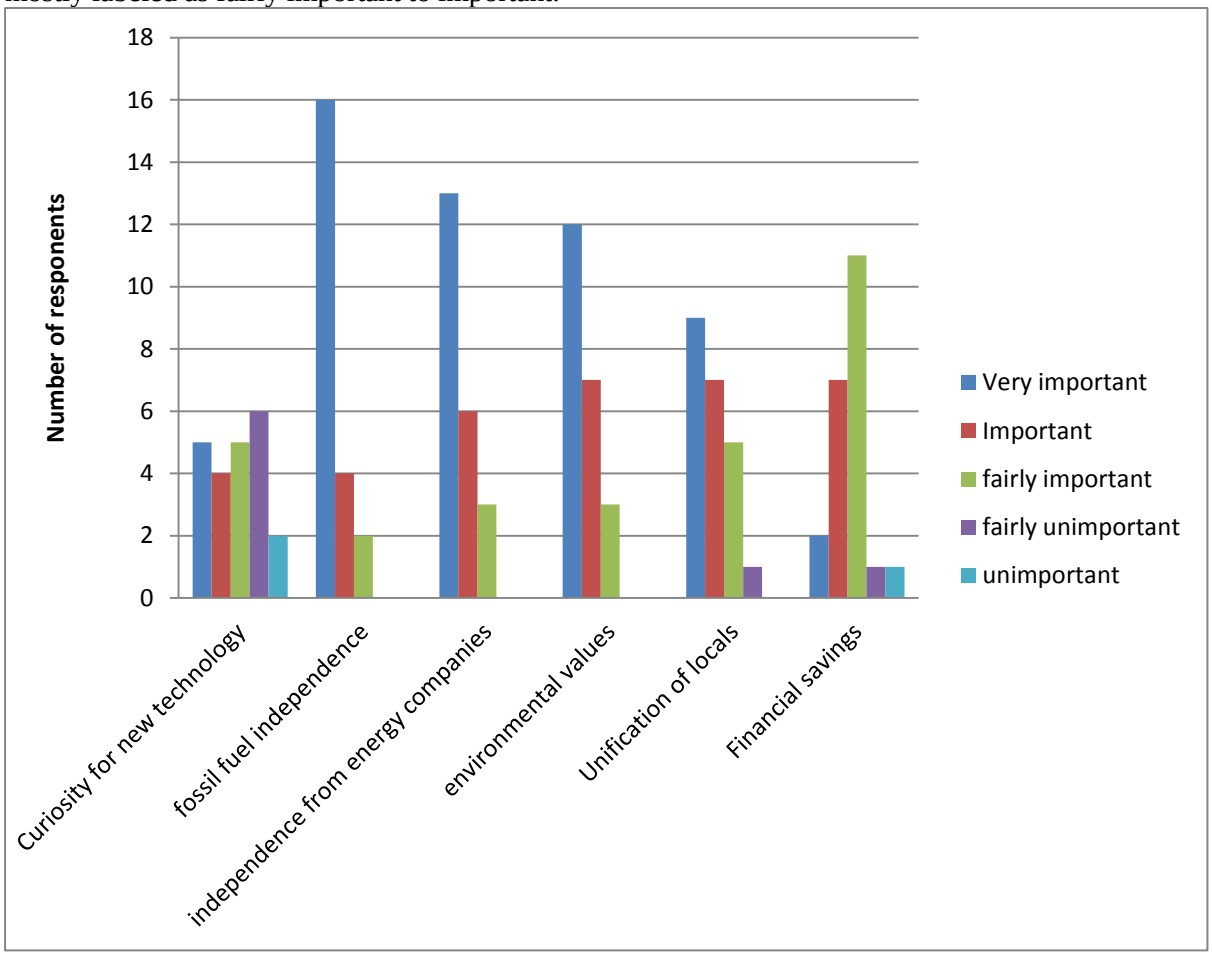


Figure 7 – Importance of values for starting an energy cooperative

Besides these six values, an open question to the goal of the cooperative was asked. The most common answer was local energy generation from renewable energy sources. The term local in this is important, many of the responding cooperatives put value in the fact that energy was generated in their local environment, this is a value that was not asked about by the survey. Secondly energy savings were mentioned by many respondents. The underlying value of this is often just referred to as 'sustainability', which could mean environmental concerns, financial sustainability, and even fossil fuel independence. A goal that may be related to the value of locally generated energy, is self-sufficiency.

Innovation

The second section asked questions about the activities of the cooperative, the roles of the different parties involved in the activities, the obstacles and barriers experienced when implementing these activities, actions taken regarding these barriers, and questions about innovative pilot projects and the cooperative.

Cooperatives were asked to select those services in which they are involved, respondents were also able to fill out additional services the survey did not mention. Figure 8 shows the results for the services that were provided. Some overlap can be found in the different services, energy savings advice and information supply cover some of the same ground. The same goes for electricity supply and the supply of collectively generated electricity. The seven most left services are clearly more deployed than the three most right. Services added by respondents are: Generation of gas, supply of gas, windmill construction and heat supply. The production of electricity was also mentioned several times, this is however already implied in "cooperatively generated electricity supply".

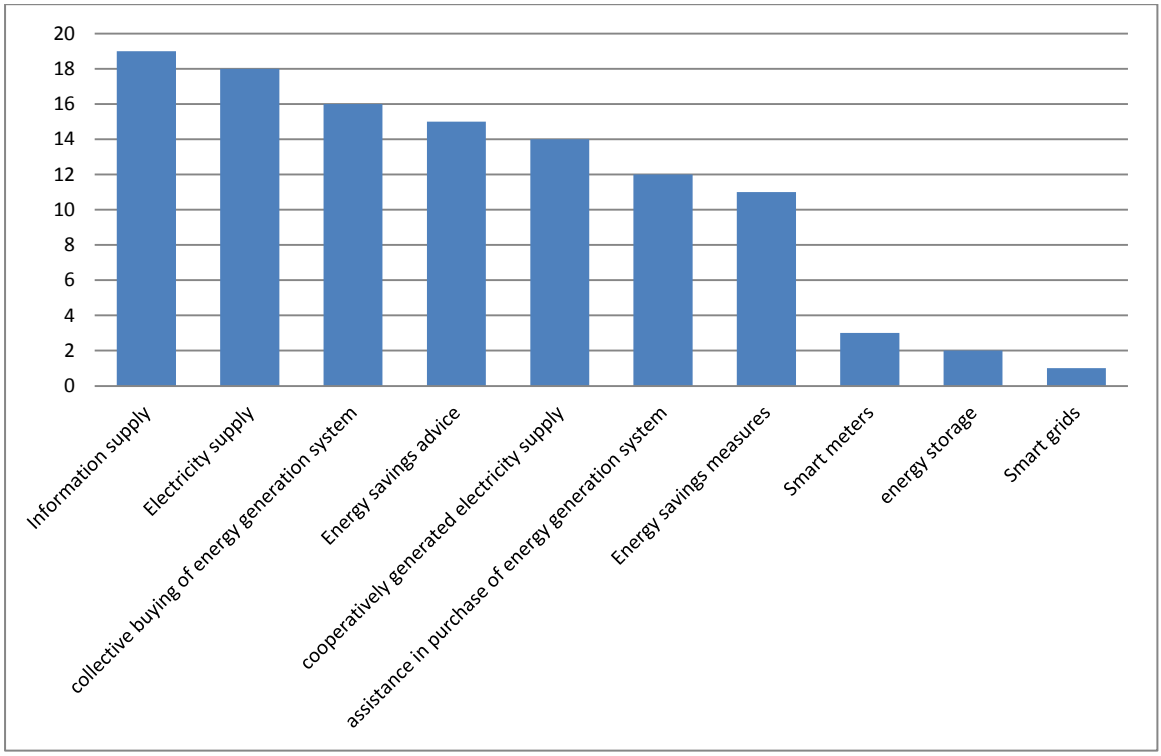


Figure 8 – number of responding collectives providing different services

Three cooperatives indicated to not have had problems implementing or designing services, these barriers that were felt are displayed in figure 9. Most troubles experienced involve regulations and the attitude of government and other regime actors. Finances were also mentioned often and also relate to government policy (subsidies).

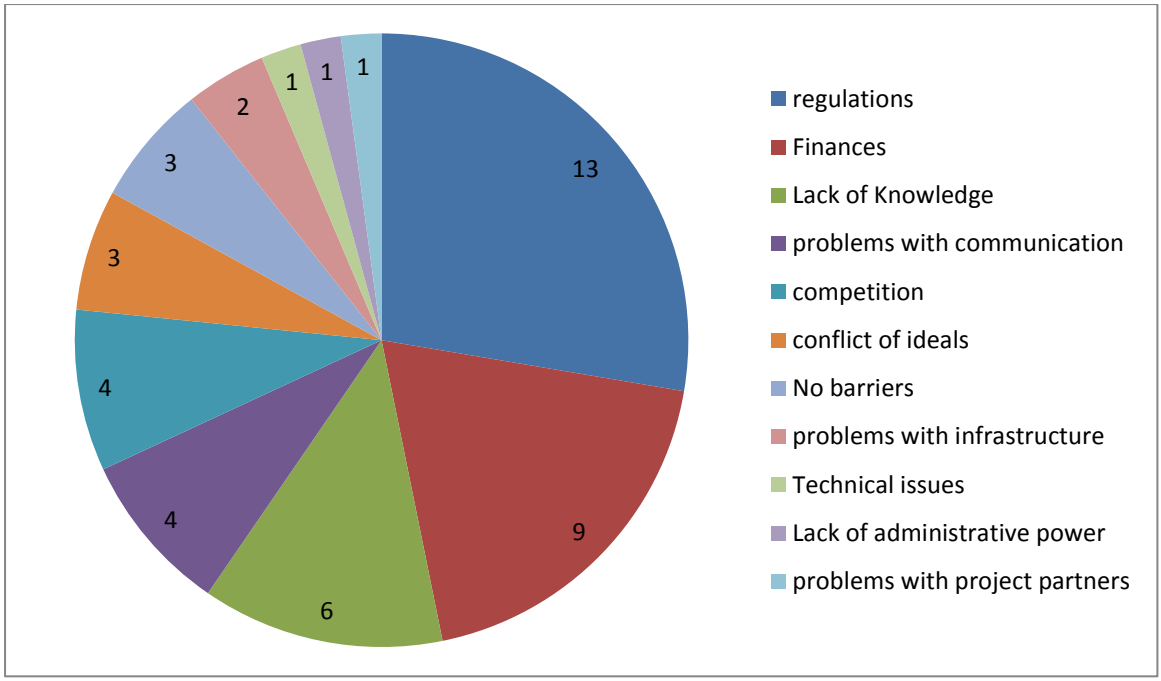


Figure 9 – Number of respondents who experienced different barriers in project design or implementation

Respondents were asked to elaborate on the problems experienced during the designing and implementation of services, several responses and the type of barriers they describe are shown in table 2.

Quote	Barriers
"Government lacks in vision and decisiveness (very slow development of a new energy agreement), which results in a lot of wasted time. Little support exists for bottom up initiatives, there is a tendency to prefer big demonstration projects."	Regulations, competition
"Local government lacks the knowledge required to collaborate efficiently with cooperatives."	Lack of knowledge, (regulations)
"The acquiring of subsidies is uncertain. The policy is confusing, the desire for green energy is articulated, but subsidies for fossil fuel projects are still four times larger than for sustainable energy projects. What's more, there are no penalties for negative externalities imposed by energy generation with fossil fuels."	Regulations, finances, competition
"Internal tensions arise between people who want to develop purely bottom up and those who prefer professionalization and marketing."	Conflict of ideals, communication(, finances)
"Hindering regulations concerning the self-supply of electricity (Recent energy agreement may change this problem). Self-supply doesn't work (even behind the meter) for bulk users."	Regulations
"Government policy is not uniform on different levels of government (National <> province <> municipality), causing different municipalities to very different policies."	Regulations
"The energy supplier Trianel has gone bankrupt in 2012, this caused cooperatives to have to find a new business partner to provide them with electricity on the fly. Which also made members lose faith in the cooperative."	Problems with project partners

Table 2 - description of barriers during service design and implementation

All respondents indicated working together with partners in order to realize their desired services. The different parties with who was collaborated are displayed in table 10.

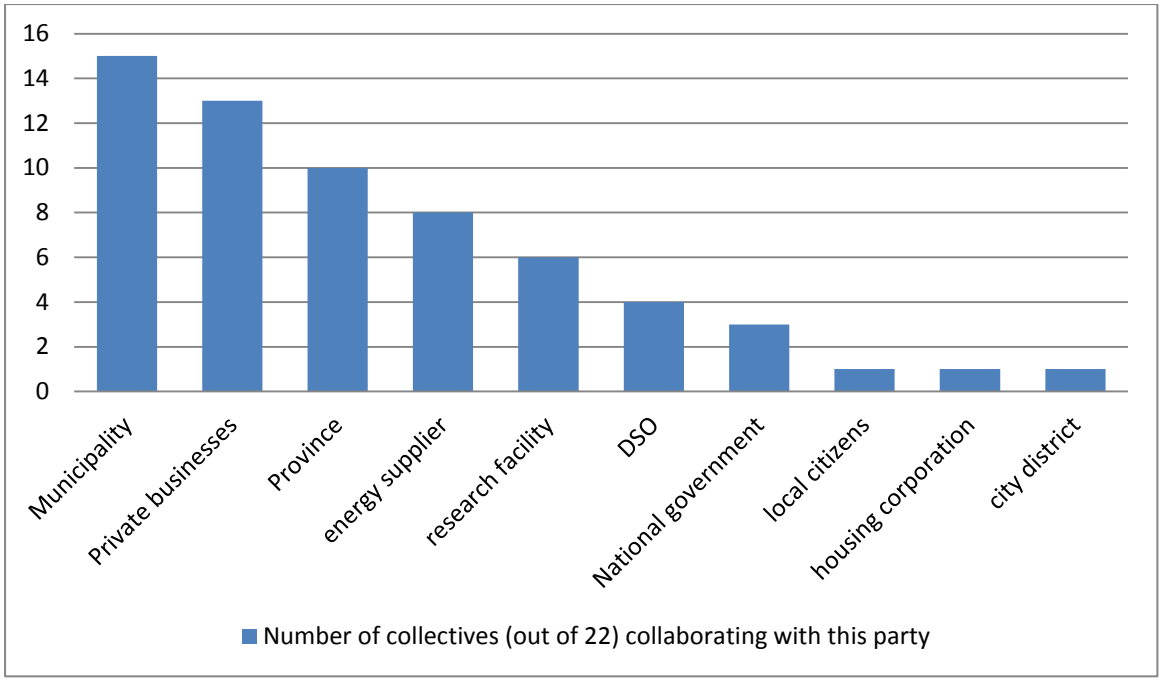
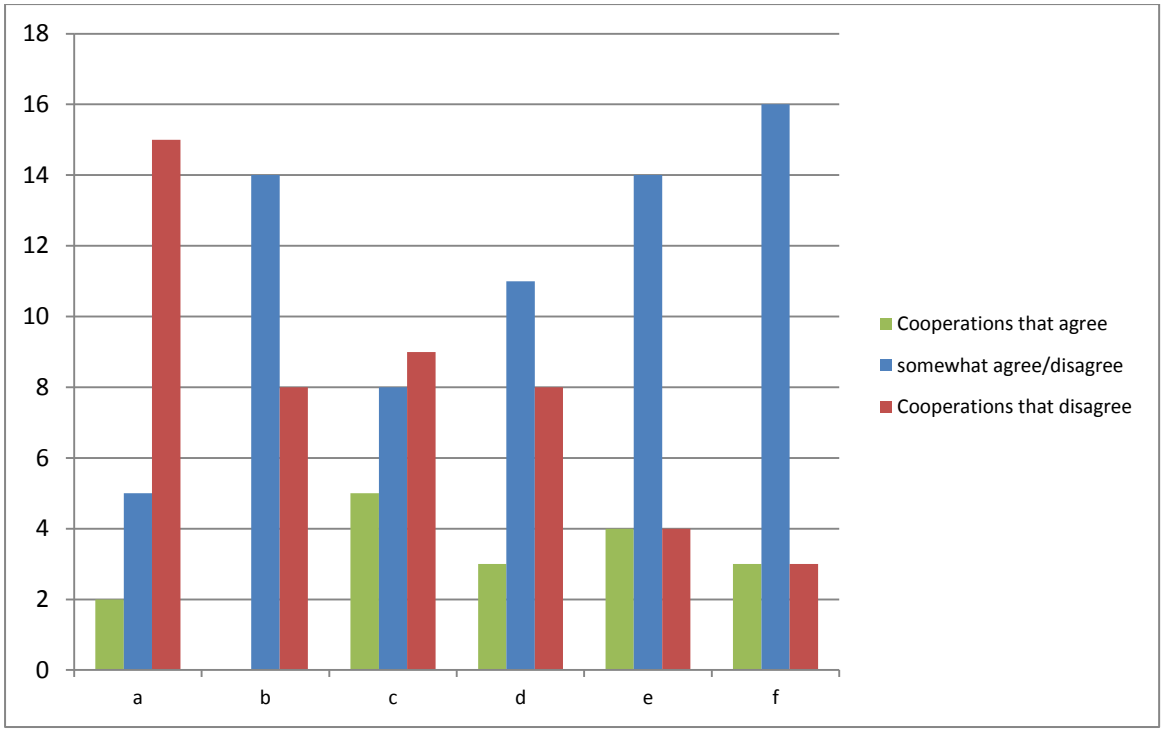


Figure 10 – Number of respondents who collaborate with different parties in implementing services

The role of the municipality and province in projects differs per collaborative, for some they are just the supplier of needed permits or funds, for others they are clients, for others they provide knowledge and are more strongly involved. The role of businesses is not explained by many respondents, but when they are mentioned it involves the business as a participant or a supplier. Some cooperatives have contracts with energy suppliers to allow the cooperative to supply generated energy. Research facilities and DSO's actively think about clever solutions for problems in projects, research facilities are also hired to do feasibility studies.

Figure 11 shows opinions of respondents on six statements regarding the way obstacles were handled. The first three (a, b, c) represent certain reformations made by other parties. The last three (d, e, f) represent ways in which the cooperative has had to adapt to a rigid environment. The majority of cooperatives indicate no changes in regulation have been made for them. None of the respondents indicated that other parties were willing to adapt their vision or goals to assist the development of the cooperative. Financial aid was more available for cooperatives, but still a larger group indicates not to have received financial support than those who did. Very few respondents indicate having adapted themselves in order to reduce barriers. Three respondents indicate working around hindering regulations, and four indicate having adjusted their ambitions.



a	Local/temporary regulation changes were made for the cooperative.
b	Other parties have adjusted their ambition/goals/vision to reduce barriers for the cooperative.
c	The cooperative has received financial support from government.
d	The cooperative has had to deal with regulation in creative ways.
e	The cooperative has had to adjust its ambition/goals/vision.
f	the cooperative has had a lot of trouble gathering sufficient funds.

Figure 11 – Opinion of respondents on several statements

Respondents were asked to elaborate on their answers to the statements, table 3 shows several responses.

Quotes
"The reality can turn out to be very unruly, we have had to make changes in our plans due to contracting rules and a non-existing water defense system."
"Following the bankruptcy of Trianel (energy supplier), our focus has shifted from the supply of energy to the generation of energy."
"Large solar energy projects have proven to be difficult, for that reason our focus is on wind energy, where more opportunities can be found."
"The independent way our cooperative works has come into being partly by our own ambitions, but also due to the passive stance of the local government."
"We are waiting for the results of the new energy agreement, and how it will change the current situation."
"The passive stance of government, banks and regulations, have caused us to take matters into our own hands."
"The municipality has assisted us by lending us money, other funds that were reached out to were dismissed."
"The cooperative has to put a lot of effort in the acquisition of support and funds."

Table 3 - Elaborations on responses to statements regarding the lowering of barriers.

Cooperatives were then asked to what degree communications with different parties were made in order to limit experienced barriers in the future. As can be seen in figure 12, half of the respondents rated this communication above average while four respondents rated it below average.

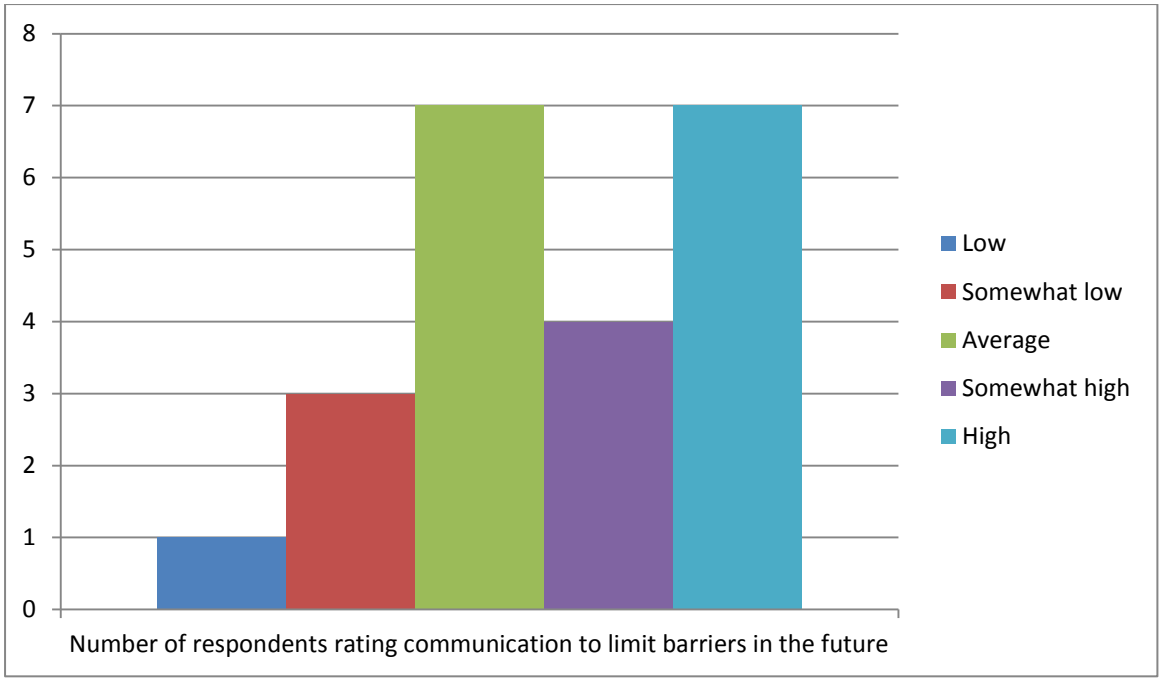


Figure 12 – Amount of communication with other parties to limit barriers in the future

When asked in what way the cooperatives desire to be facilitated further regarding innovative projects. Responses mostly involved changes in government policy, and the sharing of knowledge. Opinions about the role of overarching organization in knowledge sharing were divergent. Some respondents desire more knowledge sharing through these organizations, but another claimed the acquisition of a social network as paramount for the development of a cooperative. See table 4 for several responses.

Quotes
"Changes in current regulations regarding energy generation, current regulations favor central energy generation."
"Access to funds that will allow the construction of windmills and bio fermentation systems."
"Despite extensive social networks, meetings, mailings and the internet, the feeling of reinventing the wheel still exists. It is hard to find out the real story behind some issues, apparently the sharing of knowledge is still difficult."
"At some point, cooperatives will change from loveable local initiatives to professional business. Our policy is more focused on sustainability and local solutions. The first step that is needed now is that governments start taking energy cooperatives more seriously, and start supporting instead of competing. This is a problem since politicians tend to desire credit for solutions, rather than allowing others to solve the problem."
"Government needs to put aside their dependence on big money and realize that what matters is the citizens."
"What's most useful for us are our social networks, we create and make use of these ourselves. Overarching organizations can be seen as counter-productive in that respect."
"Nothing. We are currently cooperating with government and the business sector and we exploit proven business plans."
"More knowledge sharing through for instance an overarching organization, the reinvention of the wheel can be a big setback for starting cooperatives."
"The new energy agreement, may help create more opportunities for cooperatives as well as create more clearness about sustainable energy subsidies. Furthermore a cut in subsidies for fossil fuel energy projects."
"Constructive cooperation from government, DSO, and businesses."
"Financial engineering, fiscal support to make investment opportunities more visible."
"Local governments often want to help, but are limited by provincial or national policies. National and provincial government should express their vision and stick to it."

Table 4 - Opinions on how to facilitate cooperatives

Lastly cooperatives were asked in what way they believe the cooperative can contribute to an innovative pilot project. The results can be seen in figure 13.

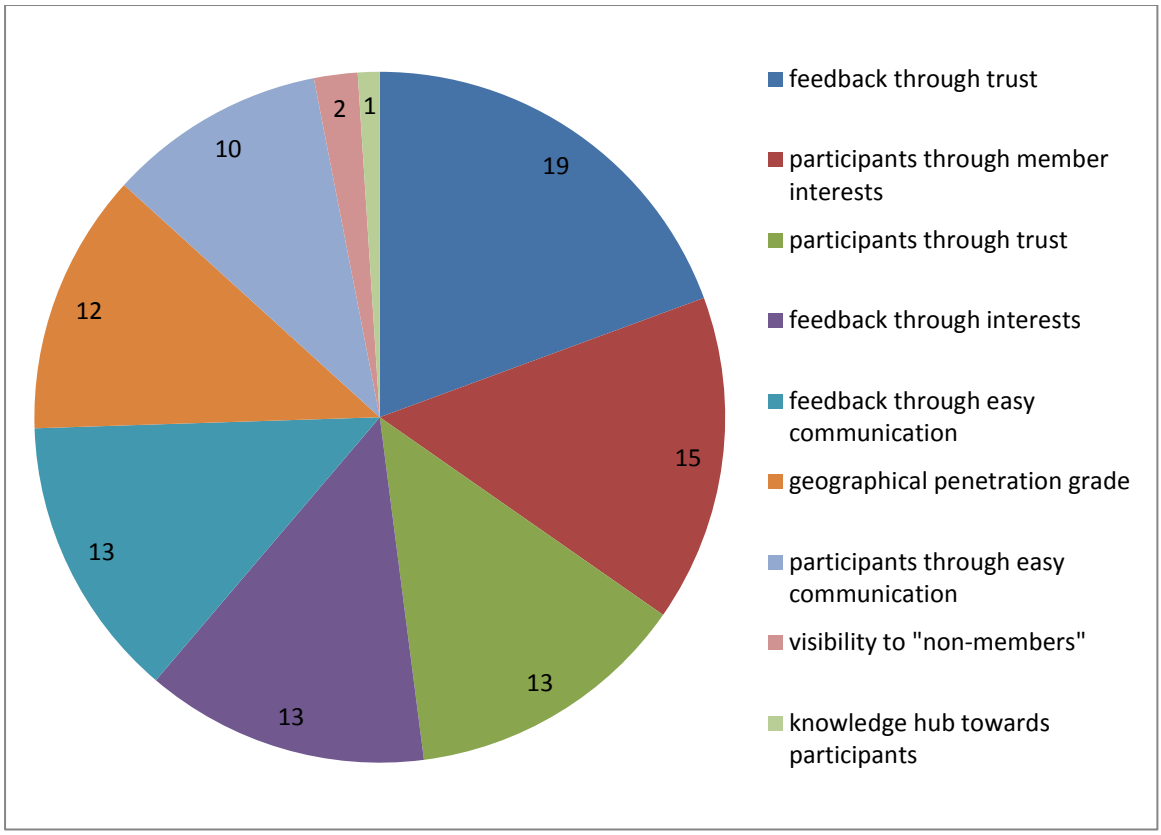


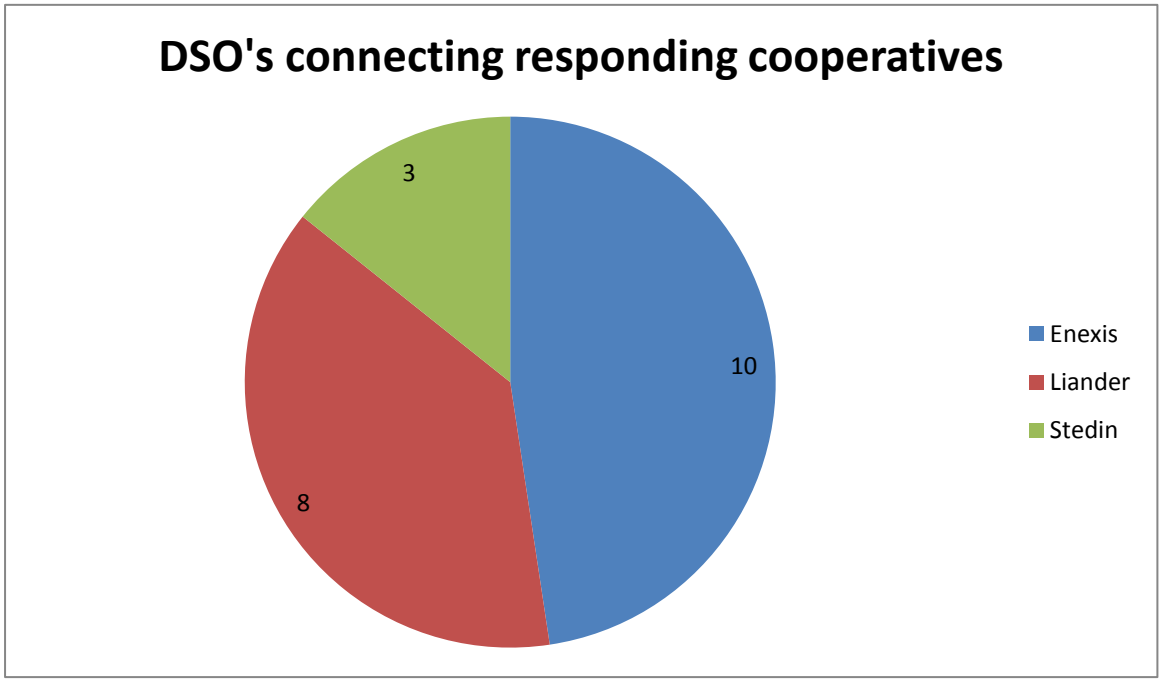
Figure 13 – Benefits cooperatives can provide a test-project

The different options were suggested by the survey and are not devised from previous research. The benefits “Visibility to non-members” and “knowledge hub”, these were additional suggestions from respondents.

The DSO

Questions are about the DSO the cooperatives are connected with. Firstly questions will be asked about the way they have experienced the relationship with their DSO and secondly questions will be asked about to what degree certain services belong to the DSO or to the cooperative.

The responding cooperatives were connected under three out eight Dutch DSO's.



The DSO's were then rated for communication, helpfulness, and attitude towards cooperatives.

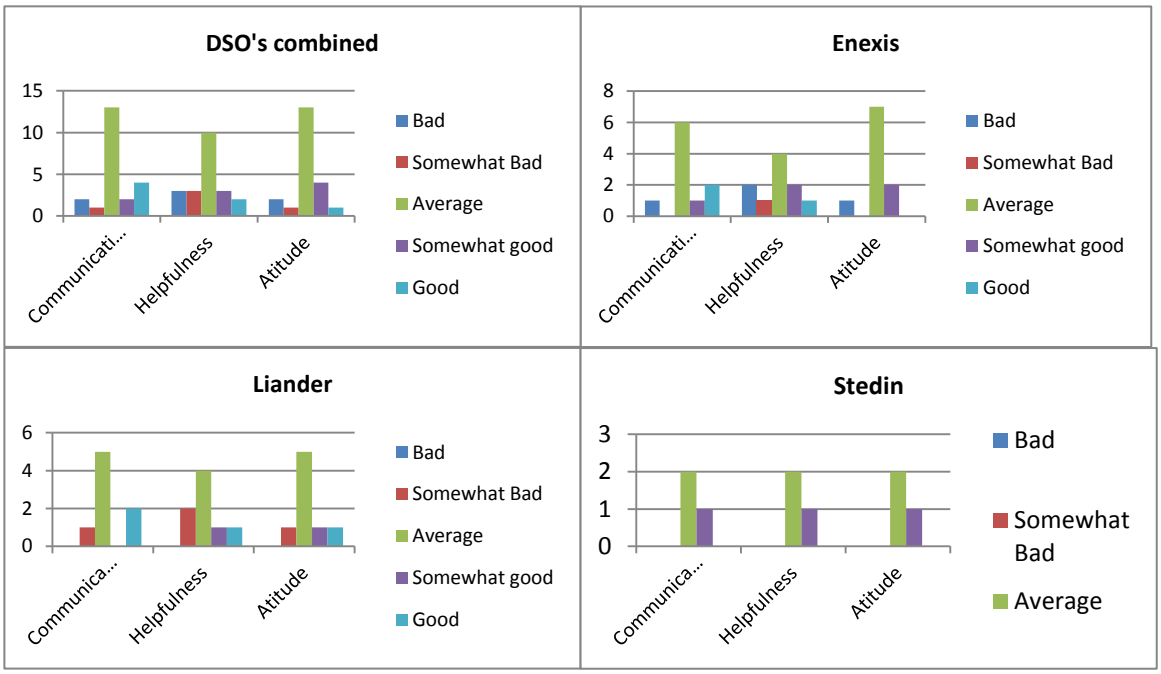


Figure 14 – Ratings of DSO's

When questioned about their expectations of the DSO, most respondents indicated that they do not have much contact with their DSO and only expect them to operate the network. Other respondents say that the relation with the DSO is largely determined by the energy law and government policy.

The responses for the questions on what services belong more to the DSO and which more to the cooperative are displayed in figure 15.

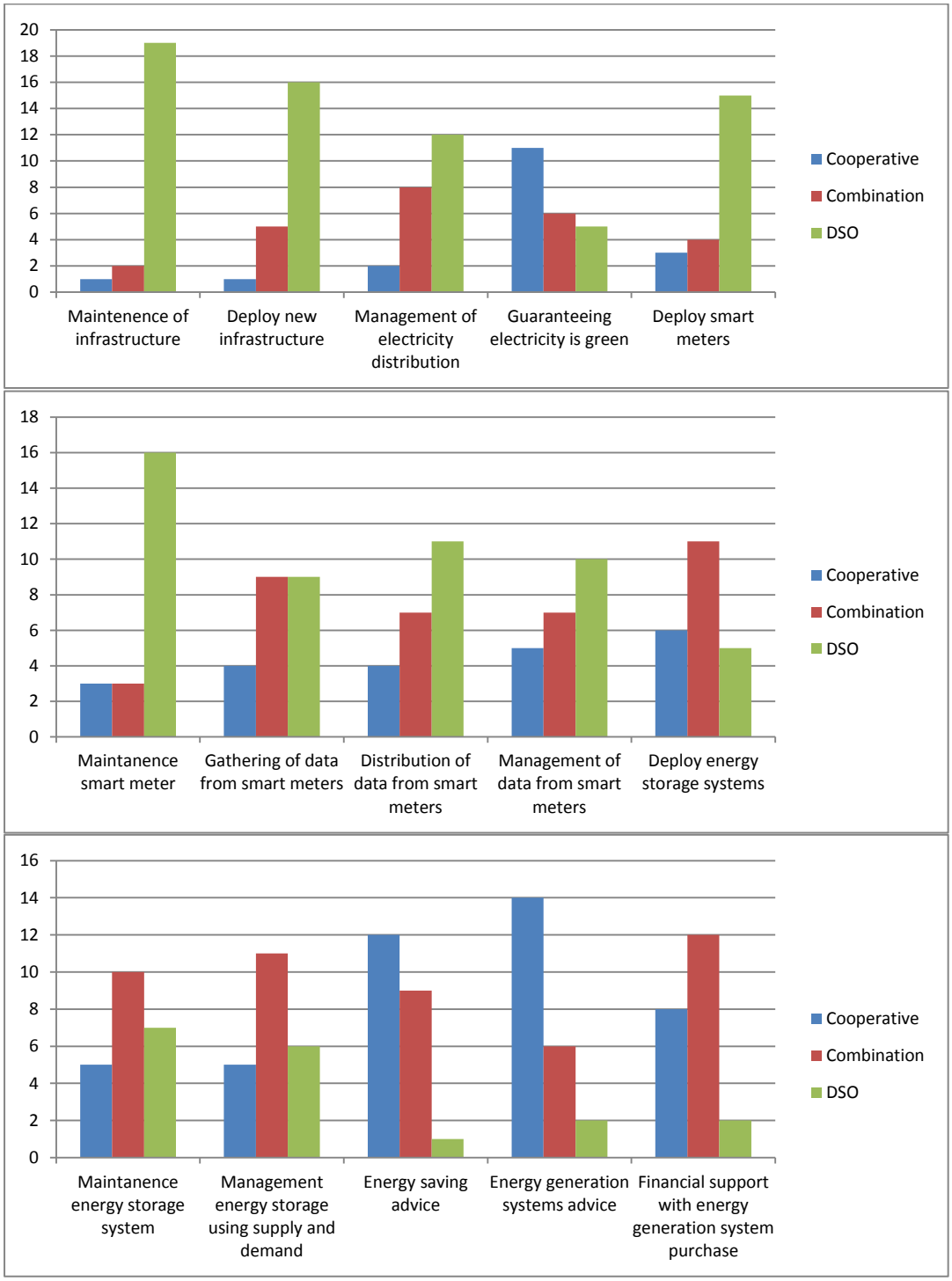


Figure 15 - Number of responses indicating which party should be responsible for which service in the future

The services, maintenance of infrastructure, deploying of infrastructure, management of electricity distribution, the deploying of smart meters and the maintenance of smart meters; are mostly assigned to the DSO. These service require knowledge of and interaction with the hardware of the system. The services, energy savings advice, energy generation systems advice, and financial support with the purchase of energy systems; are mostly assigned to the cooperative. The subjects of smart meter data and energy storage are contested between cooperatives and DSO's.

Lastly cooperatives were asked if they had additional remarks regarding energy transition, energy cooperatives and innovation. These results are displayed in table 5.

Quote
"It is sad that commercial parties regularly get a lot of space regarding energy transition, the free-market principle is undermining projects created by citizens."
"Energy transition is moving really slow, government, energy suppliers, and DSO's seem to prefer the old situation."
"A possibility exists that energy cooperatives will die off in the near future, they need to realize some good results fast. If this does not happen, citizens may become hesitant to get involved in the future."
"A DSO with smart meter data can be an important partner for energy savings projects. When houses reach higher efficiencies regarding energy, the behavior of people will really start to make a difference in energy usage. Cooperatives can agree to supply a DSO with smart meter data, if they can use it to help improve the energy savings projects of the cooperatives."

Table 5 – Additional remarks

Appendix II Case-Description 1: LochemEnergie

Name cooperative: LochemEnergie

Location: Lochem, Gelderland

Organisation: 360 paying members, 130 customers (electricity supplied by LochemEnergie), over 100 participants in innovative projects such as IPIN.

Vision: Provide citizens of the municipality Lochem with locally produced green electricity.

Establishment history:

The councillor of the municipality of Lochem, [C], had been talking with the business world to find a way to increase the adoption of solar energy in Lochem. Both parties stated that this adoption of solar energy was something they all wanted to happen. An agreement could not easily be established and these parties found themselves discussing on the needs of the citizens of Lochem. [C] perceived this to be a problem and decided that the public had to be represented in these discussions. With this in mind he spoke to [T], local chairman of the same political party as [C], and asked him to assess whether or not the people of Lochem were interested in getting involved in sustainable energy generation. Both invited two more people to the group. These six organised an information evening for people who were interested in the future of energy in Lochem. This first event attracted 60 people who were all interested in contributing to an energy transition in Lochem. This new group created a business plan, a communication plan, organised a recruitment activity and more.

Services:

Services LochemEnergie offers are described as being layered. People can first become members, this means they will be informed of the activities of the cooperative; they can ask questions on energy savings, energy generation, anything. Everyone has a vote in the general meeting of the cooperative, and as such can actively decide the direction of the cooperatives activities.

All members can become customers. Customers receive green electricity from LochemEnergie, but since LochemEnergie does not hold a supplier licence the electricity is supplied by the energy company Eneco. LochemEnergie receives a certain tariff for every household that subscribes. The customers receive a yearly reduction on their energy bill of between 50 and 75 Euro's. Eneco also pays for switching fees a household has to pay their previous energy supplier up to 250 Euros. Customers receive a welcome letter from Eneco and LochemEnergie explaining their new energy situation. If LochemEnergie attracts a total of 500 customers or more, than Eneco will double the tariff payed to LochemEnergie.

All customers can get involved in experimental services, for instance the IPIN (Innovation Platform for SmartGrids) project. Collaborators with the IPIN project (Liander/empare) provided LochemEnergie with 250 smart meters to distribute amongst her members. The Smart Meters measure the amount of electricity used or generated every 10 seconds. Another device then translates that into numbers or graphs that are interesting to the user. LochemEnergie receives these devices for free and the users provide feedback for improvements of the system or ideas for new applications the device should be able to run. The project creates an interaction between customer and company which the cooperative is happy to facilitate.

IPIN also generates other important knowledge, knowledge about energy usage in the area. This knowledge is important in order to be able to stabilise the network in the future. The energy behaviour of single users is interesting, but with this project twenty to thirty people in the same neighbourhood can be observed. This information is used to simulate what would happen if even more people decide to generate electricity. These simulations are also used to see if energy from wind or river turbines could contribute to a more stable electricity network.

Besides passing on energy supplied by Eneco, LochemEnergie also collectively generates electricity for its customers. LochemEnergie generates electricity, this goes to the customers. The amount customers pay to Eneco goes down and the amount payed to LochemEnergie goes up. In a way, customers rent the pv-panels owned by LochemEnergie.

Currently LochemEnergie has installed pv-panels on the town hall of Lochem, customers rent 5 panels for 20 euro's per month. These panels will generate around 1100 kWh per year, this means the solar electricity is sold for approximately 22ct per kWh, which is market value for electricity.

LochemEnergie cooperates with a housing corporation. Four newly built houses have been fitted with solar panels that are owned by LochemEnergie. The people who rent the houses also rent the solar panels for the same value as the electricity that is generated. The people in the houses can perform net metering behind the meter, this way LochemEnergie does not have to pay energy taxes over the generated electricity.

Members can get information on for instance energy savings. Sometimes an open gathering is organised by LochemEnergie. If members have a plan to make their home more energy efficient, LochemEnergie will come to the location to investigate and help improve the plan. Recently small customer contact groups have been set up, this way people can learn about their home energy situation and LochemEnergie can learn about the topics that are being discussed. LochemEnergie has a couple of active members that are experienced in the purchasing and installing of PV-panels. Members can send them an e-mail and they will come over to location to advice on the specific situation. LochemEnergie can also offer advice on which provider of solar panels to trust.

LochemEnergie has set up an 'Energy Shop' in the centre of Lochem. This is an office to increase their visibility within the municipality, to recruit more members, but also to increase collaborations with the business world. This energy shop is also the centre of the research conducted by LochemEnergie, research projects do not only benefit LochemEnergie but also for the region, the province, other cooperatives. This knowledge provision to other project is also a services offered by LochemEnergie. Knowledge is not simply provided for a fee, instead an employee of LochemEnergie will participate in third parties discovering and combining their own internal knowledge. This way the solutions created will be custom fitted to the third party and LochemEnergie will expand their own knowledge pool as well. A good example is the province of Gelderland, who has asked LochemEnergie what they would do with 400 miljon euros for the sustainable renovation of buildings.

Ambitions:

Expanding the energy shop to be an incubator for small businesses that are collaborating with LochemEnergie to develop sustainability services. But also a place where people can walk in thinking they need LED bulbs and walk out with a renovation plan for their house, or vice-versa ofcourse.

More cooperation with housing corporations, Lochemenergie has a plan laid out to be involved with the placement of solar panels on 100 new houses end 2013. Two different housing corporations will be building 50 rental houses that will be equipped with solar panels on the roofs.

Lochemenergie aims to build a solar park on an old garbage dump. This would be able to supply 1000 to 2000 households with electricity. However this project is delayed until changes in the energy law regarding energy taxes on self-supply have been made.

The ambition is to stop passing on electricity supplied by Eneco. This will be possible when local production of energy is great enough to the point that a back-up supplier is no longer needed.

A member of LochemEnergie is working on Smart Home Systems, he is experimenting with connecting weather predictions to a heat pump with a woodburner.

An interest is also expressed to experiment with energy storage. For this a university or a company will have to provide them with the hardware required for experimentation. Large batteries to optimize the day and night cycle of energy production and consumption. This could also include electric mobility. A project that may be realised in the near future regarding energy storage involves a water lock in the Twentekanaal . The plan is to purchase excess solar energy during the day, when it is relatively cheap, and use that energy to pump water into the water lock. Then during the evening, when energy demand is high, let the water flow down and use or sell the energy generated by the water. The efficiency of this process is approximately 80%, which is viable when the difference in energy prices is large enough.

Encountered barriers:

On becoming a customer of LochemEnergie, people have to switch to Eneco as their energy supplier. This switch to Eneco as supplier sometimes causes issues. There are typically two types of behavior for energy supplier choices. The first are people who have had the same energy supplier for decades, traditionally in the region of Lochem that supplier has been Nuon. These people do not like changing to Eneco, they dislike change. The other type of behavior is the searching of low prices for energy since the liberalization of the energy system in the Netherlands. These people actively search for the lowest energy prices they can find, LochemEnergie cannot offer such low prices for green electricity. Both behaviors offer barriers for people to become a customer of LochemEnergie.

LochemEnergie used to have a collective supply contract with Trianel (like the contract with Eneco now). In januari 2013 Trianel was declared bankrupt, this caused a lot of problems for cooperatives that were contracted with them. Besides direct problems of having to find a temporary solution for the provision of energy to members, the bankruptcy delayed the development of services and caused people to have less trust in LochemEnergie as supplier of energy.

Partners in the IPIN project had promised smart meters that would have many different functionalities. In reality the meters are not that ‘smart', they offer less than what people expected. On the other hand when the meters do have a lot to offer, privacy issues come into play.

The solar energy park LochemEnergie wishes to build, is held back by current laws on energy taxes. Revenues on the solar energy will be too low to make the park financially viable. On top of that the connection to the electricity network may cause another barrier for this project. The distribution system operator, in this case Liander, has to connect the solar park to the electricity infrastructure, this has to be performed in a smart and not too expensive way for the solar park to be viable.

Innovations developed (or envisioned):

In order to be successful the cooperative has to grow, but attracting enough members remains a difficulty. LochemEnergie addresses this problem by spreading information via many media channels. A lot of flyers, folders, booklets and signup sheets are distributed. When LochemEnergie has any news they make sure they are printed in the local newspapers, and the website is kept up to date as much as possible.

The new energy agreement in the Netherlands may make changes in laws on energy taxes for the self-supply of energy. LochemEnergie has contact with someone who is involved in the discussion of what the new agreement will be. This person is not a representative of LochemEnergie or a representative of energy cooperatives. He represents the Dutch organization of municipalities (VNG). [C] (co-founder of LochemEnergie) has also made an appearance in one of the workgroups that think about the energy agreement, and has pleaded for more stimulating regulations for cooperatives.

One of the issues surrounding smart meters is privacy, these issues are being addressed by allowing users to choose with whom to share their information. This can be with no one, with the neighborhood, with the cooperative, with the DSO, and more. On top of that, users can indicate what type of information is shared and choose the degree of anonymity.

Current role distribution system operator / desired future role:

The view on the DSO (Liander) is that it is a larger organization than is good for itself. What is meant by this is that it consists of many different departments that do not always communicate with each other. Specifically for Liander, which is governed by Alliander, there is more confusion. For communication about the IPIN project LochemEnergie has contacts with Alliander, but the actual placement and measurements of the smart meters is performed by Liander.

This confusion put aside, LochemEnergie sees the DSO as a good partner. Alliander puts faith in LochemEnergie by participating in projects such as IPIN. This causes LochemEnergie to trust Alliander as well, which allows for projects like IPIN to reap good results and increase knowledge or both parties.

The current role of the DSO according to LochemEnergie is two things. First, to deploy and maintain cables for the transport of energy. And second, to measure the energy. All other activities are less relevant. Of course these two main functions are becoming increasingly complicated with distributed generation that varies per input location but also with time due to the changing nature of wind and sun for instance. That is why the DSO will have a large role in keeping the network stable in the future, but not merely with technical solutions. Social innovation, customer behavior, relations with cooperatives, these will all be important for them in the future.

What LochemEnergie desires is a reduction in transportation costs for electricity. This means the costs for electricity that is lost by for instance inefficiencies and leakages to the earth. This may be achieved by resorting to local production and subsequently local consumption of electricity. To investigate how this can work in the future the DSO will have to work together with cooperatives even more strongly.

Power of cooperatives in an innovation process:

Members of LochemEnergie are willing to invest in projects. For the rental housing project, 123 000 Euros were collected within 10 weeks, which is 25% of the total needed amount.

The benefits of including a cooperative in a research project is the access to clients. That is the one thing LochemEnergie protects. They love being a part of research projects, but the communication and contracts have to go through the cooperative, because the cooperative protects its members. The cooperative makes sure members are not getting flooded with requests. So for instance, if a student wishes to interview some of members of LochemEnergie, then LochemEnergie takes care of the communication, preparation, and aftercare for both sides. Because if some sort of problem arises, then the cooperative can act in order to solve it.

It would be better to allow for instance supply and demand data to be managed by a cooperative. People will not like it if a DSO will know so much about them in the future. If LochemEnergie knows everything about us it is a different story, the cooperative is our own organization which is very trustworthy. It is important to layer out certain data related services.

Appendix III Case-study 2: De Groene Reus

Name cooperative: De Groene Reus

Location: Almere, Flevoland

Organisation:

1 board member, several hired externals. Cooperation owns 100% of private company that executes projects

Vision: Promotion of sustainable generation energy, energy savings and energy supply in the municipality of Almere and the province of Flevoland.

Establishment history:

The initiative started in the form of a foundation, the foundation for sustainable neighbourhoods in Almere. This organisation aimed to mobilise people to invest in solar panels or energy savings in and around the house. Together with two others, [R] created the idea of establishing a cooperative. During the interview [R] expressed that the other two founding members had a very idealistic view of what the cooperative should be. Initially this was good because this meant that there was a clear vision for what they aimed to achieve. [R] himself shared this view, but was much more in touch with the business side of running a cooperative. The cooperative was established April 2012 by these three people, after which a hectic period of organising began. The two idealists could not cope with the amount of work and put their priorities elsewhere, this resulted in [R] running the cooperative by himself. He started hiring people to take care of finances and to investigate the legal environment for envisioned services.

Services:

The first activity the cooperative was mediating between consumers and companies in the sales of solar panels. This was seen as a low risk service in order to let the cooperative grow, every person to purchase solar panels via the cooperative becomes a member, with the first year of membership included in the price for the solar panels. This was a successful service; the cooperative now has 100 members and around 250 households that have shown interest in becoming a member. This is their main activity at the moment, but [R] has expressed his ambition to expand the amount of services the cooperative can offer several times.

The cooperative is currently involved in (at least) two pilot projects. The first project involves what [R] calls ‘Smart Energy Services’. This involves measuring and profiling the energy usage of a company. The data gathered together with statistical models can then be used to judge the best ways of saving energy in the company. [R] intends to expand this service by offering measures to improve the company’s energy profile. He envisions this to include the sale of solar panels to company or to have the company provide its roof for solar panels owned by those who do not have a suitable roof themselves.

The way this construction will work is being tested in the other pilot project the cooperative is involved in. A sports centre in Almere has made its roof available for solar panels. The panels will be owned by the cooperative but the electricity will be used by the sports centre. This allows for net metering behind the meter, which means the sports centre will be able to sell excess electricity back to

the energy supplier at full price. At the end of the year the cooperative will receive revenue based on the savings made by the sports centre.

Ambitions:

[R] intends to expand his smart energy service to households. The measuring of energy usage and generation will then be done with a smart meter designed for this service specifically. The smart meters will generate energy usage data and combine this data with other smart meters in the neighbourhood. This will then be made anonymous and displayed on neighbourhood level, this way households can compare themselves to their neighbours. [R] has been in contact with a (hogeschool) te develop an app so the data can be viewed on a Smartphone in an easy way.

The placement of cooperative owned solar panels on public buildings (like the sports centre) will be continued. [R] observes that many people are willing to invest in solar panels, but for some reason are not able to place panels on their own home. At the same time schools and firms have a lot of suitable free space for solar panels, but are having trouble financing solar panel projects. These parties can be brought together via the cooperative.

Another ambition [R] has for the cooperative is supplying electricity to its members. He does not see this service as a lucrative business for the cooperative but it makes the proposition of the other services much easier. By offering energy saving, energy generation and energy supply together you are offering people a more complete package.

De Groene Reus now has 100 paying members; [R] aims to increase this number to 750 by the end of 2013, and to 5000 in 2017.

Encountered barriers:

Financing is named as the first barrier; [R] has funded the early stages of the cooperative from his own pockets. He was able to get a small subsidy from the state, but states that much more was needed.

Secondly, [R] points out that knowledge is a big barrier. He says the energy world is very complex and has specific rules for specific situations. [R] himself has a technical and business background, but claims cooperatives are often founded by idealists who have an even larger gap in required knowledge. [R] has delved into the subject of solar panels and says it was easy to grasp for him, he sees this acquired knowledge as a very valuable asset. For other knowledge intensive tasks, such as finances and regulations [R] has hired experts.

Innovations developed (or envisioned):

The general public has almost no knowledge on what is possible regarding energy generation, net metering, payback times etc. To recruit members to the cooperative it is important to inform people. When people are informed on the possibilities and are given a good proposition, they tend to join the cooperative relatively readily.

[R] believes that he, and others, would benefit from some sort of ‘Energy College’, a few days in which the complex system of energy supply and delivery is made clear. This would have to envelop laws, regulations, infrastructures and the different actors and their responsibilities.

The legal problem of virtual net metering (net metering before the meter) is circumvented by the financial construction in the pilot project with the sports centre. [R] does note that this construction has its legal limitations as well, but it is not all that clear. The municipality of Almere has asked [R] to investigate the fiscal and legal possibilities of these kinds of projects. [R] then turns to experts to look into these things.

Current role distribution system operator / desired future role:

The DSO [R] has contact with is Liander and its mother company Alliander. [R] has been in contact with these actors for their programs to make virtual net metering possible, but as of yet it is unclear whether these programs are applicable to the case of De Groene Reus.

[R] states that the energy world is very complex. He sees different strong actors trying to find their place in a potentially changing playing field. The energy suppliers such as Essent and Eneco are developing similar pilot programs as DSOs like Liander. This creates a confusing image for energy cooperatives, since this makes it even more unclear which actor has which responsibilities in the energy world.

[R] does not believe Liander sees the cooperative as an interesting development. The other way around [R] does not find Liander an interesting party for cooperation. Most services he wants to offer are easily possible and the DSO takes care of the technical part. This is part of their core business, so nothing unusual is going on.

An important future development will create a discussion on who has what role. Innovations such as smart grids will enable the growth of decentralized energy generation, which may cause the need for local storage of energy. This can put more pressure on local electricity transformers, which may have to be adapted to the new developments. In such cases a division has to be made to determine who is responsible for what. [R] thinks the scope of the cooperative should be as large as possible, but public services such as energy storage and transformer maintenance should be done by the DSO. The cooperative will then have a guiding function towards the DSO.

Currently the DSO are too much on the side lines in a couple of years they will have a real challenge on their hands if decentralized solar generation takes off. A congestion of electricity may arise and it would be smart if the DSO would think ahead in that respect. They should contact cooperatives to get a good grip on their foresights of future decentralized generation. That way they are better able to act right now. And action is necessary. Look at Germany, on sunny days they have to shut down coal plants or windmills because they have no solutions for the excess solar energy.

Power of cooperatives in an innovation process:

The cooperative has a central function in the actor network surrounding the energy system. The cooperative has strong connections with the consumer, businesses and government.

Another benefit cooperatives can bring to an innovative pilot is the number of people who sign up. Members in our cooperative will have a long term contract in which they are promised measures to lower their energy bill. People who are invested in reducing their energy usage will be very interested in participating in such projects. What also contributes to that is the “togetherness” of members of the cooperative. I believe we could get a large number of participants fairly quickly.

Appendix IV Case-study 3: TexelEnergie

Name cooperative: TexelEnergie

Location: Texel, Noord-Holland

Organization: over 3000 members on the island of Texel, several members on the mainland.

Vision: Supply green energy to the people of Texel, locally produce green energy, and stimulate energy savings.

Establishment history:

A man named [B], was working on a wind energy initiative for Texel more than twenty years ago. This wind initiative did not get going for a number of different reasons. [B] came into contact with [R] and after a big conversation the two decided to start an energy cooperative on the island of Texel. They wanted to recruit more people before really getting started. The types of people they were searching for had to have an open mind when it came to sustainable energy. People who were open to all kinds of sustainable energy generation. What's more, they were searching for people with an extensive social network that could be used to our advantage. After recruiting ten more people and after two brainstorm evenings, it was decided that the founding of an energy cooperative was going to happen. TexelEnergie was founded in November 2007, one month later the first publicity operation was launched and a couple hundred members joined in no-time.

Services:

TexelEnergie started with the purchasing of energy. Firstly with the domestic garbage incineration plant (Huisvuilcentrale) in Alkmaar, later with *Greenchoice*, and lastly with *De Groene Belangenbehartiger (DGB)*. Green electricity and gas is currently supplied to members of TexelEnergie

Supply of solar panels to members using a care-model. The cooperative rents the roofs of members and fits them with solar panels. A contract is drawn up in which a calculation is made using the person's energy bill. This ownership of the solar panels shifts to the inhabitants of the house after approximately fifteen years.

TexelEnergie is involved in a research project for electric mobility, and a research project for smart grids. These projects have allowed business owners in the area to get an electric car for a much lower price (80% of the difference with a car's gasoline equivalent was subsidized). And many houses on Texel have now been fitted with smart meters.

An energy savings contest has been organized on Texel. TexelEnergie does not perform measures for energy saving, but does stimulate people to take these actions themselves.

Ambitions:

TexelEnergie contacted a housing corporation who was planning to discontinue a heat supply system in a neighborhood on Texel. The gasburner used to supply the heat had to be replaced or removed. TexelEnergie asked if they could investigate if the system would work with a wood burner. The heat distribution system would be able to function for more than ten years with the installation of a wood

burner and the housing corporation agreed with the project. Objections by residents slowed down the process a lot, but these objections have now proven to be false.

Another project that will come to fruition in the future is bio gas generation. This project was slowed down by politics but has now acquired enough support to be executed.

Encountered barriers:

Current regulations are not very flexible when it comes to self-supplying of energy, and the processes of changing regulations are being conducted very slowly. Big energy production and supply companies have a strong lobby and are working for their own benefits. In the eyes of TexelEnergie it makes a lot of sense to start organizing energy projects on street or district size, but current regulation prohibit this.

A big barrier can be the acquisition of funds. Investments needed for projects undertaken by a cooperative are of medium in size. This size is the type of investment is usually too large for citizens to handle, but too small for professional investors and entrepreneurs to get interested.

Competencies of government can be a barrier, even if a government agree with your ideas they can lack the efficiency you do find in a commercial business. Government can work against you without them even realizing it.

A lot of barriers and problems have to with communication and partners. TexelEnergie started supplying energy with electricity they bought from the huisvuilcentrale (domestic garbage incineration plant) in Alkmaar. This plant also offered the cooperative to perform the BackOffice for them. This seemed like a great deal, but after a year it became apparent that the plant was not able to handle this task. The system they had bought and reshaped for large sums of money did not fulfill the needs that TexelEnergie had communicated to them. The separation of the two parties was a large struggle, but after a lot of effort it conveyed without much bad publicity. TexelEnergie then started working with Greenchoice, an energy supply company. This collaboration proceeded well until after a year and a half, Greenchoice was exposed to having been holding back certain margins. The board that was responsible for intentionally keeping money from customers had been fired, but TexelEnergie had decided to end the (then two year) collaboration. TexelEnergie then started collaborating with De Groene Belangenbehartiger (DGB), which at the time was an agricultural organization. Together they designed a system both parties were happy with. TexelEnergie is still with the DGB, but has had to communicate for them to keep to certain quality standards.

Inhabitants of Texel partake because they want a supplier that is associated with the island. In the future TexelEnergie may want to attract customers from the mainland. This may not be easily accepted by people on Texel.

Resistance from residents of Texel. In the case of the heat supply system using a wood burner as a heater, residents of the target neighborhood filed a concern against the project. The concern was with the wood that was going to be burned, as certain research has indicated that wood that has been saturated with salient water will release a high concentration of dioxin, which can be harmful. TexelEnergie started researching the subject, and soon found out that the study which was had originated the concern was referring to wood that had been lying in salient water for a very long time. Wood on Texel will only be exposed to salient water in much lower amounts than what could be harmful. After a procedure of four years the project can continue.

Similar resistance was felt with wind energy generation and bio gas generation projects. The recreation sector on Texel (which makes up a large part of employment on Texel) was concerned that the construction of windmills would drastically reduce the number of tourists, on whom they rely for much of their income. TexelEnergie proposed to have an independent study performed to investigate whether or not these concerns were valid or not. The recreational sector refused to go along with this plan, thus putting all wind energy projects to a halt. In the case of bio gas generation, the municipality were the ones against the project. TexelEnergie created support for this project by involving the agricultural community on Texel. Farmers can earn a lot of money by turning their residues from crops and manure from cows into biogas. This caused the municipality to eventually agree with the project.

This resistance of residents has halted production projects, this causes members that joined to be involved in local green production to become inpatient.

The installation of smart meters in the area cause some strange technical problems. Liander (DSO) installed smart meters in a large percentage of the households on Texel. After a while it became apparent that Liander was unable to read the data from the meters from a distance, and thus had to resort to reading the energy values by hand.

On the subject of knowledge a certain barrier was felt when a local business was searching for a heating system that used a renewable energy source. The system had specific requirements regarding size and power. These requirements were divergent from the usual specifications used in The Netherlands. This caused all experts to express the impossibility of the project. But the CEO of the local business started searching for systems by himself and came across a perfect system which was being used in India. The system he was looking for was readily available, just relatively unknown in The Netherlands.

Innovations developed (or envisioned):

Barriers that are created by concerns of local government or residents can be overcome but require a lot of patience. Taking the time to disprove objections to projects, or generate enough support will eventually solve the problem, but once again a lot of patience is required.

TexelEnergie has their own lobby in national government. They join discussions on sustainable energy and try to get things done on a national scale. Getting involved in pilot projects gives some flexibility in regulations as well as extra funds. It is important to stay active and take what you can get.

TexelEnergie has good relations with the CEO of Alliander (mother company of Liander, the DSO). This allows for more and easy solving of problems with connecting to infrastructure. By informally communicating with the top of the DSO, problems with high costs were solved with much more ease.

Vision on Current role distribution system operator / desired future role:

The cooperative realizes that the current energy market may turn completely on its head. The old model of centralized production which is spread out by an dense network may then not be the optimal solution anymore. A lot of thinking has to be done to come up with a better suitable system. The DSO has to investigate what the size of the changes will be and what the positions of the DSO the TNO and power plants will be. What will happen exactly is still very uncertain, also for TexelEnergie.

To what extent certain services can be performed by the cooperative and to what extent the DSO will carry responsibility depends heaviliy on the competencies of the cooperative. For some energy cooperatives it would be possible to take the management of the local distribution network under control. In that case the DSO would just have to support the cooperative with knowledge man-power and other resources. For TexelEnergie it may be possible to run a locally balanced network that connects to the national system. If such a system could be designed to the right scale.

Regarding energy storage, there is also uncertainty. But this field may prove to be a lucrative business in the future. The management of energy storage can turn out to be rather knowledge intensive, so maybe that is a role for the DSO. And in a related matter, personal data on supply and demand may prove to have a big role in the future. The DSO is able to generate all this data and has the knowledge and resources to do something with it.

Power of cooperatives in an innovation process:

It is unsure whether TexelEnergie can assure the target number of clients for a test project immediately. But what is certain is that a large amount of the target will partake, if the project reveals itself to be useful then more participants will be sure follow.

Cooperatives have a strong local network in a certain geographical area, if an innovation is dependent on local circumstances and local cohesion then a cooperative has a lot to offer.

Cooperatives are slower in decision-making than a business for instance. Policies and directions have to be approved by enough members that attend meetings. In the case of TexelEnergie these meetings tend to be visited by a hundred people, which makes it harder to be quick and decisive.

Appendix V: Interview Cooperative

1. Wie bent u?
    a. Naam
    b. Funcie
    c. Bedrijf
    d. cooperatief
2. Wanneer en door wie is het coöperatief opgericht?
    a. Samenwerkingen met Consument, overheid, bedrijfsleven, andere coöperaties, meer?
3. Hoe is er aan informatie gekomen over het oprichten van een energie coöperatief?
    a. Informatie over duurzame energie systemen
    b. Over decentraal opwekken
    c. Over een cooperatie als rechtsvorm
    d. Over financieen
    e. Over wetgeving
    f. Andere?
4. Wat was de gedachte achter de oprichting van het coöperatief?
    a. Duurzaamheidsredenen?
    b. Uit interesse voor nieuwe technologie?
    c. Gewenste onafhankelijkheid (zelfvoorzienendheid)?
    d. Geldbesparing?
    e. Andere?
5. Waarom de vorm coöperatief in plaats van individueel of een bv?
6. Wat was de visie van het coöperatief (missie) (te bereiken in de toekomst)?
    a. Wat en hoe werd dit gecommuniceerd naar (potentiele) leden, bedrijven, overheden
    b. Wat was de visie op de groei van het coöperatief?
7. Wat zijn de diensten die het coöperatief levert?
    a. Elektriciteit
    b. Informatie
    c. Slimme meters
    d. Energie advies
    e. Steun bij aanschaf opweksystemen
    f. Data levering
    g. Meer?
8. In welke zin is dit anders dan reguliere energielevering?
9. Hoe is dit alles financieel geregeld? Is dit anders dan bij oprichting?

Barrieres en innovaties

10. Wat zijn obstakels geweest?
    a. Voor het oprichten
    b. Tijdens leden werven
    c. Bij implementatie van diensten
    d. Denk aan
        i. Idealen (duurzaamheid, zelfvoorziening etc.)
        ii. Regelgevingen
        iii. Financiën
        iv. Technische problemen (opweksysteem / infrastructuur)
        v. Samenwerkingen (netbeheer, energiebedrijf, leden, overheden)
        vi. Kennis (tekort, moeilijke overdracht, leden en niet leden)

vii. Concurrentie

11. Wat is er gedaan om met de obstakels om te gaan?
    a. bescherming
        i. Door aangepaste regelgeving
        ii. Financiele steun
        iii. Wordt de bescherming langzaam verminderd
    b. Permanente aanpassingen
        i. In cooperatie
        ii. Regelgevingen
        iii. Infrastructuur
        iv. Andere partijen

Niche bescherming

12. Is de cooperatie een goede plek om te experimenteren met diensten? Waarom wel/niet?
13. Als de coöperatie akkoord gaat met een proeftuin, hoe zeker is het dan dat leden deelnemen? Waarom?
14. Zijn er veel leden in een geografisch nabij gebied?
    a. Dichtbij kwa infrastructuur?
    b. Makkelijk onder eenzelfde regelgeving te stoppen?

Rol van de netbeheerder

15. Wat is de relatie met de netbeheerder en het coöperatief?
16. Hoe was deze bij de oprichting?
17. Was de netbeheerder betrokken bij invoering van bepaalde diensten?
18. Denkt u dat de netbeheerder een andere/betere kon kan spelen voor coöperaties?
    a. Betrouwbaarheid
    b. Kwaliteit (groen?)
    c. Smart home
    d. Smart grid
    e. Energie opslag
    f. Informerend
        i. Besparingadvies
        ii. Vraag en aanbod data leveren
        iii. Andere data?
    g. Financiele diensten (lage rente lening etc)

Appendix VI: Survey

De Coöperatie

1. Wat is de naam van de Energiecoöperatie waar u bij betrokken bent? *

In welk jaar is de Coöperatie opgericht?

2. Welke partijen waren initiatiefnemer tot het oprichten van de energiecoöperatie? *

- [ ] Burgers
- [ ] Gemeente
- [ ] Provincie
- [ ] Bedrijfsleven
- [ ] Een andere coöperatie
- [ ] Other:

3. Met welke partijen is vervolgens samengewerkt bij het oprichten van de coöperatie *

- [ ] Burgers
- [ ] Gemeente
- [ ] Bedrijfsleven
- [ ] Een andere Cooperatie
- [ ] Overkoepelende organisatie (zoals hieropgewekt of e-decentraal)
- [ ] Other:

4. Wat voor obstakels zijn ervaren bij oprichting van de coöperatie? *

- [ ] Onenigheid door verschillende idealen
- [ ] Regelgevingen
- [ ] Financien
- [ ] Gebrek aan kennis
- [ ] Technische problemen
- [ ] Gebreken in infrastructuur
- [ ] Gebrekkige communicatie
- [ ] Concurrentie
- [ ] Geen obstakels
- [ ] Other:

4a. Kunt u een of meerdere van deze obstakels toelichten?

Kennis

In welke mate is er bij het opzetten van de coöperatie berust op de volgende kennisbronnen?

5. Interne kennis, b.v. kennis van leden *

	1	2	3	4	5	
Niet	◯	◯	◯	◯	◯	In hoge mate

6. Andere coöperaties *

	1	2	3	4	5	
Niet	◯	◯	◯	◯	◯	In hoge mate

Overkoepelende organisaties, b.v. HierOpgewekt of E-Decentraal *

	1	2	3	4	5	
Niet	◯	◯	◯	◯	◯	In hoge mate

8. Consultants *

	1	2	3	4	5	
Niet	◯	◯	◯	◯	◯	veel

9. Boeken, artikelen, websites *

	1	2	3	4	5	
Niet	◯	◯	◯	◯	◯	In hoge mate

10. Hoe moeilijk was het vergaren van benodigde informatie? *

	1	2	3	4	5	
Erg makkelijk	◯	◯	◯	◯	◯	Erg moeilijk

11. Op welke gebieden is er actief naar meer kennis gezocht? *

- [ ] Energie opwek systemen
- [ ] Decentraal opwekken (b.v. aansluiting infrastructuur)
- [ ] Wetgeving
- [ ] Subsidieregelingen
- [ ] Financiën
- [ ] Organisatievormen
- [ ] Het energiesysteem van Nederland
- [ ] Leden werving
- [ ] Other:

12. In welke mate waren de volgende waarden van belang bij het opzetten van de coöperatie? *

	Niet van belang	Nauwelijks van belang	Enigzins van belang	Redelijk belangrijk	Zeer belangrijk
Interesse in nieuwe technologie	○	○	○	○	○
Onafhankelijkheid van fossiele brandstof	○	○	○	○	○
Geldbesparing	○	○	○	○	○
Het samen brengen van mensen	○	○	○	○	○
Zelfvoorziening/onafhankelijkheid van energiebedrijven	○	○	○	○	○
Milieuvriendelijkheid	○	○	○	○	○

13. Wat is het doel van de coöperatie? *

welke rol wil het in de toekomst vervullen

Innovatie

14. Bij welke activiteiten is de coöperatie betrokken? *

- [ ] Levering van elektriciteit
- [ ] levering van collectief opgewekte elektricitet
- [ ] informatie voorziening
- [ ] Slimme meters
- [ ] Slimme netten
- [ ] Energiebesparingsadvies
- [ ] Energiebesparingsmaatregelen
- [ ] Hulp bij aanschaf energie-opweksystemen
- [ ] Gezamenlijke aanschaf opweksystemen
- [ ] Energie opslag
- [ ] Other:

14a. Kunt u een of meerdere van deze activiteiten verder toelichten?

15. Wat voor obstakels zijn ervaren bij het ontwerpen of implementeren van diensten? *

- [ ] Onenigheid door verschillende idealen
- [ ] Regelgevingen
- [ ] Financien
- [ ] Gebrek aan kennis
- [ ] Technische problemen
- [ ] Gebreken in infrastructuur
- [ ] Gebrekkige communicatie
- [ ] Concurrentie
- [ ] Geen obstakels
- [ ] Other:

15a. Welke activiteiten betreft dit en kunt u deze obstakels verder toelichten?

16. Welke andere partijen waren betrokken bij dergelijke projecten?

- [ ] Gemeente
- [ ] Province
- [ ] Staat
- [ ] Netbeheerder
- [ ] Energieleverancier
- [ ] Bedrijfsleven
- [ ] Onderzoeksinstelling
- [ ] Other:

16a. Wat was de rol van deze partijen in het project?

17. De volgende vragen gaan over handelingen ten aanzien van ervaren obstakels *

	Mee eens				Niet mee eens
Om de coöperatie bij te staan zijn er lokale/tijdelijke aanpassingen gedaan in regelgeving	○	○	○	○	○
De coöperatie heeft hinderende regelgevingen omzeilt met creatieve businessplannen	○	○	○	○	○
Andere partijen hebben doelstellingen/ambities aangepast om obstakels voor de coöperatie te verminderen	○	○	○	○	○
De coöperatie heeft door obstakels doelstelling/ambitie moeten aanpassen	○	○	○	○	○
De coöperatie is financieel gesteund door lokale overheid	○	○	○	○	○
De coöperatie heeft veel moeite gestopt in het verkrijgen van financiering	○	○	○	○	○

17a. Kunt u een of meerdere antwoorden op deze stellingen verder toelichten?

18. In welke mate is er over het vermijden/overwinnen van obstakels gecommuniceerd met andere partijen om dergelijke situaties in de toekomst te voorkomen? *

	1	2	3	4	5	
Niet	○	○	○	○	○	In hoge mate

19. Op wat voor manier wenst de coöperatie verder gefaciliteerd te worden ten aanzien van innovatieve projecten?

20. Wat kan het coöperatief bieden bij een innovatief proefproject? *

- ☐ Veel deelnemers aan het project door makkelijke communicatie naar veel leden van het coöperatief
- ☐ Veel deelnemers aan het project doordat leden van het coöperatief interesse hebben in duurzaamheid/innovaties
- ☐ Veel deelnemers doordat leden veel vertrouwen hebben in projecten die de coöperatie selecteert
- ☐ Veel deelnemers in een klein geografisch gebied, doordat een hoog percentage mensen in een dergelijk gebied lid zijn van de coöperatie
- ☐ Goede feedback doordat leden van de coöperatie interesse hebben in duurzaamheid/innovaties
- ☐ Goede feedback doordat leden makkelijk communiceren met de coöperatie
- ☐ Goede feedback doordat leden vertrouwen dat de coöperatie dit op een goed manier zal gebruiken/doorcommuniceren
- ☐ Other:

Rol Netbeheerder

21. Bij welke netbeheerder (elektriciteit) is de coöperatie aangesloten?

- Cogas Infra en Beheer
- Liander
- DELTA Netwerkbedrijf
- Enexis
- Endinet Groep B.V.
- RENDO Netwerken
- Stedin
- Westland Infra

22. Hoe is de communicatie met de netbeheerder? *

	1	2	3	4	5	
Slecht	○	○	○	○	○	Goed

23. Hoe behulpzaam is de netbeheerder? *

	1	2	3	4	5	
Niet behulpzaam	○	○	○	○	○	Erg behulpzaam

24. Hoe stelt de netbeheerder zich op tegenover coöperaties? *

	1	2	3	4	5	
Reactief	○	○	○	○	○	Proactief

25. Wat zou u graag anders zien in de relatie met de netbeheerder? *

26. In hoeverre ziet u de volgende diensten in de toekomst bij de coöperatie of de netbeheerder liggen? *

	Volledig bij de Coöperatie				Volledig bij de Netbeheerder
Onderhoud infrastructuur	○	○	○	○	○
Aanleggen nieuwe infrastructuur	○	○	○	○	○
Management elektriciteit distributie	○	○	○	○	○
Garanderen dat elektriciteit groen is	○	○	○	○	○
Installatie slimme meters	○	○	○	○	○
Onderhoud slimme meters	○	○	○	○	○
Verzamelen van de data van slimme meters	○	○	○	○	○
Distributie van de data van slimme meters	○	○	○	○	○
Management van de data van slimme meters	○	○	○	○	○
Installatie energie opslag systemen	○	○	○	○	○
Onderhoud energieopslag systemen	○	○	○	○	○
Management energieopslag aan de hand van vraag en aanbod van elektriciteit	○	○	○	○	○
Het leveren van energiebesparingsadvies	○	○	○	○	○
Adviseren over energieopweksystemen	○	○	○	○	○
Financiële steun bieden bij aanschaf energieopweksystemen	○	○	○	○	○

27. Zijn er andere energiediensten die u in de toekomst verwacht te zien bij de coöperatie?

28. Heeft u overige opmerkingen over energietransitie, energiecoöperaties en innovaties?

Einde Enquête

Hartelijk bedankt voor uw deelname aan deze enquête. Als u geïnteresseerd bent in de resultaten van het onderzoek kunt u hier uw e-mail adres invullen, dan zullen deze met u gedeeld worden.

E-mail adres