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Energy Cooperatives in Denmark, Germany and Sweden - a Transaction Cost Approach

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Energy cooperatives in Denmark, Germany and Sweden - a transaction cost approach

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Abstract: By 2020, at least 20 percent of the gross final consumption of energy in the European Union should be produced from renewable energy sources. The cooperative movement as such is not new, but has a long history in the agricultural and credit sector. Over the last years, energy cooperatives have become an important option for decentralized electricity production. The transaction cost theory has been applied numerous times to agricultural cooperatives, but not to energy cooperatives. A number of case studies and a subsequent survey analyzed the main benefits and challenges associated with energy cooperatives as well as their relation to each other.
The study revealed that while Denmark and Sweden focus mostly on wind power as a source for their electricity generation, German cooperatives use a more diversified portfolio. The differences are due to national legislation and affect the total installed capacity as well as membership numbers. Although the individual motives to join a cooperative vary, the reasons to establish a cooperative clearly show a dedication to support renewable energies. The most important benefits associated with this organizational form are the positive environmental impact as well as local value creation, ownership aspects and the limitation of the individual liability. Contrarily, most of the disadvantages discussed concern factors outside of the cooperatives such as the change of regulatory frame conditions and the insecurity towards the development of the electricity price. Transaction costs play a minor role since professional governance structures are in place and the trust among members prevents opportunistic behavior.

Keywords: Cooperative, energy, renewable energy, sustainable development, transaction costs.

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Summary: Energy cooperatives can be defined as a voluntary and democratic organization, focusing on renewable energies in order to meet the members' shared economic, social, and cultural needs. Cooperatives are also known in the agricultural and credit sector. Recently, energy cooperatives have been an increasingly important option for a decentralized electricity generation. The transaction cost theory has been applied numerous times to agricultural cooperatives, but not to energy cooperatives. Transaction costs have been developed as a part of the new institutional economics framework, a term coined by Oliver E. Williamson with the underlying principles of methodological individualism, bounded rationality and opportunism. The costs arise as a consequence of economic actors' behavior and the subsequent need for supervision. As energy cooperatives deal with large financial sums and have to make decisions which are hard to reverse, aspects of free riding and difficult decision-making have a possible impact on the cooperatives. Consequently, a number of case studies and a subsequent survey analyzed the main benefits and challenges associated with energy cooperatives as well as their relation to each other.

The study revealed that while Denmark and Sweden focus on wind power, German cooperatives use a more diversified portfolio. The differences are due to national legislation and affect the total installed capacity as well as membership numbers. Although the individual motives to join a cooperative vary, the reasons to establish a cooperative clearly show a dedication to support renewable energies. The most important benefits associated with this organizational form are the positive environmental impact as well as local value creation, ownership aspects and the limitation of the individual liability. Contrarily, most of the disadvantages discussed concern factors lying outside of the cooperatives such as the change of regulatory frame conditions and the insecurity towards the development of the electricity price. Transaction costs play a minor role since professional governance structures are in place and the trust among members prevents opportunistic behavior.

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Abbreviations

EU	European Union
GW	gigawatt
GWh	gigawatt hour
kW	kilowatt
kWh	kilowatt hour
MW	megawatt
PJ	petajoule
RE	renewable energy
UN	United Nations

1. Introduction

> "*With a growing share of renewable energies, the energy turnaround becomes more decentralized. Cooperatives play an important role because they are able to bring together people with economic actors and other local stakeholders, and ultimately produce also a broad societal consensus. This is a crucial pillar of a successful energy transition"* (Gabriel, 2014, para. 2).
>
> "*The energy turnaround has the chance to become a democratic turnaround"* (Sladek, personal communication, 2015).

The global energy system currently experiences stressful times. Turmoils in parts of the Middle East, the conflict between Russia and Ukraine (International Energy Agency, 2014), and the still growing global CO_2 emissions pose strains on the energy generation. The recent developments lead to insecurity with respect to long-term and capital-intensive investments (Canes-Wrone and Park, 2014). Moreover, large infrastructure projects, especially in the energy sector, often face local resistance (Keir and Ali, 2014). One attempt to overcome these conflicts is to focus on local, small-scale renewable energy (RE) projects.

1.1. Background

Renewable energies can be characterized as "*energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases*" (European Union, 2009, p. 27). The IPCC defines RE as "*any form of energy […] that is replenished by natural processes at a rate that equals or exceeds its rate of use. Renewable energy is obtained from the continuing or repetitive flows of energy occurring in the natural environment and includes low-carbon technologies such as solar energy, hydropower, wind, tide and waves and ocean thermal energy, as well as renewable fuels such as biomass*" (Edenhofer *et al.*, 2012, p. 958).

The European Union has set a target for at least a 20 percent share of energy from renewable sources in the gross final consumption of energy by 2020 (European Union, 2009). All member states have national targets depending on their potential for RE and also the base level in 2005. With the directive the EU tries to achieve that energy prices contain the external costs of energy production and consumption, including environmental, social and healthcare costs (European Union, 2009, p. 19).

The UN declared 2012 as the International Year of Cooperatives "*recognizing that cooperatives, in their various forms, promote the fullest possible participation in the economic and social development of all people*" (United Nations, 2009, p. 1). The cooperative movement is not new; it is described in empirical records in England around 1850 (Anderson and Herr, 2007). Cooperatives are predicated on the values of "*self-help, self-responsibility, democracy, equality, equity and solidarity*" (The International Co-operative Alliance, n. d.) and have formulated seven principles, among them voluntary and open membership, democratic member control and concern for the community (*ibid.*).

A cooperative can be defined as a "*user-owned and controlled business from which benefits are derived and distributed on the basis of use*" (Dunn, 1988, p. 85). Cooperatives have been long known in the agricultural sector with varying scopes and ranges. The so-called "farm marketing cooperatives" could for example bargain the price on behalf of their members, process the crops or even turn them into finished products and market those (Hansmann,

1996). The importance of this organizational form can be underlined by taking into account the market share. By the early 1970s, cooperatives accounted for 48 percent of the agricultural market in Germany, over 70 percent in Denmark and 80 percent in Sweden (Hansmann, 1996, p. 123). More recent data points in the same direction: With an EU-27 average of 40 percent market share, agricultural cooperatives have a market share of around 60 percent in Denmark and Sweden and 45 percent in Germany (Bijman *et al.*, 2012, p. 30).

At least for Germany, energy cooperatives have a long history as well, although not as persistent as the agricultural cooperatives or credit association (Bonus, 1986; Yildiz, 2014). By the end of the 19th century, cooperatives were formed to produce energy, install and operate a distribution grid since larger companies did not operate these yet due to low profitability. With the 20th century focus on rather cheap and abundant fossil fuels (Yildiz, 2014), the recent attempt to promote renewable energies led to a revival of energy cooperatives. Energy cooperatives, also called citizen energy or community energy, mostly realize RE projects and allow the participants to engage in the decision-making of local energy policy (Yildiz, 2014, p. 681). Moreover, they are enterprises striving for "*the economic, social, and cultural advancements of its members by following goals other than profit maximization*" (Yildiz *et al.*, 2015). Especially the democratic principles, expressed by the "*one-member-one-vote principle*" (Yildiz *et al.*, 2015, p. 60), allow members to strive towards a more sustainable future. The author of this thesis defines energy cooperatives as a voluntary and democratic organization, focusing on renewable energies in order to meet their shared economic, social, and cultural needs.

Cooperatives can be distinguished by several characteristics. One is the distinction between consumer and cooperatives. Consumer cooperatives are owned and operated by their users, such as housing cooperatives or credit union producer cooperatives (Spear, 2000, p. 508). Another example are farm supply cooperatives that provide the agricultural sector with fertilizer, livestock feed and seeds (Hansmann, 1996). Contrarily, producer cooperatives are owned by suppliers such as agricultural marketing cooperatives (Spear, 2000, p. 508). If multiple stakeholders are involved in the cooperative and thereby combine different types of members such as suppliers as well as consumers, a hybrid form is created (Spear, 2000, p. 508). Energy cooperatives can be counted as such an organizational form.

Another approach is to differentiate the energy cooperatives across the industry value chain, as proposed by Porter (1985). The industry value chain consists of all activities of value creation in the industry from the raw materials to the production and distribution of goods. Keeping his model in mind, energy cooperatives can be distinguished according to their primary activity such as generation and production, distribution and transmission or trading (Yildiz *et al.*, 2015). Lastly energy cooperatives can also be classified according to their maturity, *e.g.* start up, community scale developer or mature cooperative (Viardot, 2013).

Research in the field of cooperatives has focused on the benefits and challenges associated with the organizational form as well as the motivations behind founding one. The establishment of a cooperative can be seen as a response to countervail excessive market power which is expressed through monopolistic or oligopolistic structures (Spear, 2000, p. 512). The existing institutions are able to exploit the customers by setting high prices or offering poor quality (Huybrechts and Mertens, 2014). Moreover, cooperatives can fill a role where the state is unable to provide a certain quantity or quality of quasi-public products, such as health care and education (Spear, 2000, p. 513). Since cooperatives do not strive for profit maximization, they are able to produce positive externalities as well which is not feasible for investor-owned firms (Huybrechts and Mertens, 2014, p. 198). The cooperative model which is a particular type of a democratic organization has been depicted as one of the best solutions

for governing common resources (Ostrom, 1990). Still, the legitimacy to establish a cooperative might vanish when the state enacts proper regulation to correct the market failure or provides an acceptable quality and quantity of products (Hansmann, 1996). Therefore, other reasons foster the foundation of cooperatives. The desire to influence the local energy policy decisions as well as active and democratic participation are motivations to form a cooperative (Yildiz *et al.*, 2015). Lastly, also financial reasons motivate residents to come together and form a cooperative. While the local citizens expect an improvement in incomes, local authorities are motivated by increases in tax revenues as well as an improved image (Li *et al.*, 2013).

The establishment of cooperatives based upon the fact that current institutions abuse their market power is a key benefit since existing structures are challenged which leads to an improved competitive situation (Bonus, 1986; Hansmann, 1996; Huybrechts and Mertens, 2014). As cooperatives are built upon democratic principles, participation and a democratic decision-making is seen as a benefit (Spear, 2000). Trust among the members helps to overcome asymmetric information and opportunistic behavior (Hansmann, 1996). The notion of trust significantly lowers the enforcement costs attributed to governance structures (Sagebiel *et al.*, 2014). Moreover, cooperatives are founded by a group of people which reduces the individual financial risks (Hansmann, 1996). Cooperatives lower the individual liability and thus make them an interesting choice for large scale energy projects (Yildiz *et al.*, 2015). In the case of energy cooperatives, the main benefits can be attributed to "*lower energy costs, a local approval and planning permission and a local income*" (Walker, 2008, p. 4402).

Cooperatives face several challenges. Of particular interest are problems that occur because the benefits of joint action accrue to every member and thus individuals might be tempted to ride on the efforts of others (Bomberg and McEwen, 2012). As the individuals engaging in cooperatives have heterogeneous interests, trust and aspects of conflict resolution become crucial success factors (Yildiz *et al.*, 2015). To lower the free riding problem, governance structures are established. The enforcement of those monitoring activities is connected with costs (Ménard, 2004). Although a cooperative benefits from the participatory and democratic approach as shown above, running the organization leads to substantial organizational costs (Yildiz, 2014) compared to other organizational forms. These costs can be subsumed under the term transaction costs (cf. chapter 2.2). As stated above, energy cooperatives are also called community energy projects. Keeping the prior challenges in mind, the notion of community needs a critical reflection. Two groups can be distinguished – communities of locality and communities of interest. While community of interest refers to individuals sharing a common interest but who are not geographical close to each other, community of locality points towards a spatially defined area that can be embellished in various ways (Walker, 2008). Especially for the case of energy cooperatives, capital intensive investments are needed. This might pose a challenge for collective ownership (Hansmann, 1996). Other barriers to establish such an organization may lie in economies of scale since existing producers can offer their services at a lower marginal cost due to their size of production, government regulation or customer loyalty (Huybrechts and Mertens, 2014). Furthermore, technical barriers might occur due "*a lack of equipment, technical knowledge and expertise*" (Bomberg and McEwen, 2012, p. 436). The benefits and challenges associated with energy cooperatives show that the application of this organizational model depends on the context (Huybrechts and Mertens, 2014).

1.2. Problem

With respect to the background description above, cooperatives have been quite successful in the agricultural sector with high market shares. Contrarily, the majority of electricity in

Denmark, Germany and Sweden is currently produced by large companies such as Dong Energy, E.ON or Vattenfall (Dansk Energi, 2009; Bundesnetzagentur, 2014; Energimarknadsinspektionen, 2014). As shown above, comprehensive research on the benefits and challenges associated both with agricultural and energy cooperatives has been conducted with a special emphasis on Germany. Most research has focused on either one case or a spatially limited area (Rogers *et al.*, 2008, Li *et al.*, 2013, Yildiz, 2014). Still, the question remains whether applicability of the transaction cost theory can be transferred to energy cooperatives. Based upon the strong number of growth energy cooperatives experienced in the past years (Huybrechts and Mertens, 2014), it consequently seems to be essential to get better understanding of the benefits and challenges attributed to energy cooperatives.

Since energy cooperatives differ from agricultural cooperatives especially when it comes to the specificity of investments (Ménard, 2004) and the long-term nature of those, it is unclear how this affects the benefits and especially the challenges (Yildiz *et al.*, 2015). Energy cooperatives have highly specific investments since the investment *e.g.* in a wind turbine cannot be changed easily. Moreover, wind turbines have to be installed a particular place to be able to function properly. Due to the high financial costs of energy facilities, a longer time horizon is needed to reach a break-even. As depicted above, the free rider problem and its countermeasures lead to increased transaction costs. This is particularly critical because the investments in energy projects are capital intensive (Simelane and Abdel-Rahman, 2011). Furthermore, the size of cooperatives has an impact on the decision-making and the possibility for participation (Sagebiel *et al.*, 2014), which is also highly interesting for the governance structures and the attributes that constitute cooperatives. Lastly, an empirical gap exists on the features of energy cooperatives in Sweden and Denmark, although energy cooperatives are also strongly concentrated in Sweden and Denmark (Huybrechts and Mertens, 2014).

1.3. Aim and research questions

The research aim is to assess in what way the transaction cost theory is applicable for energy cooperatives based on the existing knowledge coming from agricultural cooperatives. The thesis' aim will be achieved by focusing on the following questions:

- What are the main benefits connected with energy cooperatives?
- What are the major challenges that can be attributed to energy cooperatives?
- How are the benefits and challenges related to each other?

In order to answer those questions, a special emphasis will lie on the size and location of the cooperatives since these factors have been neglected in a transnational analysis so far.

1.4. Delimitations

The main delimitation of the study is the unit of analysis. As from Porter's theory (1985), there is a large variety of energy cooperatives. This research will focus on cooperatives producing electricity which makes the collected data comparable and allows a consistent application of the theoretical framework. Moreover, the choice of countries refers to the fact that agricultural cooperatives are well-spread in developed market economies. Since the electricity markets are comparable (c.f. chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**), it appears to be a justifiable choice to concentrate on Denmark, Germany

and Sweden. Lastly, it can be assumed that those countries hold similar values (Schwartz, 1992) so a meaningful discourse on the motivation can actually be conducted.

This thesis builds upon the ideas of the new institutional economics theory, mainly transaction cost and agency theory. Other theoretical foundations for analyzing the role of cooperatives could derive from political or behavioral science. The theoretical framework of transaction costs is well established (cf. chapter 2), but only few empirical studies in the field of energy have been conducted (Yildiz *et al.*, 2015, p. 70). Consequently, it seems to be a just approach.

Finally, this study follows a rather qualitative approach. The distinction between the approaches will be further elaborated in chapter 3, also with a particular emphasis on the differences between qualitative and quantitative approaches. Since a transnational comparison using the transaction cost theory has not been conducted yet, a qualitative approach seems to be justified to explore the field. Moreover, the study employs varying methods which allows triangulation and thereby a higher significance of the research results.

After providing a general overview on the background of cooperatives and energy cooperatives in general, chapter 1 stated the problem as well as the research aim and the subsequent questions followed by giving a short summary on the delimitations of the study. Chapter 2 focuses on the theoretical background by stating the underlying beliefs on the new institutional economics. Transaction cost theory and agency theory are presented and also criticized. Chapter 3 gives an overview on the chosen methods while the following chapter presents the results from the case studies and the online questionnaire. To make the results more understandable, the situation on the countries' electricity markets are introduced. Chapter 5 focuses on the analysis of the results; the following chapters discuss the results and summarize the thesis' content.

2. New institutional economics as a framework

Analyzing energy cooperatives from an economic point of view poses the consequent question why cooperatives should be formed at all. Two reasons for establishing a cooperative can be found in the literature, one being that producers need institutional mechanisms to bring economic balance under their control, the other being a protection against opportunism and holdups when markets fail (Cook, 1995, p. 1155). These reasons are part of the theoretical framework of new institutional economics, a term coined by Oliver E. Williamson. He argues that micro economics operates a level which is too abstract to explain the observed phenomena (Williamson, 1975). Moreover, he puts the "*study of transactions*" at the core level asking for a focus on transaction costs as a possible explanation for observed economic behavior (Williamson, 1975, p. 1). This demand is supported by others, who attribute the failures of neoclassical economic theory to the disregard of transaction costs and cognitive limitations of human agents (Furubotn and Richter, 2005). The beginnings can be traced back to the early 1960s, whereas operational content began to appear in the early 1970s (Williamson, 1985).

The following chapters will give an overview about underlying beliefs and concepts of the new institutional economics, before focusing more in-depth on institutions, transaction costs and the principal agent theory. Obviously, other theoretical approaches such as behavioral economics could have been used in order to find suitable explanations. With reference to chapter 1.1, the transaction cost theory has not been applied to energy cooperatives thoroughly, most importantly not in a transnational approach. Transaction cost theory is therefore a sound approach to addressing the research questions. The main criticism will be presented in chapter 2.4

2.1. General beliefs and underlying concepts

The new institutional economics mark the renunciation of the formerly prevalent model of the homo economicus or economic man (Dugger, 1990). The economic man is defined as an individual that makes rational decisions in order to maximize the utility under certain restricting boundaries (Leibenstein, 1976, Black *et al.*, 2009). Moreover, the individual is supposed to have „*a well-organized and stable system of preferences*" (Simon, 1955, p. 99), which should lead to fair assessment of personal material costs and benefits (Frank, 2006) The term emerged in reaction to John Stuart Mill's work on political economy (Persky, 1995, p. 222).

Critics argue that assuming fully rational choices, individuals must be aware of all possible consequences, their dimension and probability to make well-informed choices. As this only seems feasible with the help of computer intelligence, the assumption of rationality becomes obsolete, especially when it comes to information gathering since completeness here is only achievable at a very high cost (Simon, 1955, p. 106). Moreover, a particular moral behavior is expected of individuals such as honesty or following a certain code of conduct. The issue of opportunism is relevant, but not addressed in the original concept of the homo economicus (Furubotn and Richter, 2005).

Consequently, the original concept of the homo economicus seems to have limited applicability for this study. The following sub-chapters focus on the underlying beliefs of new institutional economics.

2.1.1. Methodological individualism

Methodological individualism means that the analysis of economic approaches should center on individual behavior. As actions can only be performed by individuals, their preferences are important to keep in mind when analyzing collective actions (Kirchgässner, 2008). Consequently, organizations do not have separate preferences that are independent from those of their members. Methodological individualism emphasizes the fact that individuals, even when they work together towards a shared goal, have different interests, tastes, purposes and ideas (Furubotn and Richter, 2005).

2.1.2. Bounded rationality, uncertainity and complexity

With reference to the criticism of the homo economicus presented above, the assumption of a rationally acting actor is replaced with the concept of bounded rationality that takes into account that human behavior is "*intendedly rational, but only limitedly so*" (Williamson, 1975, p. 21), which is due to neurophysiological and language limits. This takes into account that decision makers cannot be fully informed for each decision they make. Moreover, as shown below, trying to acquire every piece of information becomes economically unviable with the introduction of transaction costs. Bounded rationality apart from the human limitations can be illustrated by looking at the example of uncertainty and complexity. An example of the limited human capacity is the so-called travelling salesman problem. The task is to find the shortest route with a given list of cities and distances between them so that each city is just visited once while returning to the starting point at the end. With only a couple of cities, the problem is solvable since the options are limited. If one only has a map with the cities instead of the distances, the uncertainty increases while it becomes more complex to make a decision based on the existing information. While computers can solve these problems using algorithms, humans lack this capacity and consequently have to make decisions based on a bounded rationality. This can lead to information impactedness since the conditions affecting a decision might be better known to one party than another (Williamson, 1975, p. 31).

2.1.3. Opportunism

Opportunism can be defined as an attempt to change the terms of an agreement although both parties have already agreed on the content (Black *et al.*, 2009). This certain behavior "*involves self-interest seeking with guile and has profound implications for choosing between alternative contractual relationships*" (Williamson, 1975, p. 26). As the economic man tries to pursue his self-interest, some actors try to disguise preferences or distort data in order to have an advantage (Furubotn and Richter, 2005). Since the bounded rationality prevents individuals from concluding an agreement in a way that anticipates every possible opportunistic behavior, control mechanisms must be enforced. If the actors involved could rely on the premise that everybody involved would act in an honorable way, it would not pose a problem. Contrarily, opportunism leads to the result that actors will take advantage of this failure to foresee possible actions. Therefore, opportunism is to be seen as a behavioral uncertainty (Williamson, 1985).

A well-known example of opportunism is the case of Enron. Enron filed for bankruptcy in 2001, which at that time was the largest case of a cooperation going bankrupt (Arnold and Lange, 2004). Enron's rise began with the deregulation of natural gas pipelines which Enron used to sell energy derivatives which contractually secured both supply and the price to the customers (*ibid.*). Traders were compensated with bonuses depending on short-term earnings, which created paranoia "*as trading contracts were developed with highly restrictive confidentiality clauses to protect self-interest* […]. *Secrecy and minimal information disclosures became a cultural corporate mechanism of survival*" (Arnold and Lange, 2004, p. 754). As information were protected, control mechanisms were overridden which reinforced

the behavior.

Another example of opportunistic behavior is the prisoner's dilemma. The situation is depicted as following: Two members of a criminal gang are arrested. They are individually presented two options. Either they choose to cooperate with the other imprisoned member by not talking with the authorities, or they defect by blaming the other gang member to have committed the crime. They are not allowed to communicate with the other prisoner before making the decision. The charges depend on the behavior with three different outcomes possible. If they cooperate, they will face a minor charge. If one defects while the other one chooses to cooperate, the informer will be set free while the other gang member will face the highest charges. If both defect, the sentence will be moderate (Parkhe, 1993). Since the two prisoners are not allowed to communicate with each other, they have to make their decision in a way that will maximize their individual utility. Table 1 shows the possible outcomes by stating the sentences for both A and B with the sentence for A listed first.

Table 1: Prisoner's dilemma

	A cooperates	A defects
B cooperates	1/1	0/3
B defects	3/0	2/2

Since both actors cannot be sure how the other gang member decides, they will choose to defect instead of cooperating which would reduce their sentence. An individually rational choice can lead to irrational outcomes (Ostrom, 1990, p. 5) which seems paradoxical. At the heart of opportunism is the problem of free riding: "*Whenever one person cannot be excluded from the benefits that others provide, each person is motivated not to contribute to the joint effort, but to free-ride on the efforts of others*" (Ostrom, 1990, p. 6).

2.1.4. Consequences

As described above, the actors do not behave as rationally as the economic theory would like them to. Contrarily, decisions are made under uncertainty and a high complexity. Since individuals will act opportunistically when given the possibility, the question becomes how to set up an organization that provides more benefits and reduces the risk of harm to the individual by acting jointly (Ostrom, 1990, p. 39). What is needed is a set of rules that improve the possibility of predicting and steering human behavior.

This function is fulfilled by "institutions". Those can be defined as *"the legal, administrative and customary arrangements for repeated human interactions*" (Pejovich, 1995, p. 30). The purpose of an institution is to navigate human behavior towards a particular direction. When individuals use institutions, organizations are created. An organization "*is a group of individuals seeking to achieve some common goals* […]. *Each member has objectives of his own, in general not coincident with those of the organization*" (Feiwel, 1987, p. 53). Contrary to an organizational approach, another possible solution to act jointly is to use the market mechanism and to conclude contracts. Coase described in the 1930s that there is a certain cost for using the price mechanism that is inherent to the market (1937, p. 390). These costs can be described as transaction costs and can be seen as an approach to justify the use of the organizations instead of the market approach. Therefore, the chapter 2.2 gives a more detailed view on transaction costs and institutional arrangements. Since energy cooperatives are an organizational form, the questions of management and actual monitoring need to be discussed as shown above because actors might have objectives that are contrary to the ones of the organization. Thus, chapter 2.3 concentrates on agency theory which deals with the interaction between agents and principals.

2.2. Transaction cost theory

Generally, economic analysis focuses on costs in a production setting, such as the costs for

raw materials, labor and overhead costs. Contrarily, transaction cost theory rather focuses on the economic interaction between two parties, not specifically on a production setting. A transaction can be defined as actions "*when a good or service is transferred across a technologically separable interface*" (Williamson, 1985, p. 1). The original idea of transaction costs links back to Coase's findings. He described that the costs of negotiating and concluding contracts is more expansive using the market mechanism instead of establishing a firm (Coase, 1937, p. 390). Although most research focuses on the distinction between using a firm versus the market mechanisms as two organizational approaches, the concept is applicable to different governance forms (Sykuta and Cook, 2001), such as cooperatives. At the heart of transaction cost theory is the idea to decide which organizational approach should be used, based upon the relative efficiency of each mode (Williamson, 1975). The following subchapters will provide deeper insights on varying ways of distinguishing transaction costs as well as their determinants.

2.2.1. Different kinds of transaction costs

A possible way of categorizing transaction costs is to analyze the time frame when engaging in transactions. Before an agreement is made, an agreement needs to be drafted, negotiated and also safeguarded (Williamson, 1985). These costs are called ex ante costs since they occur prior to the transfer of goods and services. Naturally, costs can also arise after a transaction has been completed and are consequently named ex post costs and consist of maladaptation costs, the bargaining costs for correcting formerly faulty agreements, the costs for setting up and running certain governance structures which ensure the compliance of agreements and lastly costs of ensuring the obligation of parties involved. Transaction costs, similarly to production costs, can vary depending on the number of transactions. When the number of transaction influences the transaction costs, then they are called variable transaction costs, whereas otherwise those are fixed transaction costs.

With reference to the two prevalent options of organizing transactions, the costs associated with using the market mechanisms (market transaction costs) can be distinguished from costs that occur because of utilizing an organization (managerial transaction costs). Market transaction costs can be classified as search and information costs, costs of bargaining and decision making and costs of monitoring and enforcing the contractual agreements (Furubotn and Richter, 2005, p. 52). Examples for search and information costs are the expenditures for gathering information such as conducting a feasibility study on whether a location is feasible for a wind turbine. Moreover, the opportunity cost of the time invested in finding and gathering the information must also be included in the analysis. This aspect is also of high importance for the bargaining and decision costs which also include legal advice and the expenses for making the gathered information and data usable. Lastly, costs for supervision and enforcement accrue. Those occur because of the necessity to monitor whether the subject matter of a contract arrive on time, in the right quantity and quality. As before, those expenses deal with information again – for that it is crucial to know the expected properties and conditions of the subject matters of the contract. To conclude, the costs of using the market mechanism mostly consist of bargaining and varying forms of information costs.

Managerial costs can be split into two groups – the costs of setting up, sustaining, or altering an organization as well as actually running the organization (Furubotn and Richter, 2005, p. 54). The costs of setting up and maintaining the organization entail the expenses for personnel, public relations and are typically fixed transaction costs. Contrarily, the costs of running the organization are again information costs, but this time especially to prevent opportunistic behavior. These costs are typically associated with the governance of an organization. Expenses associated with running an organization can also be due to the physical transfer to goods and services, although this is not applicable in the case of energy

cooperatives since they produce an intangible product.

2.2.2. Determinants of transaction costs

Transaction costs are influenced by the asset specificity, uncertainty regarding and frequency of transactions (Williamson, 1985, p. 52). When an investment is made but would lose almost all of its value if it was redeployed, this investment is highly specific. An example is the acquisition of a machine which is built in a way that it fits spatial requirements of the manufacturing site. This machine loses value when it would be moved or sold to a different company since the spatial requirements will differ. The given instance is an example of physical asset specificity; site specificity, human asset specificity and dedicated assets are others (Williamson, 1985, p. 55). While site specificity focus on the characteristics of a production site and could be for example natural resources, human asset specificity is a result of learning processes, for example for an employee being trained on a company specific software. Dedicated assets are those that have been put to a certain appropriation which would not have been used in the same way without the prospect of using them for a specific purpose (Williamson, 1985, p. 95). An example is the investment in large production capacities with the prospect of selling high quantities to one customer – this creates a dependency and thus the term dedicated assets.

With reference to the underlying concepts of new institutional economics, uncertainty becomes relevant for determining transaction costs as a direct consequence of opportunistic behavior. Moreover, uncertainty together with specificity increases the transaction costs. The more specific and the more unsecure a transaction is, the higher are the market and managerial transaction costs. A similar logic applies to the frequency of transactions. Creating special governing mechanisms for a small number of transactions is more costly compared to larger number recurring transactions. Constructing a wind turbine for instance is an occasional and highly specific transaction, while purchasing standard production material is a recurrent and non-specific transaction. The given example underlines the importance of the theory for energy cooperatives since they deal with similar circumstances.

2.3. Agency theory

The premise of behavioral uncertainty becomes relevant especially when using an organizational approach. Naturally, at least two actors are involved in an economic transaction where one (the principal) engages the other (the agent) to perform action on the principal's behalf (Jensen and Meckling, 1976). After concluding the contract, there is an imbalance between the principal and the agent because the agent's action is not directly observable by the principal (Furubotn and Richter, 2005). As it is too costly for the principal to monitor every action of the agent, the underlying idea is that the agent will not act in the best interest of the principal (*ibid.*). A well-known example is the relationship between the stockholders and managers of a corporation associated with the issue of separation of ownership and control. The question therefore arises how to prevent those situations where agents exploit their advantage, which subsequently asks for monitoring schemes. Moreover, incentives can limit the agent's interest to exploit the information advantage and rather commit to the principals' benefits. Those costs can be subsumed with the term "agency costs". Trust and reputation can significantly lower the agency costs, which is of high importance for cooperatives.

2.4. Critique

The subsequent chapter will give a short overview of the critics associated with new institutional economics, transaction cost and agency theory. Firstly, Williamson's focus on the market as the one institution to explain the functionality of capitalism is criticized as being ideological (Ankarloo and Palermo, 2004, p. 426). Moreover, the authors excoriate the fact that institutions are merely seen to fulfill an allocative purpose of scare resources instead of for example fulfilling regulatory responsibilities. Furthermore, critics argue that organizations are seen to be less efficient than the market mechanisms, although from their perspective companies are efficient and consistently invent products and services. Markets should therefore be seen as the "*beginning where organizations fail*" (Ghoshal and Moran, 1996, p. 30).

Similarly, the critique on transaction cost economics focuses on the underlying assumptions of the new institutional economics, dominantly the assumption of opportunism. While Williamson argues, as shown above, that opportunism can be reduced by monitoring and control mechanisms, the effect can also work the other way around. Controls enforced by organizational structures can create negative feelings towards the institution and thus increase the likelihood of opportunistic behavior (Ghoshal and Moran, 1996, p. 23).

With respect to agency theory, the information asymmetry between the actors involved is questioned. While agency theory is built upon the premise that an imbalance exists between agents and principals, other models assume that both parties share the same information (Caers *et al.*, 2006, p. 27) and thus no opportunism could occur.

Although the critics raise valid points, this thesis will still employ the new institutional economics' approach with a focus on transaction cost and agency theory, especially for the reasons stated in chapter 1.2. These theoretical foundations have successfully been used in analyzing agricultural cooperatives and can therefore most likely be used for energy cooperatives. Since the investments in energy facilities are more specific compared to agricultural organizations – agricultural equipment can be redeployed , an interesting field of research offers the possibility of employing a variety of approaches.

3. Method

The following chapter gives a background on the choice of methods. Often, qualitative and quantitative methods are seen as a dichotomy, *i.e.* as opposites (Creswell, 2009). While a quantitative social research approach is based upon a deductive logic testing existing theories and frameworks, focuses on the behavior and tries to measure and quantify data, a qualitative research uses a rather inductive approach and emphasizes the importance of the contexts which is underlined by a focus on meanings (Robson, 2011). Qualitative approaches concentrate on the verbal or non-numerical findings where the researcher is able to get close to the participants (*ibid*). Contrarily, the quantitative method rather focuses on a generalization of data and therefore distance and standardization of research procedures (*ibid*). Still, the two different approaches need to be seen as two ends of a continuum (Creswell, 2009) since also a mixed methods approach that integrates both qualitative and quantitative research techniques (Yin, 2013) is possible. Mixed methods research or also multi-strategy research allows for the two types of method in the same project (Robson, 2011). The benefit of such an approach is to profit from the strengths of the concepts and consequently increases the overall robustness of the study which is then greater than either a qualitative or quantitative research (Creswell, 2009). A possible difficulty lies in the fact that traditionally researchers have been trained in one particular research approach and thus may not have the diverse skills needed to conduct multi-strategy (Robson, 2011).

As the choice of method depends on the research aim as well as the corresponding questions and reflects the researcher's underlying assumptions, the choice needs to be motivated with respect to the criteria stated above. For this thesis, a multi-strategy research will enable the researcher to answer the research questions. Since the theoretical framework is well-known, a deductive approach can be used. Still, the transaction cost theory has not been applied to energy cooperatives yet. Moreover, some level of generalization should be reached as well. Lastly, analyzing the influence of size and location on energy cooperatives asks for some kind of accuracy, precision and statistical analysis.

Therefore, the research was conducted in two phases. The qualitative phase came first in order to get a better understanding of the topic. The requirement for a quantitative analysis is that "*you know what kind of information you want to collect*" (Robson, 2011, p. 242). Therefore, a series of interviews were conducted and presented in a case study format which allows to "*explore the topic with participants at sites*" (Creswell, 2009, p. 206). The quantitative data allows a discussion on a more abstract level and decrease the bias attached to the researcher. This data was generated through a questionnaire asking mostly closed questions on themes that have been brought up in the interviewing phase. The primary focus of this model is to explore the applicability of the transaction cost approach on energy cooperatives. The choice for this research approach can also be motivated by the fact that it allows for triangulation. The multiple sources of data investigate the same phenomenon and thus strengthen the construct validity of the thesis (Yin, 2013, p. 121).

The following paragraphs briefly describe the two different methods used in this thesis. The qualitative phase will be investigated using case studies built upon interviews, whereas the quantitative phase will employ an online questionnaire.

3.1. Case study

A case study can be defined as *"an empirical inquiry that investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident*" (Yin, 2013, p. 16).

As case studies can be built upon varying qualitative and quantitative methods, they consequently need to be understood more as a research strategy than a method (Eriksson and Kovalainen, 2008, p. 116). Therefore, this chapter focuses on the case study approach, whereas chapter 3.2 concentrates on the method employed in creating the case studies.

Case studies have a long history across academic disciplines such as psychology, law, medicine and sociology (Eriksson and Kovalainen, 2008, p. 115). Still, the approach has been subject to some criticism. One concern is that the results from a case study might not be generalizable (Yin, 2013). Nobody would dare to generalize the findings from one experiment, but rather from a series of experiments conducted under the same condition. A case study therefore tries to achieve an analytic generalization by expanding knowledge in a specfic field rather than a statistical generalization by proving the existence of a general rule. Secondly, another concern is that case studies take too much time and consume too many resources (Yin, 2013). The effort for a case study, however, depends on the chosen method and thereby varies a lot. Participant-observation might be a higher effort than conducting interviews. Lastly, case studies can be seen as having a comparative advantage over other research approaches. As different research strategies employ varying questions in order to reach their research aim, case studies can rather ask "*how and why questions*" (Yin, 2013, p. 9) whereas randomized controlled trials or so-called real experiments allow the analysis of the effectiveness of certain treatments or inventions (Yin, 2013). All in all, case studies, especially for this thesis, are a powerful tool for examining the underlying relations between thoughts and actions amongst individuals and organizations (Woodside, 2010, p. 3).

Rather than just creating one case study, this thesis will work towards multiple case studies. This approach is in line with the research aim and questions since the situation in three countries should be examined. Although taking more time and resources than single cases, the evidence from multiple cases are seen more robust (Yin, 2013, p. 57). The unit of analysis remains untouched, i.e. multiple cases with the same unit of analysis are generated which allows a holistic analysis. As described below, the case studies were chosen from a pool of energy cooperatives in the respective countries. Emails were sent out to a sample of cooperatives differing in size and location in order to gain a broader overview of the issues relevant to the cooperatives. The case study design was not tested for construct validity or internal validity. Since the case studies are part of mixed methods research, the findings of the case studies are tested in a survey which allows potentially a certain generalization. The questionnaire used to validate the case studies is attached in Appendix 3. All information other than the interviews is referenced.

3.2. Interview

When choosing a method in order to meet the requirements described above, one has the choice between several alternatives. Feasible approaches to collecting qualitative data include participant observation, focus groups interviews or narrative analysis (Liamputtong and Ezzy, 2005; Hesse-Biber, 2010). This thesis employs a case study approach based on semi-structured interviews. Interviews have the advantage that they are focused on a particular issue and provide both insightful explanations and personal views (Yin, 2013, p. 106). On the other side, interviews can have an inherent bias due to poorly articulated questions. Furthermore, interviewees can create inaccuracies since they might recall wrongly the true nature of events. Lastly, interviewees might feel a pressure, either by the question itself or by the interview situation, to give answers they feel the interviewer might want to hear (*ibid*). It is an inherent problem of the interview approach itself and will thereby be solved by conducting a questionnaire survey which will show whether the interview results are valid.

A semi-structured interview is based on an interview guide "*that serves as a checklist of*

topics to be covered and a default wording and order for the questions" (Robson, 2011, p. 280). The wording and also order of the questions can be changed depending on the progress of the interview. Moreover, follow-up questions are possible in reaction to what the interviewees say. A semi-structured interview balances the need to explore the field of energy cooperatives in order to get a better understanding while it poses a relatively unbiased manner to create the knowledge (Yin, 2013). Due to the wide geographic spread of the cooperatives, interviews were conducted via telephone.

Since the semi-structured interview aims at exploring the field, most questions are open-ended. In order to avoid problems with the wording, the following principles were kept in mind (Robson, 2011):

- The questions were formulated in short and precise manner.
- Negative and leading questions were avoided.
- In order to get comparable results, the language was adopted in each country's version to ensure a common understanding of the phenomena discussed.
- The focus of the questions lay on the cooperatives. If members showed an extensive knowledge in for example energy policy and legislation, those questions could be asked as a follow-up question, but were not part of the standardized interview checklist.

The prepared questions for the interview can be found as Appendix 1. In order to be able to get qualified answers from all countries, an email was formulated to ask for the interview in each country's language. The questionnaire itself was phrased in German, English and Swedish. The original version was drafted in English and translated into the other two languages. It is built upon the theoretical foundation since it tries to get a better understanding of possible transaction costs while at the same time the term is not used because participants might not be used to the choice of words. Chapter 5.1 provides more information on the cooperatives interviewed. The interview's focus lay on the cooperative's members as well as their motivation to engage in this organizational form. Furthermore, attention was given to the main benefits and challenges attributed to energy cooperatives. Asking for statistical data in the beginning showed whether those categories were feasible and could be used in the online survey. The interviews as well as additional information found on the respective webpages or published in other formats allowed for the creation of case studies – those results will be presented in chapter 5.1.

The interviews were taped with the permission of the interviewees. The main advantage lies in the fact that the researcher can focus on conducting the interview (Robson, 2011) and asking follow-up questions instead of taking notes. As the interviews were the basis for the questionnaire, they were not fully transcribed but selectively with a special emphasis on relevant passages (Robson, 2011, p. 301). To analyze the data, a narrative analysis was conducted, meaning the analysis of the spoken and written word (Schulz, 2006).

3.3. Questionnaire

As the last part of the research approach, a standardized internet-based survey was conducted. Since the interviews established a common understanding of the issues between the cooperatives and the researcher, standardized questions could then be formulated. The importance for a questionnaire-based survey is to know what to ask since the respondents do not have the chance to ask any clarifying questions. Three different uses of a questionnaire are thinkable: Questionnaires can be employed in a face-to-face interview situation where the

questions are asked in a strict order. Secondly, telephone interviews following a strict procedure can use a set of questions in order to create standardized data. Lastly, a self-completing questionnaire can be developed where the respondents fill out the data by themselves. The main advantages in conducting an internet-based survey are the low costs, the speed of data collection and the possibility to create more appealing and sophisticated surveys with respect to the use of visuals or the sequence of questions based on prior answers (Robson, 2011). Critics contrarily argue that not all households have internet access and mention the sometimes high rate of non-responses. Most importantly, the questionnaires need to be self-explanatory since no direct interaction between the interviewer and the interviewees takes place (*ibid.*). This problem can partly be avoided by providing an email address for further inquiries.

The most difficult challenge will be to motivate members of cooperatives to participate in the survey. Consequently, the approach will be to contact as many cooperatives as possible in order to get a high number of responses. Following up this thought, a general tendency in society has been found that people are less and less willing to participate in surveys for a variety of reasons (Robson, 2011, p. 261). Consequently, the sample might not be representative for the population of energy cooperatives in respective countries. This aspect of conducting a questionnaire-based survey affects the generalizability and external validity, which has already been touched upon in chapter 3.1. Still, contacting a larger group of cooperatives will improve the robustness of the results. This claim can be supported by the fact that the additional effort for reaching out to more cooperatives is marginal. Additionally, an incentive was presented to the energy cooperatives that took part in the survey: For every participant completing the survey, a specific amount of money was invested in renewable energies through a crowdfunding project.

For a self-completion survey, the open-ended questions have to be cut down to a minimum in order to increase the significance of the data since it is easier to compare the answers to closed-ended questions. Moreover, most of the open-ended questions will already have been asked in the interview phase so that possible responses are already established.

In order to carry out a questionnaire-based survey, a few steps have to be considered. Firstly, the questions have to be developed, followed by a pretest and possible adjustments. This process will be realized with the help of the thesis' stakeholders, i.e. the supervisor, peers and energy cooperatives that have been contacted during the interviewing phase. For phrasing the questions, the same standards apply as for the interview phase.

The questions of the survey can be found in Appendix 3. Using an online platform provided by the Internet survey tool *Netigate* ™, three surveys were created to lower the barriers for the cooperatives to take part in the survey since they were able to participate in their native language. The translations were checked by native speakers so that language mistakes could be virtually avoided. The survey started by giving an introduction to the research project as well explaining the context. Moreover, the researcher was presented and some information provided which should increase the likelihood of responses (Brace, 2008). The questionnaire itself started by asking for some basic statistics such as the year when the cooperative was founded, the number of members as well as the energy type employed. The second page focused more on the financial aspects of the cooperative such as the minimum financial commitment and the price of one generated kWh. Since cooperatives might vary slightly with respect to the financial setup, the third page asked follow-up questions depending on the answers given earlier. If there was a maximum financial commitment to the cooperative for example, a follow-up question asked for the amount. Next, a section explained the concepts of management and supervisory board as well as general assembly. This is crucial because the

terms might be used in different ways in the three countries due to varying regulations. Depending on whether the cooperatives have a management and supervisory board and a general assembly, the next page asked follow-up questions such as the number of members for each board and the frequency of meetings.

The second half of the survey mostly focused on the underlying motivation to establish a cooperative, the impact of several cost items on the organization as well as the benefits and challenges associated with cooperatives. While the questions in the first half employed either a drop-down choice, multiple answer choices or asked the respondent to fill in a number, the items asking for the attitudes employed Likert scales. When employing this technique, respondents are presented a series of attitude dimensions and for each one they have to state whether and how strongly they agree (Brace, 2008, p. 73). A similar approach can be used to rate the impacts of *e.g.* cost items on the cooperative by giving a scale from very high to very low. The questionnaire finished by giving the respondents space for personal comments and thanking them for their time. The researcher's email address was provided at the beginning and the end for possible inquiries. The results of the survey is presented in chapter 5.2.

4. Background empirics

In order to create a common understanding of regional differences, a brief overview on the current situation of the electricity markets in the three countries is depicted. The subsequent chapters give a short summary of the legislative conditions as well as developments over the last few years. The description will focus on the electricity production and on the role of large energy companies.

4.1. Denmark

Denmark's energy policy was severely influenced by the oil crises in the 1970s since the country was heavily dependent on fossil fuels (Danish Energy Agency, 2012). Consequently, the country started a program to support RE along-side the establishment of a natural gas grid. By 2050, Denmark wants to achieve 100 percent RE in the energy and transportation sector (Danish Energy Agency, 2012, p. 8). In 2013, 46.7 percent of the total electricity production of 125 PJ was produced from renewable sources, almost exclusively from wind power and biomass (Danish Energy Agency, 2015). Solar energy and hydro power play an insignificant role, whereas wind power contributes almost 33 percent of the domestic electricity supply. Biomass facilities account for roughly 12 percent and are mostly powered by wood (*ibid.*). The rest of the electricity is supplied by coal and natural gas. Coal accounts for 34.6 percent of the supply, whereas natural gas contributes 9.8 percent. Interestingly, the role of coal has been reduced strongly in the past 20 years, as in 1994 coal supplied almost 83 percent of the domestic electricity. In the meantime, the importance of natural gas has been promoted.

All in all, two trends are observable: While the role of coal is declining, the importance of energy forms with lower CO_2 emissions such as natural gas and wind power increases. Moreover, a second trend in the wind power sector is apparent. Between 1980 and 2000, the focus lay more on small turbines with a power below 500 kW. As Table 2 shows below, the number of small turbines (below 500 kW) increased fast in the beginning, but decreased lately. In the year 2000, the slightly larger turbines started to become very prominent and are the most used type of turbine as of today and also have the largest installed capacity. Between 2000 and 2013, the number of turbines that were larger than 2 MW increased substantially, resulting in the fact that those turbines now provide a higher installed capacity compared to the 500 to 999 kW ones. Remarkably, the overall number of turbines in Denmark has decreased while the installed capacity has constantly increased. All these developments are due to the fact that Denmark has focused more on offshore wind power resulting in the fact that fewer, but larger turbines are needed (Danish Energy Agency, 2015, p. 10).

Table 2: Number and total capacity of wind turbines in Denmark between 1980 and 2013 (Danish Energy Agency, 2015, p. 10)

Type of turbine	Number of installed wind turbines				Total installed capacity in MW			
	1980	1990	2000	2013	1980	1990	2000	2013
below 500 kW	68	2,656	3,688	1,411	3	317	538	237
500 - 999 kW	0	8	2,293	2,561	0	6	1,517	1,739
1,000 – 1,999 kW	0	2	251	359	0	3	279	438
2,000 and above kW	0	0	28	909	0	0	56	2,396

As described above, the split between coal and natural gas on the one side and wind and biomass on the other side is almost even. Coal and gas require larger infrastructures in the form of central generation plants which are run by institutions such as DONG Energy and Vattenfall (Dansk Energi, 2009). Moreover, those companies also operate wind parks. The remaining rest is run by smaller energy companies, local authorities or cooperatives (*ibid.*).

With reference to the facts presented above, Denmark has a strong focus on renewable energies which is reflected in the country's energy policy until 2050 which also focuses on heat savings in buildings, the use of RE in buildings and energy efficient electricity and district heat production (Danish Energy Agency, 2012). At the end of 2008, Denmark passed the Promotion of Renewable Energy Act (*ibid.*). In the 1990s, Denmark used the percentage of the retail price model, which defines a fixed percentage of the retail price at which the electricity from RE sources will be purchased (Couture and Gagnon, 2010). Denmark set the percentage at 85 percent of the retail price, but abandoned the model in 2001. Since then, a premium price model was established offering varying price supplements for wind parks depending on when they were connected to the grid (Klima-, Energi- og Bygningsministeriet, 2008). Moreover, Denmark fostered the development of small scale RE technologies through a pool of EUR 3.35 million per year[1]. Public participation is part of the wind power development scheme since local citizens receive the option of purchasing wind power shares. The law states that "any person who erects one or more wind turbines of at least 25m in height onshore, or offshore wind turbines established without a tendering procedure [...], shall, prior to commencement of erection, offer for sale at least 20 per cent of the ownership shares to the persons […]" (Klima-, Energi- og Bygningsministeriet, 2008, § 13) living within a 4.5 km radius to the turbine. All in all, Denmark has a strong focus on RE and tries to ensure that the public benefits from the wind power projects.

[1] This thesis only uses EUR as a currency. DKK and SEK have been converted into EUR.

4.2. Germany

Germany aims at having a share of RE of 40 to 45 percent by 2025 and of 55 to 60 percent by 2035 while at same time achieving an affordable and secure electricity supply (Bundesministerium für Wirtschaft und Energie, 2014a).

In 2014, the electricity generated from renewable sources accounted to almost 24 percent of the gross electricity production of 632.1 TWh or 22,756 PJ (Bundesministerium für Wirtschaft und Energie, 2014b). Figure 1 shows the split between different energy sources in Germany and the overall development of the gross electricity production. Since 1990, the production of electricity has increased by 80 TWh or 15 percent. The graph shows one major decline in recent years which was in 2009 and due to the worldwide economic crisis.

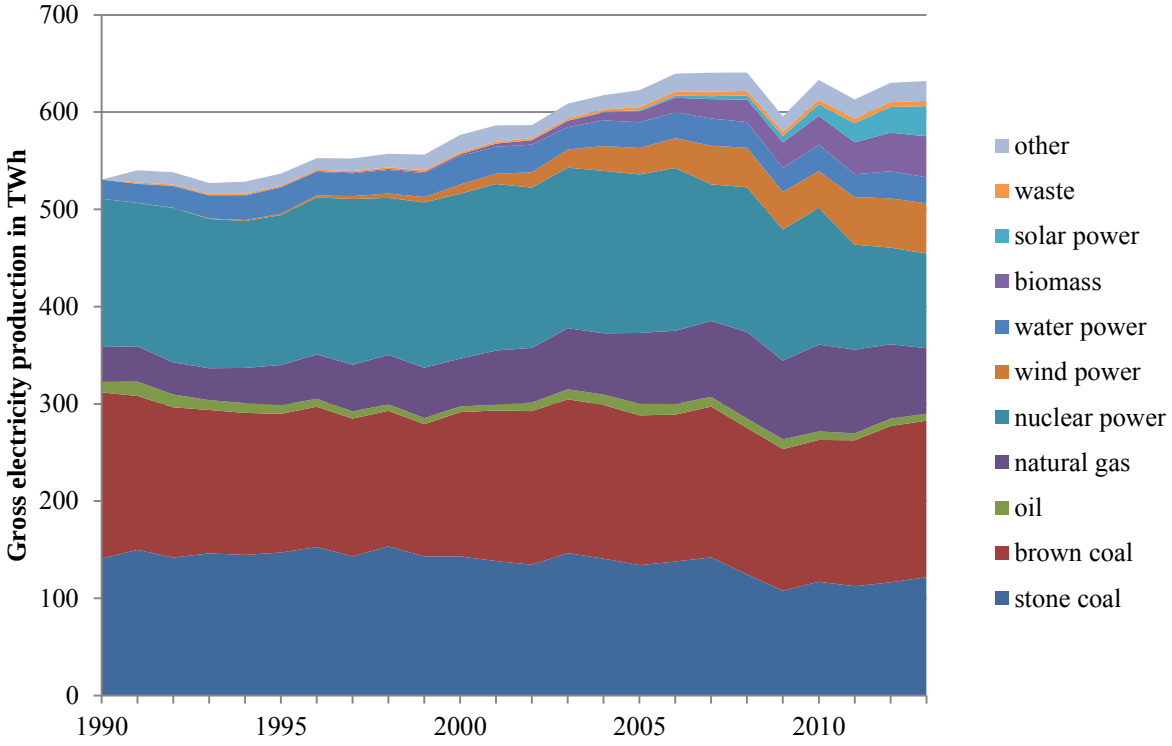

Figure 1: Gross electricity production in Germany between 1990 and 2013 (Bundesministerium für Wirtschaft und Energie, 2014b, p. 22)

Currently, the majority of the electricity is provided by coal adding up to a share of almost 45 percent. The second biggest source after coal is nuclear power with a present ratio of 15.4 percent. Nuclear power will continue to decrease since Germany has decided to phase out nuclear energy by 2022. While oil plays an almost negligible role, natural gas contributes with 11 percent to the gross electricity production. Among the renewable sources, wind power is the most important with a portion of 8.2 percent, followed by biomass with 6.7 percent and solar power with 4.9 percent. Other forms of RE sources in the electricity mix are hydro power, biogenic waste and geothermal power. The structure of the electricity supply is reflected in the ownership structures. More than 73 percent of the electricity is provided by public utility companies, almost 7 percent are operated by industrial facilities that use the electricity directly for producing goods. The remaining 20 percent are owned by private operators (Bundesministerium für Wirtschaft und Energie, 2014b).

As Figure 2 shows below, the installed capacity of hydro power is almost stable, whereas wind and solar power have experienced a steep increase in the last twenty years. Interestingly, the boom of wind power started around the year 2000, while solar power started developing

fast around the year 2007 with a growth of solar power capacity between 2007 and 2013 of 32 GW. As a result, solar power has now a higher installed power than wind power. Although the installed power of biomass has been increasing over the last years, it is relatively low compared to the solar and wind power.

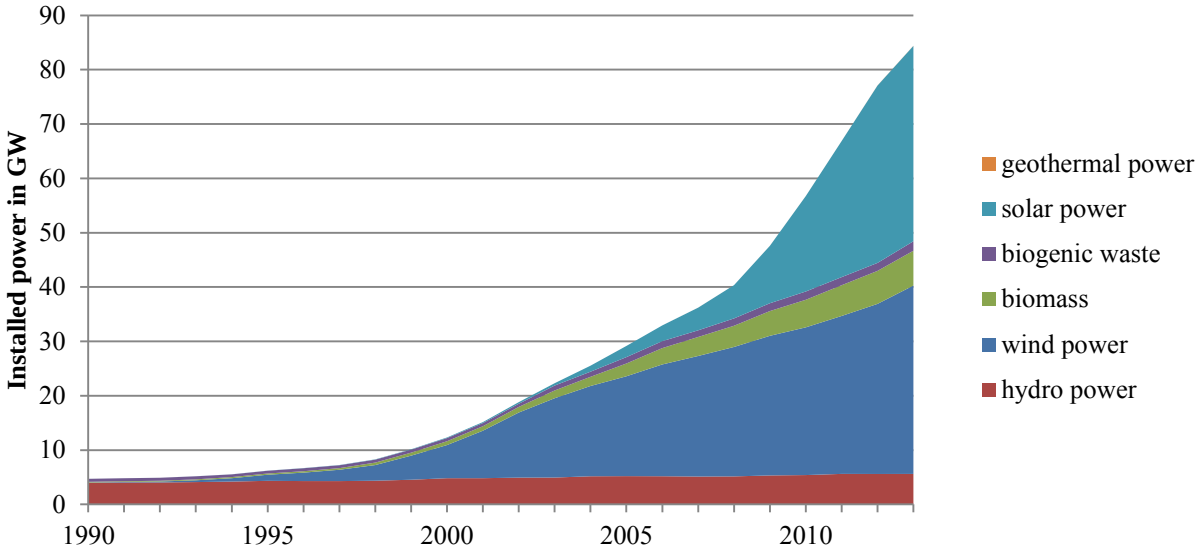

Figure 2: Installed RE power in GW in Germany between 1990 and 2013 (Bundesministerium für Wirtschaft und Energie, 2014b, p. 20)

The actual electricity production of the RE sources, portrayed in Figure 3, presents a different image which was already described above. Wind power is the most important source for RE production, followed by biomass and solar power. Although solar power has such a high installed capacity, the actual production is rather low.

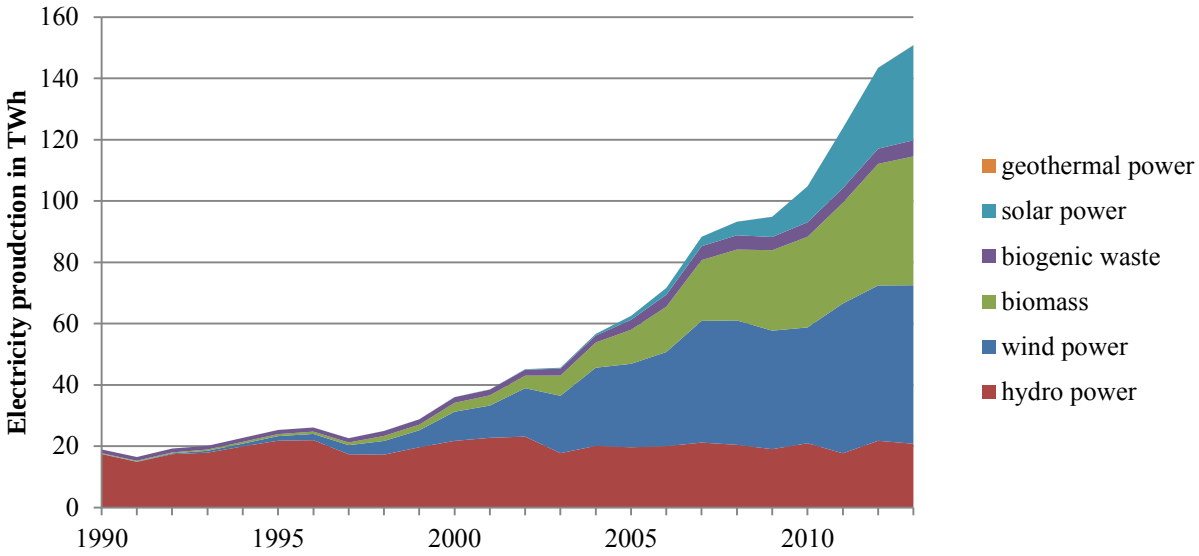

Figure 3: Electricity production from RE in Germany between 1990 and 2013 (Bundesministerium für Wirtschaft und Energie, 2014b, p. 20)

The trends presented above are the result of Germany's energy policy which promoted renewable energies from 1990 onwards. Between 1991 and 2000, the country used the same model as Denmark, namely the percentage of the retail price model, paying a maximum of 90 percent of the retail electricity price depending on the size of the project and technology

used (Couture and Gagnon, 2010). In 2000, Germany switched to a fixed price model in order to increase investor security and diversify the technologies employed. This development is reflected in the installed power capacities presented above. By leaving the feed-in tariff unchanged for the time of the contract, the mechanism provides security for investors since revenues can be predicted over the time of the project (Couture and Gagnon, 2010, p. 957). The main disadvantage of such a system is that electricity can become relatively expensive. Therefore, Germany has revised its Renewable Energy Sources Act and will introduce a market premium approach soon. Since onshore wind and solar power have been increasing strongly, the revised law will ensure through the use of premiums that the installed capacity stays within certain corridors, namely 2,500 MW each for solar and wind power. Moreover, all RE installations will have to sell their electricity directly on the market. A transition period has been introduced to ensure that market players can adapt (Bundesministerium für Wirtschaft und Energie, 2014a). Lastly, the support of renewable energies will be determined by a bidding scheme in the future – details are not clear yet since pilot projects are yet to be put into action.

4.3. Sweden

The Swedish government has set ambitious energy and climate targets for 2020. By then, Sweden wants to achieve a reduction of 40 percent in greenhouse gas emissions and at least a RE share of 50 percent (Miljö- och energidepartementet and Näringsdepartementet, 2009). Moreover, the country wants to establish a national planning framework for wind power with a production capacity of 30 TWh by 2020. Two thirds of the capacity should be erected onshore, while 10 TWh are to be built offshore.

In 2014, Sweden had an electricity production of 151.2 TWh (Svensk Energi, 2015). The production is made up of 42.4 percent hydro power, 7.6 percent wind power, 41.2 percent nuclear power and 8.8 percent thermal power. Since the latter is partly renewable, more than 50 percent of the country's electricity supply comes from renewable sources. As Figure 4 shows below, Sweden's electricity historically has mostly been supplied by hydro power (vattenkraft), supported by nuclear power (kärnkraft) which started to develop in the 1970s. The share of wind power increased during the 2000s after the introduction of a system of green electricity certificates in 2003. Unfortunately, the graphics are in Swedish since the raw data was not available and other graphs are not up-to-date.

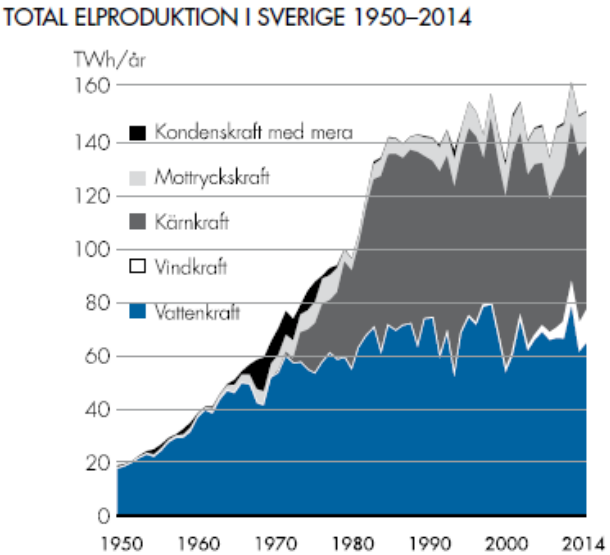

Figure 4: Electricity production in Sweden between 1950 and 2014 (Svensk Energi, 2015, p. 29)

In 2014, more than 400 new wind turbines were installed adding up to more than 3,000 turbines in the country with a power of more than 50 kW each resulting in a total installed capacity of 5,400 MW (Svensk Energi, 2015, p. 33). Hydro power on the other hand had an installed capacity of 16,155 MW. These trends are also observable in Figure 5 which on the left presents the installed power in Sweden between 1960 and 2014. Since 1980, hydro power has been more or less stable whereas the curve for wind power reflects the strong increase in the last years. At the bottom of the left graph, a yellow line represents solar power (solkraft). As it can be seen from the

graph, this energy type is almost negligible since the total installed power is 79 MW as of 2014 (Svensk Energi, 2015, p. 38). The graph on the right shows the amount of electricity produced in TWh.

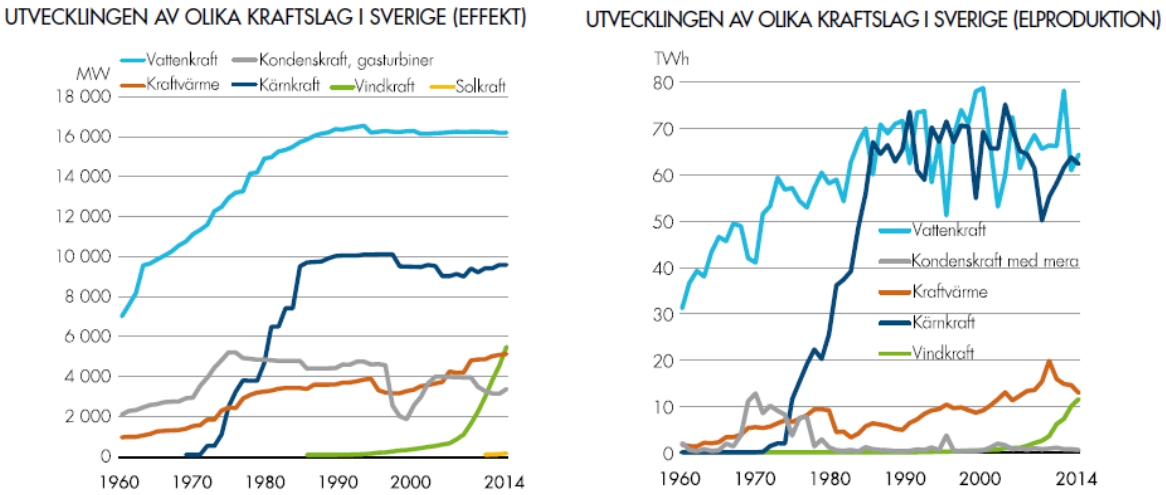

Figure 5: Installed power and electricity production in Sweden between 1960 and 2014 (Svensk Energi, 2015, p. 30)

Nuclear and hydro power are the most prominent sources in Sweden's electricity supply over the last thirty years. The trends in the installed capacity are reflected in the electricity production although the different efficiency levels can be observed from the graphs. Wind power has more than half of the nuclear power's installed capacity but contributes only a sixth part to the electricity production compared to nuclear power. Interestingly, solar power is not even shown in the electricity production. The electricity is produced by institutions either belonging to the state, municipalities or foreign owners. Only 12 percent of the electricity is produced by entities belonging to other groups (Svensk Energi, 2015, p. 39).

Sweden has chosen to use a variety of instruments to foster the development of renewable energies. First and foremost, an electricity certificate system has been introduced to increase the share of electricity produced from RE sources. While the owner of a RE facility receives a certificate for producing electricty from renewables, certain industries have to buy certificates depending on their electricity use or electricity production which is not based on renewable sources (Energimyndigheten, 2014). Moreover, the country subsidizes certain energy sources *e.g.* solar power by providing direct capital subsidies for the installation of solar power capacities (Lindahl, 2013). Lastly, the Swedish government has passed a law in 2014 which gives the option for net metering. Net metering is a service where locally generated electricity can be transferred to the public grid and offsets the electricity consumed in a specific period, thus the consumer just needs to pay the difference (Kirby, 2002). The bill allows for a tax reduction of EUR 0.07 per kWh up to a generation of 30,000 kWh and applies from 2015 onwards (Svensk Energi, 2015, p. 53).

5. Results

The following sections present the findings of the case studies and the quantitative survey.

5.1. Case studies of energy cooperatives

In order to get a diverse understanding of the sector, six energy cooperatives in each country were contacted, trying to include organizations with different membership numbers as well as energy types. These 18 interview requests led to six interviews which correspond to a response rate of 33 percent. Table 3 gives an overview on the interviewees and the respective organizations covered in the case studies.

Table 3: Overview on the collected interviews

Name	Organization	Date	Format	Homepage
Andreas Bauer	Friedrich-Wilhelm Raiffeisen Energie eG, FWRE eG Hohenroth, FWRE eG Großbardorf	23.02.2015	Telephone interview	http://www.raiffeisen-energie-eg.de/index.php
Sebastian Sladek	Elektrizitätswerke Schönau	23.02.2015	Telephone interview	http://www.ews-schoenau.de/homepage.html
Anders Pettersson	Hycklinge vind	24.02.2015	Email interview	http://hjovind.se/hycklinge/
Björn Larsson	Göteborgsvind Nr. 1	03.03.2015	Telephone interview	http://gbgvind.se/
Hans Chr Soerensen	Lynetten, Middelgrunden, Hvidore and Prøvestenen	10.03.2015	Email interview	http://www.middelgrunden.dk/
Micha Jost	Energiegenossenschaft Starkenburg eG	27.03.2015	Telephone interview	http://www.energiestark.de/

The questions were designed to be able to conduct the interviews within 30 minutes, in one case the interview lasted for one hour, but the majority could be carried out in the given time frame. Since the persons addressed sometimes were involved in more than one energy cooperative, the interviews were able to discuss eleven energy cooperatives. The case studies are presented in the following.

5.1.1. Lynetten, Middelgrunden, Hvidore and Prøvestenen (Denmark)

Since the interview covered four different cooperatives all having a similar setup, the discussion of the benefits and challenges centered on a more general level. The cooperative Lynetten was founded in the mid-1990s operating seven wind turbines with a power of 600 kW each (Lynetten Vindkraft, n.d.). 3,600 shares were given out to around 900 members, while the local utility company owns three out of the seven turbines. One share had a price of EUR 604.

In 2000, Middelgrunden was established to operate 20 wind turbines with a power of 2 MW each right outside of Copenhagen. The price per share was EUR 570 and 40,500 were issued to more than 8,500 members. For Middelgrunden, the local utility company owns 50 percent of the turbines, i.e. ten facilities (Larsen, 2000).

Three turbines with 3.6 MW each were erected after the cooperative in Hvidore was founded. 10,700 at a price of EUR 570 each were given out to approximately 2,300 members (Hvidovre Vindmøllelaug, 2011). Contrarily to the cooperatives above, the majority of the turbines is owned by the utility company.

Just recently in 2013, the cooperative in Prøvestenen was established which operates three turbines with a power of 2 MW each (Prøvestenens Vindmøllelaug, 2013). 4,000 shares have been given out at a price of EUR 663 to more than 1,800 members, while the ownership structure is the same compared to Hvidore with the utility company owning two of the three turbines.

All cooperatives have a mixed membership structure. Since no additional data is available, no further statements can be made. Communal authorities are not allowed by law to be part of such an organization, so those can be ruled out. Sometimes even unions become members of a cooperative to use the electricity for their houses. All cooperatives are principally open to new members, but this is up to the current shareholders so that one can just become a member by buying a share from another member. Consequently, the term member in the cooperative is a bit misleading since shareholder would be the more appropriate term. In order to make the case studies comparable, this thesis will continue to use the term member but acknowledges the difference in meaning. By having this principle, the membership is generally quite stable since shares are only seldom traded.

The main motivation to become a member in the cooperatives is to act out a green consciousness which points towards a more sustainable lifestyle. A second motivation is also the economic return although it is not seen to be the dominant one. On that note, the original motivation to found the cooperatives was due to Denmark's energy strategy from the 1970s with a strong focus on renewable energies, especially after the first oil crisis in 1973 (c.f. chapter 4.1). For the Copenhagen area, a strategy for local and regional urban sustainability called Agenda made many people more aware of how to produce energy.

By and large, major decisions are made by the general assembly[2] where every member has one vote independent from the number of shares the individual owns. The issues discussed at those meetings include the economic situation of the cooperative or production and other technical details. Furthermore, the cooperative has a management board which consists of five to seven members depending on the cooperative. These members are elected for a period of two years and are not paid for holding this position.

The main benefits associated with the establishment and operation are mostly related to the fact that energy cooperatives can lead to an involvement of the public for energy projects and thereby to acceptance as well as the idea that benefits from the electricity production stay in the local area. Local communities profit since they are direct consumers of the electricity produced in their area while they also have to adapt to the consequences. Moreover, local service providers can be used when it comes to the maintenance of equipment. Contrarily, the

[2] The terms management board, supervisory board and general assembly are used to analyze the different countries, although in practice there might be some differences. A management board has the task of handling the day-to-day activities of a cooperative, whereas a supervisory board monitors the management board's actions. The general assembly generally consists of all members of the cooperatives and meets rotationally to decide on significant issues and hold elections.

disadvantage associated with cooperatives is that they are mostly small scale organizations. Since wind power turbines are quite capital intensive and good locations are not abundant, larger organizations have an advantage over cooperatives. Moreover, the barriers for energy cooperatives have been increased with respect to regulations. An example of this is the necessity to conduct environmental impact assessments. As described above, a law requires an operator of a wind park to offer 20 percent of the ownership to the citizens within 4.5 km of the turbines. Therefore, real cooperatives are more seldom whereas the organizations with 20 percent public ownership increase.

With respect to future plans, repowering and the extension of the life span for the existing turbines are crucial elements.

5.1.2. Elektrizitätswerke Schönau (Germany)

The cooperative Elektrizitätswerke Schönau (EWS) has its origins in the anti-nuclear movement. When the catastrophe of Chernobyl occurred, worried citizens formed an action group which was named "parents for a nonnuclear future" (Elektrizitätswerke Schönau, n.d.b). After being founded in 1994, the cooperative was able to take over the local electricity grid a few years later following a massive struggle. Today, EWS has more than 4,000 members, 155,000 to 160,000 customers and employs 97 people. With a total capital stock of EUR 34 million, the cooperative is still open to new members. In order to become a member, one has to buy five shares with a price of EUR 100 each while the maximum investment is EUR 10,000. A maximum contribution is seen as a measure to prevent a dependency on few members that own a great part of the organization. The cooperative buys electricity in Norway, Germany and Austria generated from renewable sources, such as hydro and wind power (Elektrizitätswerke Schönau, n.d.a).

The motivation to be part in a cooperative is to promote the energy turnaround towards renewable energies which was also the original idea behind founding the cooperative.

With respect to the management structures of EWS, the general assembly meets annually and discusses issues such as the interest yield per share and future projects. Also, the general assembly has to approve the actions of the supervisory and management board. The latter is composed of four members, whereas the supervisory board comprises six people. The supervisory board is elected by the general assembly and chooses the management board members.

A major advantage of the cooperative is the mixture between business elements and grassroots democracy. As stated in the interview, the democratic approach is seen to be essential for the energy turnaround since it fosters public participation. On the other hand, the main disadvantage lies in the fact that a cooperative needs to be audited twice – once by an auditing firm and once by the cooperative association which is costly. Consequently, the cooperative might not be the best solution for small-scale projects due to the costs related to the operation.

5.1.3. Energiegenossenschaft Starkenburg eG (Germany)

The energy cooperative of Starkenburg was founded in 2010 by 13 individuals focusing in the beginning not so much on a specific community, but rather a region. Currently, the cooperative has 720 members. The minimum investment to become a member in the cooperative is EUR 2,000, containing of two shares at a price of EUR 100 each and a subordinated loan of EUR 1,800. The loan is dedicated to a specific project which leads to individual returns and retention periods. While the cooperative's first project was a wind turbine, it now has realized 12 solar panels, two wind power turbines and two interests in

wind turbines. The acquisition of a biomass plant was the latest project. Although the members of the cooperative are mostly private individuals, the organization is generally open to everybody under the condition that new projects will be realized so a steady return can be ensured. The cooperative has a waiting list for potential new members but will prioritize those that live close to prospective projects (Energiegenossenschaft Starkenburg, n.d.).

Members had three different reasons to become a part of the cooperative. Firstly, around 40 percent of the members have always been interested in a sustainable lifestyle, but especially the Fukushima catastrophe motivated them to become a member in the organization. Secondly, 30 percent of the members have joined the cooperative because they enjoy the cooperative spirit of doing things together and the self-efficacy of people. The last group, also encompassing 30 percent of the cooperative's members, is interested in a clean and ethical investment as well as the return of the investment. Since the Fukushima events fall into oblivion, the third group of members becomes larger, while the first one decreases in size. Originally, the motivation to found a cooperative lies in the idea that the participatory approach would lead to a higher acceptance of the projects which is incorporated in the cooperative's mantra.

The organization has both a management and a supervisory board that meet collectively once per month to share information and discuss new projects. Furthermore, the cooperative has an annual general meeting. The management board consists of two, the supervisory board of four people.

The main advantage of this organizational form for the cooperative in Starkenburg is the fact that a lot of people can be engaged in the RE projects. All members are equal despite of their initial investment, which reflects the cooperative spirit of participation and democracy. Contrarily, the main disadvantage lies in the fact that incipiently a large sum of money is needed to start the cooperative. Moreover, the cooperative has to have a concrete project to start with. As regulations have been changed, it now becomes harder for the cooperatives. Formerly, cooperatives would often start with a photovoltaic project which now became almost impossible due to recent legislation. As a result of this, the cooperative in Starkenburg will focus on wind power projects as well as hydro power. The direct marketing of electricity will also play an important role in the cooperative's future business plan.

5.1.4. Friedrich-Wilhelm Raiffeisen Energie eG (Germany)

The Friedrich-Wilhelm Raiffeisen Energie cooperative was founded in 2008, uses solar energy and has 280 members (Friedrich-Wilhelm Raiffeisen Energie, n.d.). Since this cooperative was used as a blueprint, several others have been founded consequently using the same structures and even the name with the addition of the specific location of the cooperative. Thus, the interview focused also on the Friedrich-Wilhelm Raiffeisen Energie eG Großbardorf, founded in 2009 (Friedrich-Wilhelm Raiffeisen Energie Großbardorf, n.d.), which currently has approximately 170 members. The cooperative produces energy from solar panels but has also invested in a biomass plant. Moreover, the Friedrich-Wilhelm Raiffeisen Energie eG Hohenroth with 108 members (Friedrich-Wilhelm Raiffeisen Energie eG Hohenroth, n.d.), also employing solar energy and being founded in 2010 was covered in the interview. All cooperatives have the same financing scheme for prospective members: To become a member, one has to buy a share of EUR 100, but also a subordinated loan of EUR 1,900 which is consequently repaid by the cooperative with a certain interest rate.

Although they are generally open to new members, the cooperatives currently are not accepting new members since no projects are planned and otherwise the revenues would be split among more people and thus lowering the interest rates. This links directly to the

motivation of joining a cooperative which is seen to be mostly due to economic interests, but also to intrinsic factors inherent to the members that are expressed in the desire to preserve the environment. Lowering the individual's energy consumption by involving them in the actual energy production can be seen to be both economically and intrinsically motivated.

The principal body of the cooperative is the general assembly that is held once a year. Although this is where major decisions are made, the day-to-day business is handled by a management board such as deciding on a telephone provider but also managing the financial assets of the cooperative. These actions are reviewed by a supervisory board. Generally, the cooperatives have two managers, whereas the supervisory board consists of at least three members which then can be increased to a higher number of delegates but just in uneven numbers since decisions should be made in a distinct manner. A mix of various backgrounds and qualifications is seen as an advantage of the boards as it allows the delegates to make better informed decisions. The same is true for the general assembly which typically would represent a cross section of the society.

The main advantages of this organizational form are the accountability, i.e. taking over of responsibility towards the community and also towards the other members of the cooperative. Furthermore, the democratic structure of the cooperatives is seen as positive, although the negative aspects such as slowing down decisions are acknowledged. The fact that members of the organization become owners of RE facilities while sharing the risks and that there are tax advantages when disbursing the dividends for the subordinated loans are also regarded as positive features of the cooperatives (Friedrich-Wilhelm Raiffeisen Energie, n.d.; Friedrich-Wilhelm Raiffeisen Energie Großbardorf, n.d.; Friedrich-Wilhelm Raiffeisen Energie eG Hohenroth, n.d.). Contrarily, disadvantages are the costs of operating the organization including expenses for insurances. As stated above, the one-member-one-vote is looked upon favorably. It does not really affect the general decision-making, but rather creates an unsettledness among members.

The business model of the cooperatives discussed focus more on direct marketing of electricity produced from renewable energies in the future. Since the laws concerning the energy production have been changed recently in Germany, newly founded cooperatives might be forced to merge in order to use scale effects to be able to compete. Other possibilities lie in the field of diversifying the portfolio by investing in e.g. biogas plants and thereby also being active in the field of district heating. Lastly, the cooperatives could invest in storage facilities although this is seen to be a more long-term approach.

5.1.5. Hycklinge vind (Sweden)

The cooperative Hycklinge vind has been founded in 2010 by an information meeting for the residents of the small village of Hycklinge, but has been formally established in 2012 by five individuals interested in wind power. The organization plans to erect two wind turbines with a rated power of 2 MW each (Hycklinge vind, n.d.). Although the members provided the necessary documents, a granted building permit was appealed. The decision was dismissed by the means of legal procedures so that the planning can actually continue. A share in the cooperative will resemble a yearly electricity consumption of 1000 kWh and will cost around EUR 670. The target group for the future members concentrates on the residents living where the turbines will be installed. To finance the turbines, 1,500 shares are planned to be sold, the remaining amount will be funded through a bank loan. Consequently, the cooperative is open to new members.

To become a member in the cooperative, there are two main drivers. If the price for electricity goes up, it's good for the cooperative, since it generates more money and thus higher revenues

for the members. If the price for the electricity goes down, the members profit from lower electricity prices. Secondly, it is also seen as important to have an environmental friendly investment which shows that customers can create an independent energy production. These factors are also seen as the main advantages, whereas the challenge lies in the circumstance that formal requirements have been and are so complex.

Day to day issues are decided in the management board which consists of five people whereas major issues are discussed by the general assembly that is formed of all the cooperative's members. The organization has no supervisory board.

With respect to future plans, the cooperative waits for net metering to become reality in the area.

5.1.6. Göteborgsvind Nr. 1 (Sweden)

Founded in 1993, the cooperative was started by the local community owned energy company Göteborg Energi but given to the consumers as soon as the board was in place (Göteborgsvind Nr. 1, n.d. a). Currently, the cooperative operates three wind turbines of 225 kW each and one with a rated power of 600 kW (Göteborgsvind Nr. 1, n.d. b). The cooperative's production is split up into shares of 1,000 kW resembling an electricity consumption worth of approximately EUR 330. With a member base between 900 and 1,000 members, each member is eligible to own up to ten shares. As the shares resemble a particular consumption, one is not allowed to own more than he or she can possibly consume. Interestingly, the cooperative's members are only private individuals since no companies were allowed. Generally, the cooperative is open to new members but since the cooperative issued 3,300 shares, one needs to buy the share of a current member in order to join the cooperative. To foster this process, a buy and sell section was established.

A major driver to become a member in the cooperative is to help to build up RE capacities and to support the technologies employed. Secondly, being a member in the cooperative has also proven to provide a pleasant income.

The cooperative has a board that consists of six regular members and two back-up members in a case of illness or absence due to travelling. The board members are elected by the general assembly and meet almost every month. An issue discussed by the general assembly was the location of the wind turbines. Since the contracts concerning the lease of the land span for 30 years, members recently expressed the wish to build new turbines. This proposal was turned down by the general assembly since the overall desire was to run the organization just for a limited amount of time. As the installation of a new wind turbine would require the cooperative to issue new shares, recent members would need to pay more for these than the older ones which would create an imbalance and difficulties. To increase the cooperative's capacity, two options would be viable. One would be to buy an already erected turbine which is normally quite costly. The other option is to investigate potential sites by as a cooperative which is more risky due to potential negative outcomes, i.e. the sites turn out to be not viable for wind power. Göteborgsvind Nr. 1 does not have a supervisory board.

The main benefit of forming and operating a cooperative is to produce electricity from renewable sources in an economic way, although it becomes harder to work economically. A few years ago, the electricity price was around EUR 0.10 per kWh, whereas nowadays it is around EUR 0.04 per kWh (before taxes) (Göteborgsvind Nr. 1a, n.d.). Consequently, it becomes harder to operate the cooperative in an economic way. Moreover, future investments have to be rethought since they might not be able to generate the necessary paybacks. This fluctuation in the electricity price is also seen as the biggest challenge.

As depicted above, the location of the turbines are crucial for the cooperative's future. The lease agreements are renewed, but only for a year at the time. Thus, the cooperative could be forced to shut down the turbines every year now, although it will be operated as long as the turbines are to stand on the land.

5.2. Quantitative survey results

This chapter presents the findings of the online questionnaire which was sent out to the energy cooperatives after compiling the case studies. More than 200 entities were contacted with an email and the survey in their native language as described above. After one week, a reminder was sent to representatives of those cooperatives which did not have accessed the survey until then. The researcher's email address was provided throughout the survey so that further inquiries were possible. Out of the 205 cooperatives contacted, 23 fully completed the anonymous survey which corresponds to a participation quota of 11 percent, although 25 organizations answered the first page of the survey. Twelve of the 25 participants are Swedish, eight German and five Danish.

Figure 6 displays the founding year of the participating cooperatives. German cooperatives were founded between 2007 and 2010. Cooperatives in Denmark and Sweden have been established continuously, although there is a stronger concentration in Sweden between 1994 and 1998 as well as 2005 and 2010.

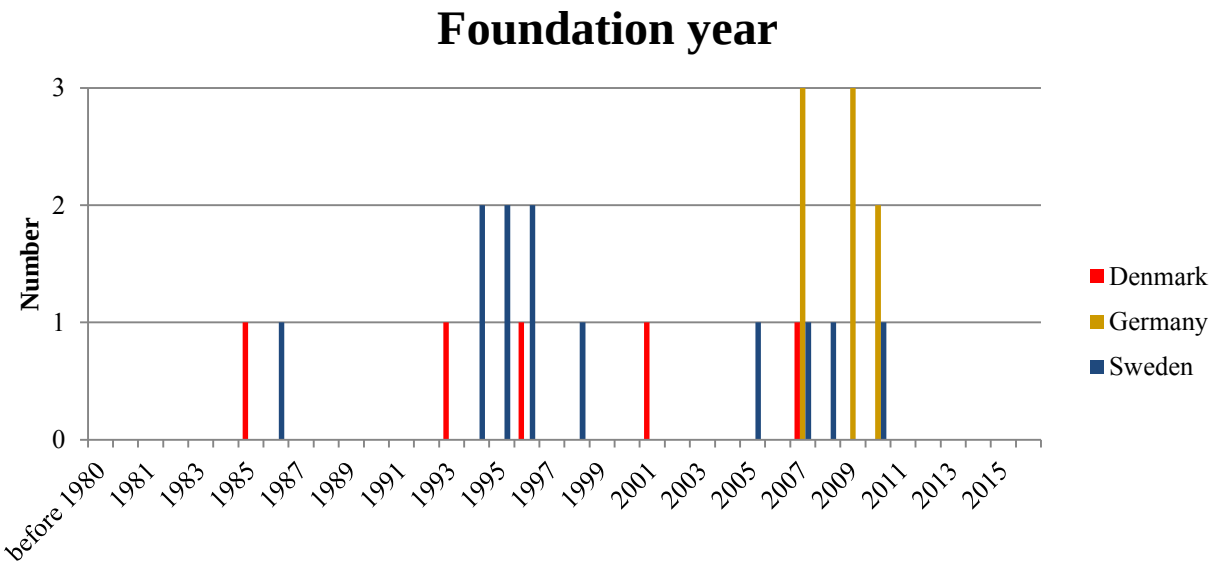

Figure 6: Number of newly founded cooperatives in the respective countries over time

Moreover, Figure 7 shows the split of numbers per cooperative. In Sweden, the majority of the cooperatives have between 201 and 500 members which is also the maximum amount. Contrarily, Danish cooperatives have mostly between 201 and 500 or more than 1,000 members. One cooperative is rather small and has between 11 and 20 members. German cooperatives in Germany mostly have between 101 and 200 members. As in Denmark, two cooperatives have more than 1,000 members. As a common description of Figure 7, the cooperatives in those countries show a tendency to have between 101 and 500 members.

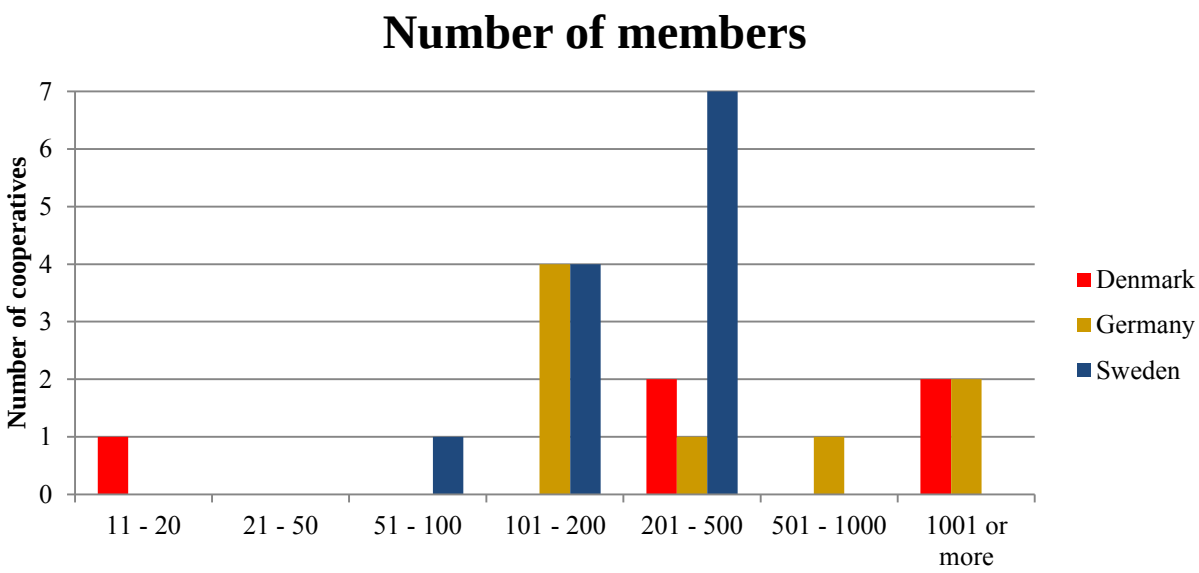

Figure 7: Number of members per cooperative

The cooperatives who have participated in the survey employ various kinds of energy sources to produce the electricity although a clear difference is observable in Figure 8 between the countries. While Denmark and Sweden focus on onshore and offshore wind energy, the German cooperatives have a more diversified supply with solar power and biomass. Biomass is often used for the production of electricity and heat at the same (co-generation). In order to allow a comparability of the results, cooperatives were asked to focus on the electricity part. The cooperatives that chose "Other" do not produce, but buy their electricity on the market. Multiple selections were possible.

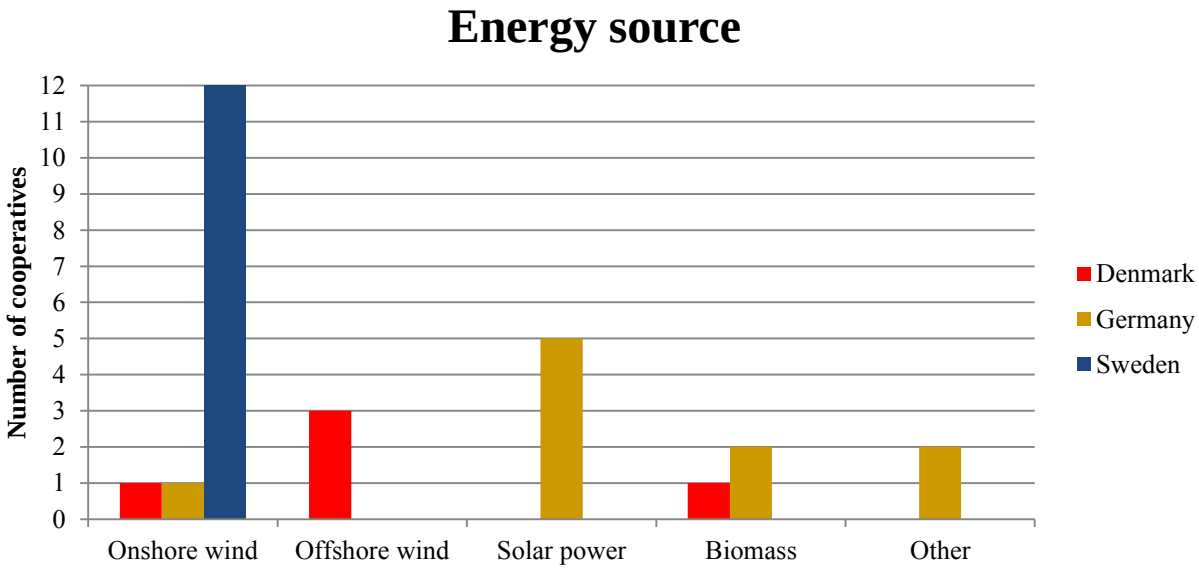

Figure 8: Energy sources used by the cooperatives

Figure 9 complements the picture presented above with respect to the cooperatives' member sizes and their use of energy. German cooperatives have a rather low installed capacity compared to Denmark and Sweden. Four cooperatives have a significantly higher installed

capacity than the rest. As observable from the figure, most organizations have an installed capacity between 0.5 and 2.5 MW.

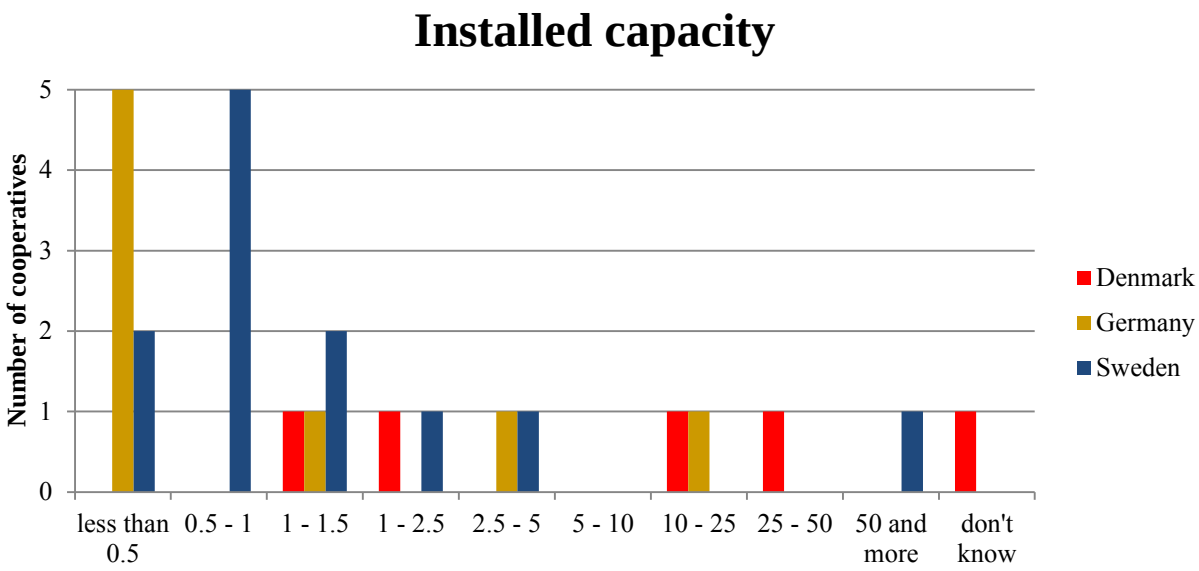

Figure 9: Installed capacity of the cooperatives in MW

To become a member in the cooperative, different minimum financial requirements are needed. While in Sweden an average of EUR 410 is necessary to become a member, Danish cooperatives expect a financial contribution of EUR 740. Cooperatives in Germany have the lowest financial requirements with EUR 350. Moreover, the majority of German organizations have limited the maximum financial contribution, whereas Swedish and Danish cooperatives tend to not have a limit. The maximum financial contribution lies between EUR 5,000 and EUR 50,000 depending on how expensive one share in the cooperative is. Another difference between the cooperatives is the scope of their activities. German cooperatives deliberately do not only produce for the member's electricity consumption, whereas around 40 percent each in Sweden and Denmark produce only for their member's demand. Another difference is the meaning behind the shares in the cooperative. For the majority of the Swedish and Danish cooperatives a share in the cooperative resembles a specific electricity consumption. This is not the case for the German organizations. The survey revealed that the most common equivalent is an electricity consumption of 1,000 kWh per year. Two thirds of the cooperatives in Denmark and Germany do not have members from abroad, whereas none of the Swedish organizations has non-Swedish members.

With regard to the governance of the cooperative, differences between the countries are observable. Regardless of their origin, all cooperatives have a management board which takes care of the day-to-day activities as well as a general assembly. Moreover, all German cooperatives have a supervisory board which checks upon the management board's decisions. Only two of the Swedish cooperatives have such a board, while in Denmark no organization has a supervisory board.

Figure 10 gives an overview of the distribution regarding the management board members. While the German cooperatives use a smaller board size, the Danish and Swedish tend to be larger. Interestingly, one cooperative in Sweden has nine board members. As observable from the figure, most cooperatives have between three and seven members. The majority of the members being part of the management board in Germany and Sweden are not paid for this

function and if so only with expense allowances. 60 percent of the Danish management board members receive an expanse allowance, compared to 30 percent in Sweden and 14 percent in Germany.

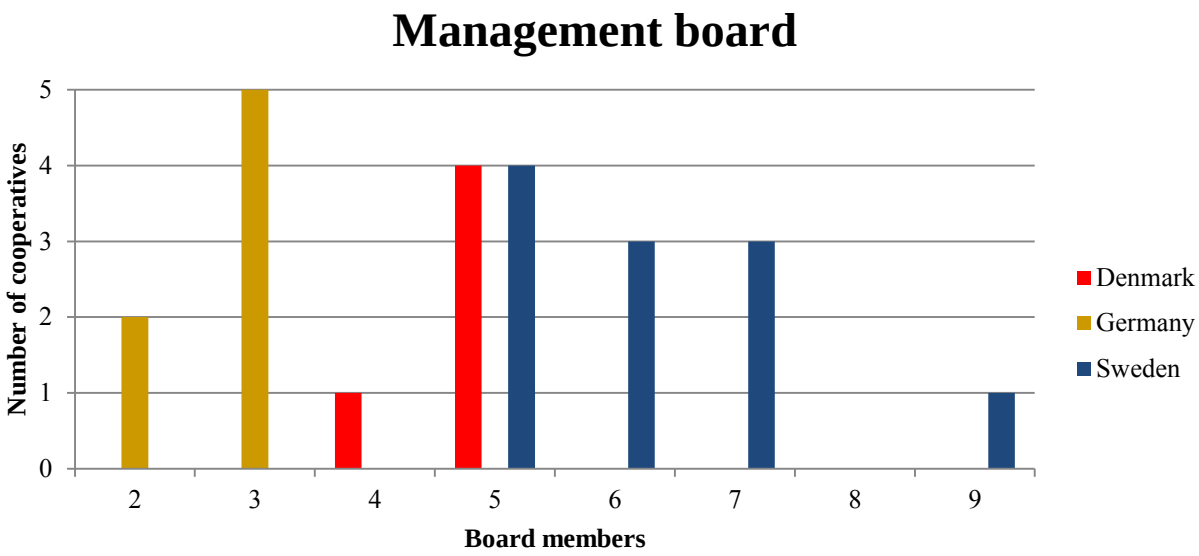

Figure 10: Number of members in the management board

The management boards vary in the frequency they meet. Figure 11 shows the frequency of the management board meetings from a range of weekly to yearly. As the figure clearly displays, management boards of cooperatives in Germany tend to meet more often than in Denmark and Sweden. The majority of the Danish cooperatives' management boards meet on a monthly basis, whereas the majority of the Swedish ones get together every six months or even annually. While in Germany the members of the management board are elected by the members of the supervisory board, in Denmark and Sweden they are chosen by the general assembly – keeping in mind that Danish and Swedish cooperatives mostly do not have a supervisory board as presented above.

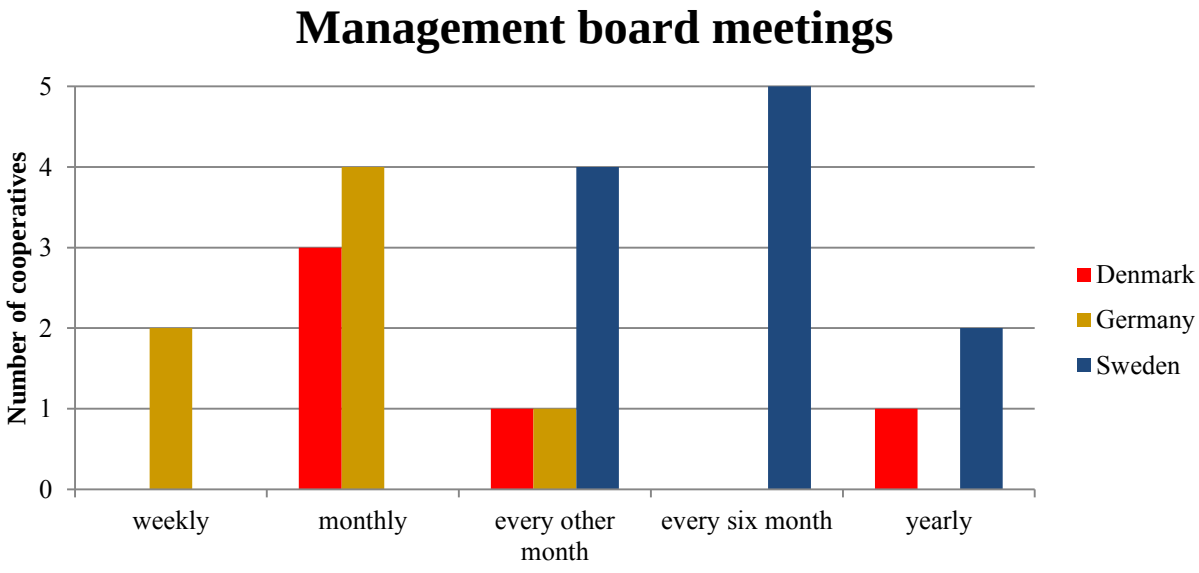

Figure 11: Frequency of management board meetings

The data for the supervisory boards in Sweden has a limited significance since only three cooperatives have them, one with two and two with five members each. In Germany, half of the participating cooperatives have a supervisory board with three members; the rest has either four, five, eight or ten and more members. The supervisory members in Sweden get paid in two of three cases, in Germany two out of seven receive an expense allowance. In the remaining cases, those members do not receive any compensation for their function. The members meet either every other month or every six months, although two cooperative's supervisory board have weekly respectively monthly meetings. In Germany, the supervisory is elected by the general assembly, whereas in Sweden the supervisory board's members are either chosen by the general assembly or the management board.

Most of the cooperatives have one general assembly per year; only one cooperative in Sweden meets twice a year. Remarkably, the attendance rates of the general assemblies are relatively low. In Denmark an average 24 percent of the members attend the annual meeting, compared to 17 percent in Sweden. Germany has the highest attendance rates with a mean of 34 percent of the members attending the general assembly.

Figure 12 shows the most important reasons for establishing a cooperative. The factors were mentioned in the interview phase with the cooperatives and tested in the online questionnaire. The scale ranged from one to five, with one being "very important" and five "very unimportant". The most important motivations to establish a cooperative are to support renewable energies and to increase the local acceptance for them. Those factors are shared by the cooperatives in all countries, but are more important to German cooperatives than Swedish and Danish ones. Offering members a clean and ethical investment is very important for Swedish cooperatives and important to German ones, but neither important nor unimportant to Danish ones. With regard to changing the roles of consumers in society, this aspect appears to be important for German cooperatives, but rather neutral for Swedish cooperatives. It is highly unimportant to Danish organizations. Being independent from conventional electricity producers seems to be important for German cooperatives, but rather unimportant for Danish and Swedish organizations. Creating an income for their members is unimportant to German and Swedish cooperatives, but it is neutrally important to the Danish. Lastly, bringing people of a local community together is unimportant to Swedish organizations, whereas it is neither unimportant nor important to Danish and German cooperatives.

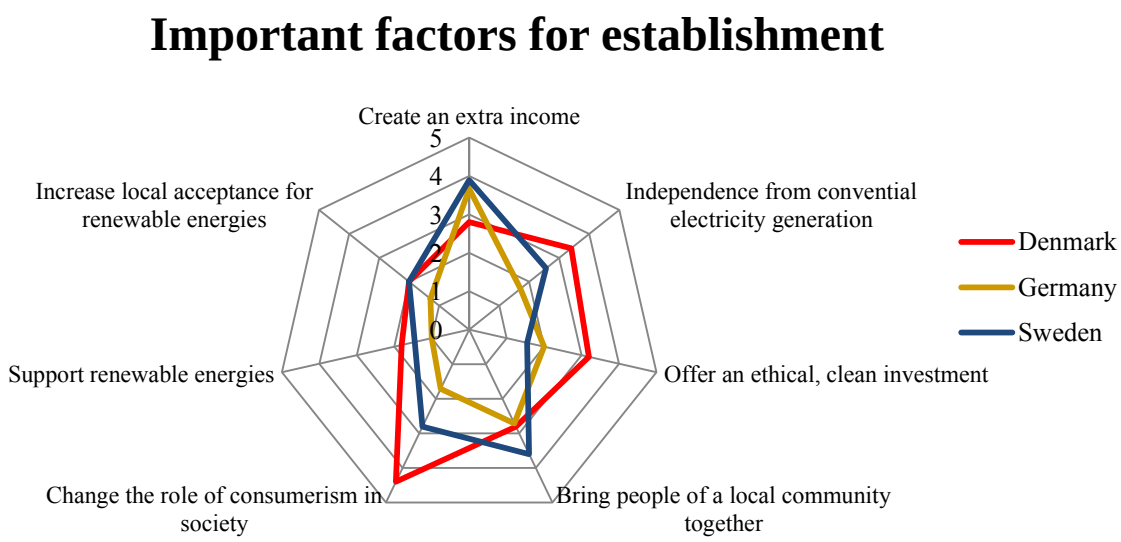

Figure 12: Most important factors in establishing a cooperative

Cooperatives from all three countries agree that trust plays a crucial role in their organization. On the other hand, they do not agree with the statement that because of the democratic structures it is hard to make decisions. Neither do they agree with the proposition that there can be conflicts between old and new members because they have been sharing different risks throughout the cooperatives' period of operation.

Since the case studies revealed a variety of cost elements influencing the cooperatives, the survey focused particularly on those. Figure 13 shows the cooperatives' opinion regarding the influence of the cost factors on their respective organization. Possible answers ranged from "very high" (one) to "very low" (five). The most important influences on a cooperative are the costs of the energy facilities including the purchase, installation and connection of the facilities. Moreover, investigating potential sites and maintaining the equipment are connected with costs. Contrarily, administrative expenses, auditing costs and the supervision of the cooperative are rather unimportant for a cooperative. Costs for licenses and permits have been an item mentioned in the case studies, but seem to be rather unimportant to the cooperatives.

With respect to the future of the cooperative, the ability to find new projects is very important to German cooperatives, but only neutrally important to Swedish organizations, whereas it is not important to Danish cooperatives. The development of membership numbers is a rather unimportant factor in all countries, which is also the case for the members' demand for high dividends. Contrarily, the most important factor influencing a cooperative's future is political decisions on regulatory conditions.

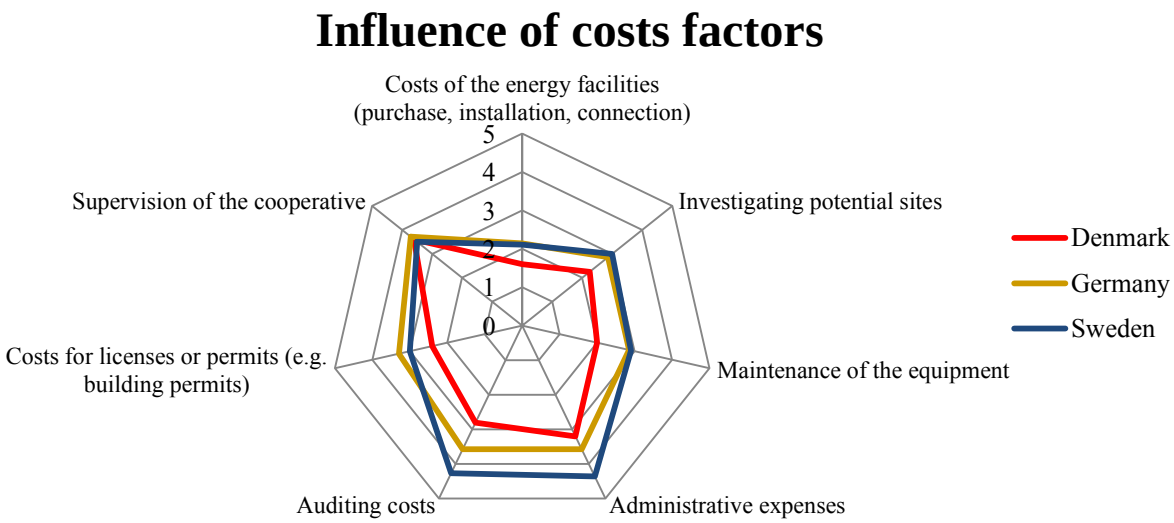

Figure 13: Influence of costs factors on the cooperative

Figure 14 presents the main advantages of cooperatives. The participants of the survey were asked to value them with respect to their cooperative from one "very important" to five "very unimportant". The most important factor is the positive environmental impact that is shared by cooperatives in all countries. Based on the data, the financial benefits of forming a cooperative are rather unimportant, although Swedish cooperatives think that the tax advantages regarding the distribution of dividends are important. Creating an extra income for the members is important to Danish and Swedish cooperatives, but neutrally important to German ones. On the other hand, limiting the liability and the local value creation are seen as clear advantages of this organizational form. Other important features of the cooperative are the simplicity to found such an organization, being an owner of a RE facility, the equality among members and the democratic structure within the organization. As observable from the figure, Swedish and German cooperatives demonstrate similar attitudes towards the items with the exception of creating an extra income for the members and the tax advantages. Danish organizations on the other hand show a rather dismissive attitude towards the statements presented.

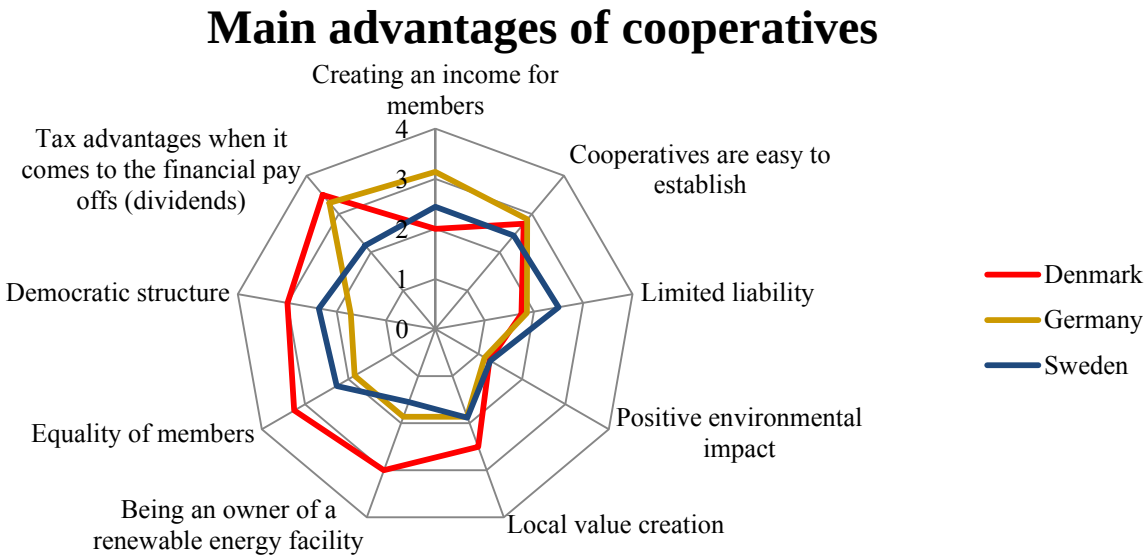

Figure 14: Answers to the question: "The following items are generally considered benefits of cooperatives. Please value them with respect to your cooperative."

Since the participants were asked for the main benefits of the particular organizational form, the negative aspects of the organizational form were covered as well. As above, the participants were requested to value them with respect to their cooperative from one “very important” to five “very unimportant”. Low values reflect an approval of the statements, whereas high numbers mirror dissent. Figure 15 depicts the results regarding the disadvantages of cooperatives. Only three of the items are seen as clear disadvantages of cooperatives especially in Germany and Sweden, namely the insecurity towards the development of regulatory frame conditions, the development of electricity prices and that the cooperatives are dependent on their members’ commitment. The appreciation of the first two items is higher than the latter one. Cost elements for supervision and administration are not important or have only a minor influence on the cooperative. Furthermore, the Swedish cooperatives tend to value those issues less than German or Danish cooperatives. While the German organizations neither value the assumption that the cooperative form can be difficult for decision making, that costs for supervisory activities occur and that the lack of expertise inside the organization can be a disadvantage as important or unimportant, Danish and particularly Swedish cooperatives show that those factors are unimportant disadvantages for them. Again, Danish organizations present a rather dismissive attitude towards the statements presented.

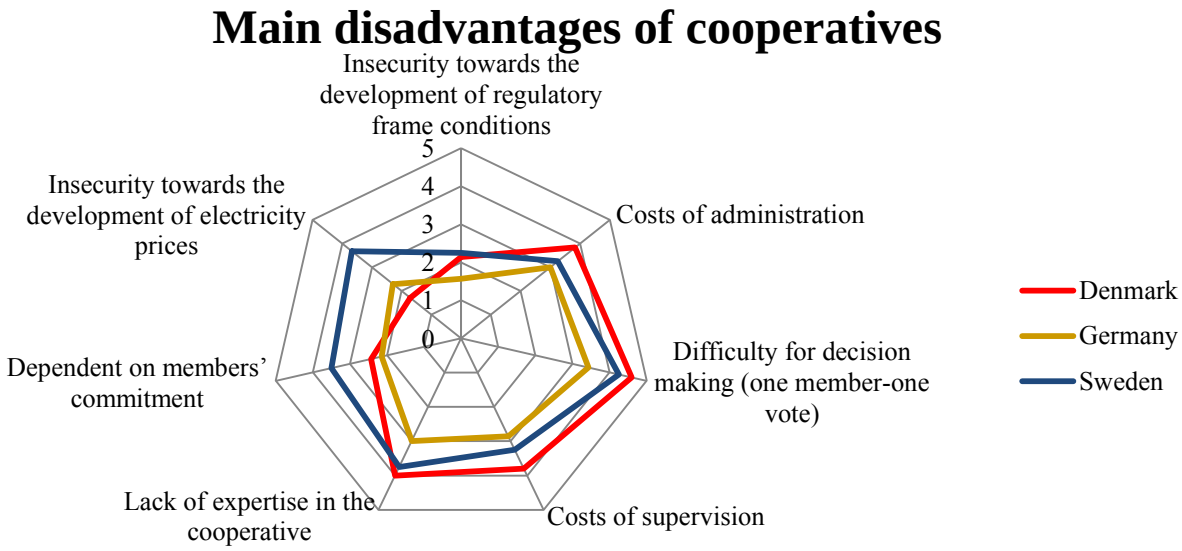

Figure 15: Answers to the question: "The following items are generally considered challenges of cooperatives. Please value them with respect to your cooperative."

The open question towards the role of cooperatives in society underlined their role for an energy turnaround, but also pointed out the importance of political decisions for a future development. One Swedish participant mentioned the "uttagsskatt" (socket tax) which is a financial instrument to tax the cooperative's members' consumption and was formerly tax free. Since the government has mentioned possible changes, the development of cooperatives has stopped. Generally, they are seen as important entities for a local and decentralized energy and electricity supply with a major potential for public participation. Cooperatives can act as a counterbalance to oppose existing structures. Although cooperatives own a decent share of the installed capacity, they still play a rather minor role in the overall market.

6. Analysis

The analysis of the results above will take into account the case studies as well as the survey findings. Differences and similarities between the cooperatives are pointed out with a special focus on the transaction costs in chapter 6.3.

6.1. Case studies

The case studies have created an interesting view on the situation of energy cooperatives in the respective countries. The following paragraphs will analyze the findings by providing hypotheses and subsequently giving reasons for them.

1. The location of the energy cooperative defines the energy type used

With respect to the interviews conducted, there is a remarkable difference between the energy types used by the cooperatives in the respective countries. While Danish and Swedish cooperatives focus on wind energy, cooperatives in Germany also use solar power and biomass facilities. This has two reasons. First of all, the interviews have pointed out that an investment in solar power requires less capital and thus is easier to finance. Secondly, the building regulations are more moderate for solar cells because they have a lower impact on the residential areas as sound and visual impacts are negligible or comparably low (Tsoutsos *et al.*, 2005). As the interviewees revealed, solar cells could be installed on the roofs of public buildings or private homes. The geographical advantage due to a higher solar insolation combined with lower investment costs and low environmental impacts can be seen as one reason why the development of energy cooperatives has sparked especially in Southern Germany but it is comparatively slower in Denmark and Sweden. This conclusion can be supported by the fact that the majority of German energy cooperatives employed solar power as their main energy supply, followed by biomass and wind power (Yildiz *et al.*, 2015). The change of legislation described above has slowed down the development of new cooperatives in the past year. Therefore, it remains to be seen whether the trends in the countries will be similar in the future. The survey will present a more detailed view on the energy types used in the different countries.

2. Cooperatives vary in size

Since only a limited number of cooperatives have been interviewed in each country, the generalization of results is limited. Still, a certain trend can be described among the cooperatives. Interestingly, the underlying cooperative model slightly varies between the three countries. In Denmark and Sweden, one can simply become a member when buying a share. Since one share resembles a particular electricity consumption of e.g. 1,000 kWh, the number of shares issued by the cooperative is limited. Therefore, no new shares are emitted, but only traded when one of the members decides to leave the cooperative. Contrarily, the German cooperatives have developed two other models. One is to become a member by buying a share and subsequently profiting from the activities. Another option is the combination of shares and subordinate loans. The subordinate loans allow that every project has an individual interest rate which prevents the discrimination against older members. Those had to take on more risks whereas the newer members could otherwise profit from an already profitable operation. Generally, all cooperatives are open to new members, but depending on the varying schemes, it might be actually hard to become a member in the cooperative. Based on the limited number of interviews, the cooperatives tend to be larger in Germany and Denmark than in Sweden. As described in the problem statement, no sufficient literature is available on the situation of cooperatives in Denmark and Sweden. Still, the case studies have shown that

the Swedish cooperatives focus more on the local aspect of energy production and consequently are limited in size whereas the Danish and German ones have more members. Moreover, the number of members correlates also with the installed capacity, at least in the case of Denmark and Sweden. Since each share should represent a defined energy production, based on the installed capacity only a number of shares are issued which then is bought by a limited number of members. Consequently, the cooperatives tend to be smaller in size and more localized whereas the German cooperatives are rather aiming at a growing and expanding their business.

3. Democratic principles and a non-exclusive focus on profits

Remarkably, all cooperatives in the case studies valued the democratic principles which become manifest in the "one member – one vote" principle which is one of the most important features of a cooperative and is put into practice by every cooperative. Furthermore, the general assembly is the most important institution where decisions are made although the day-to-day activities are handled by a management board. These aspects will be further elaborated below. The case studies show that profits are not most important factor for the organizational form but rather a beneficial side effect. This links back to the traditional cooperative principles presented above and shows itself in the notion that cooperatives care for example for the communities they act within.

4. Motives to join or establish a cooperative vary

The motives to join a cooperative as well as to found one vary and are fairly individual, although several tendencies can be detected. From a members' perspective, three distinct reasons can be found to become engaged in the organization. First of all, cooperatives seem to attract people who prefer and follow an environmental and sustainable lifestyle which is due to the fact that these organizations invest in renewable energies. Traditional energy sources such as gas and coal are not feasible investments for cooperatives because of their capital intensity. As described in the case studies, the organizations experienced an increase in members especially after catastrophes related to traditional energy sources. Examples are the Chernobyl and Fukushima incidents. Secondly, another reason to become a member in a cooperative is the self-efficacy of members which reflects the original idea behind founding and operating a cooperative: People come together and realize projects that would not have become reality without the members' commitment. Lastly, the financial aspect of being a member in a cooperative clearly is apparent in the case studies. All cooperatives offer some kind of interest yield for the initial investments and provide renewable electricity at the same time. Consequently, an environmental friendly investment is a motivating factor to become a member in the cooperative.

Contrarily, the reasons to establish a cooperative are rather individual and cannot be generalized from the case studies' findings. Since the interviewed individuals have often been involved in the process of establishing the cooperative, the reasons to become a member can also be valid for establishing cooperatives. This aspect will be further elaborated on in the survey. Still, three distinct motives can be found in the case studies. Firstly, a particular event can lead to the formation of cooperatives, such as the incident of Chernobyl. Secondly, political decisions in favor of renewable energies and citizen participation can also lead to the establishment of cooperatives since it becomes easier to found the organizations with the support of the political decisions. Thirdly, another motivation to establish a cooperative is the notion of participation. A participatory approach should lead to higher acceptance towards renewable energies. Something that was indicated in the case studies but needs further research is the perception of regular energy producers, which is consequently analyzed more

in the questionnaire. A possible motive to found a cooperative would be the dominant market powers of the regular energy producers. This aspect will be covered in the questionnaire.

5. Governance structures are professional, but country specific

The case studies show that all energy cooperatives covered have proper management structures in place with respect to the organizational structures. Opportunistic behavior as such is not prevented by the structures, but those institutions work towards lowering the possibility of it. As described above, the main decision making body of the cooperatives is the general assembly which theoretically consists of all the members of the cooperative. The online questionnaire will show which percentage actually takes part in the meetings.

Moreover, the case studies illustrate the professionalism of the organizations since most have management boards which handle the day to day business. The board size varies from cooperative to cooperative but can be narrowed down to two to seven members. Interestingly, German cooperatives often have a supervisory board which checks upon the management boards' actions and decisions. The case studies do not reveal similar structures in Sweden and Denmark. A possible explanation for the difference is that in Germany, these structures are prescribed by law for cooperatives with more than 20 members as specified by § 9 GenG (Bundesministerium der Justiz und für Verbraucherschutz). The original law aimed providing legal certainty as well as limiting the members' liability and was introduced in 1889. To be sure, the online survey will specifically focus whether those structures exist. Still, the case studies have provided a clear understanding of how decisions are made. Those governance structures can be seen as a contribution to the problems described above, especially the one of opportunism. Since all cooperatives have clearly defined rules for the decision-making process, opportunism can be prevented. Although German cooperatives are required by law to have a supervisory board, this structure also prevents the problems described by the agency theory. With reference to the theory presented above, another solution for the agency problem is building up reputation or trust that can prevent an imbalance between principals and agents, which is discussed below.

6. Trust and concern for community

As described in the introducing remarks, trust helps to significantly lower the enforcement costs attributed to governance structures. Still, the case studies do not reveal that trust is a crucial factor for them. Since this was not part of the semi-structured interview survey, further research is needed which is why this aspect will be covered by the questionnaire survey.

As the concern for the community is even a cooperative principle (The International Co-operative Alliance, n. d.), this aspect should be important to the cooperatives. The case studies reveal that responsibility and a concern for the community are understood in two ways. On the one hand, local communities are affected by the installation of the energy facilities by noise, visual disturbances or changes of the landscape. On the other, local communities often profit from the facilities through economically priced electricity, local employment and returns from the loans that were primarily given to the organizations. Moreover, citizens can be involved in the organization and thereby alter decisions – given they find a majority for the opinion - to prevent negative outcomes. Compensating the negative consequences of the installation of the energy facilities with monetary and participatory approaches is seen as the major aspect of realizing the concern for the community. Still, this aspect has not been covered thoroughly in the interviews and thus does not run like a common thread through the case studies. Therefore, the online questionnaire will take this issue into account.

7. Advantages

The case studies clearly show a few features of energy cooperatives which are seen as the key advantages of the organizational form. First and foremost, the democratic structure and participation are two aspects which have been mentioned repeatedly. Interestingly, the democratic structure and the participatory approach are two sides of the same coin. While the democracy in decision-making refers to the internal organization and is reflected in the institution of the general assembly, the participation corresponds to the opportunity of the general public to be involved in the energy cooperative and thereby have a say in the decision-making. As depicted above, participation can lead to a higher acceptance of the RE projects.

By forming energy cooperatives, the members become independent from regular energy producers which manifests itself in two ways. On the one hand, members are independent from engaging in costly contracts since their electricity is provided by the cooperative. If the cooperative's electricity prices are comparatively low, members profit since they pay less than the average. If the prices are higher than average, members still benefit because of their shares and the consequently higher interest rates for those. Obviously, this argument is only valid if the cooperative operates at profitable level.

Moreover, the ownership aspect of the RE facility seems to be an important one since it appears in the case studies more than once. As the organizations focus on RE projects, the positive environmental impact they achieve, i.e. low carbon emissions, is also a factor that is seen as an advantage.

Interestingly, several financial aspects appear in the case studies as distinctive advantages of this organizational form. Firstly, this organizational form is suitable for sharing risks when investing in the energy facilities while at the same time reducing the individual liability. As portrayed above, the financial schemes vary substantially. Based upon the schemes, possible tax advantages may apply when distributing the dividends. Independent from the chosen scheme, energy cooperatives often pose an extra income for the members.

The main advantages will be further investigated in the questionnaire since the factors stated in the case studies might not apply to the majority of cooperatives. To summarize the aspects above, the main advantage lies in the fact that energy cooperatives combine the best attributes of both democratic and economic approaches and at the same time work towards a more sustainable future.

8. Disadvantages

With respect to the most prominent factors influencing the cooperatives negatively, the costs of operating the organization are seen as the strongest argument against energy cooperatives. Besides expenses for administrative costs, German cooperatives are audited twice – once by an auditing firm and as well by the cooperative association for which expenses occur each time.

Secondly, the organizations need to collect a large sum of money before they can invest in their first project which is seen to be more difficult for smaller organizations such as cooperatives compared to regular business enterprises. As especially wind power is rather capital intensive, those projects are not recommended to start with. Since solar power seems not to be a wide-spread option in the Nordic countries, it poses a limiting constrain on the possibilities for energy cooperatives to expatiate. On the other, especially solar power might be a great opportunity for energy cooperatives e.g. in Sweden, since the installed capacity has

been increasing lately as described in the background information on the electricity market in Sweden. As portrayed above, capital requirements are lower so that cooperatives are easier to establish.

Furthermore, the fluctuation of the electricity price is seen as a constraining factor since it hinders a strategic planning of the energy cooperatives' futures. Besides that, a fluctuating electricity price can also pose a financial threat to the organization itself since the members expect the distribution of dividends which influences the financial liquidity of the organization. This affects the cooperatives in Denmark and Sweden more than the German ones because the German ones tend to a more diversified portfolio and therefore are able to build up resistance against price shocks. Since the price for electricity depends on the cost for distribution and the actual generation, a diversified portfolio can help to lower production costs and thereby increasing potential profit margins.

The most prominent factor affecting cooperatives negatively is a change in legislative surrounding conditions. As those factors lie outside of the cooperative's area of influence, they have to be acknowledged, but can hardly be changed.

As described above, also the disadvantages will be further investigated in the questionnaire since the factors stated in the case studies might not apply to the majority of cooperatives.

6.2. Quantitative Survey Results

The online questionnaire has helped to put the case studies' findings in a broader context. Generally, the findings of the case studies can be confirmed, although a more detailed picture can be painted now. Due to the relatively low number of respondents, the degree to which these results can be generalized is limited, although the give a good overview on the situation in Sweden since a high number of Swedish cooperatives participated. As above, the subsequent paragraphs will analyze the findings by providing hypotheses and subsequently giving reason for them.

1. The energy type employed determines the size of the cooperative

With reference to the analysis of the case studies results, the link between the size of the cooperative and the energy type used could be confirmed. Generally, the cooperatives tend to be larger in Denmark and Germany than in Sweden. The survey revealed on the other hand that a lot of small scale organizations exist in Germany which was not covered in the case studies. Figures 7 to 9 show the connection between number of members, energy types used by the cooperative and the installed capacity. Danish and Swedish cooperatives focus on wind energy, whereas the German ones have a more diversified energy supply. The installed capacity is closely linked to the actual number of members which can be explained by two reasons. Firstly, in Denmark and Sweden one share resembles a particular electricity consumption which links the number of members to the installed capacity. Secondly, the higher the installed capacity, the more capital is needed to finance the energy facilities, which explains the correlation between membership and installed capacity. Furthermore, the energy type used by the cooperative is reflected in the installed capacity and thus in the membership numbers. Solar and biomass are rather small scale applications compared to wind energy which is why the cooperatives represented in the survey are smaller in membership size than Danish and Swedish ones. This finding is differing from the case studies. As stated in the study's delimitations, this thesis focuses on the electricity part. Although biomass applications often use a combined heat and power production, the heat generation is neglected in the study.

The cooperatives' strategies reflect the respective national approach when it comes to the energy strategy. While Germany has a strong focus on wind and solar power as well as

biomass as shown above, Denmark and Sweden focus mostly on wind power. Apart from the geographical conditions, the political frameworks and incentives are reflected in the energy type used by the cooperatives.

2. Cooperatives follow different strategies

As already mentioned in the case studies, the organizations follow a different approach when it comes to accepting new members and the significance of one share. Again, in Denmark and Sweden most cooperatives have connected the value of one share to an electricity consumption of 1,000 kWh per year and therefore limited the amount of shares as the installed capacity and the projected electricity generation determines the number that can be issued. Consequently, becoming a member is more difficult in those countries as the shares are hardly traded. The situation in Germany is rather the opposite, where individuals can become a member of a cooperative by buying a share. Another option is the use of subordinate loans. Since these aspects have been mostly covered by the case studies, the survey focused on the aspects which have the highest influence on the cooperatives' future. Again, a clear difference between the countries is observable. Whereas German organizations express that the ability to find new projects and the development of membership numbers is very important or important, these two aspects are rather unimportant to the Scandinavian cooperatives. Consequently, Danish and Swedish cooperatives focus rather on the already existing projects, whereas German organizations try to expand and grow.

3. Motivation to start a cooperative

The case studies revealed a broad variety of reasons why to start a cooperative. Since those statements were based on individual perceptions, the survey tried to test these attitudes analyzing the dominant factors.

Remarkably, the online questionnaire revealed that the prevalent motivation to establish a cooperative is to support renewable energies and increase the acceptance for them – factors shared by cooperatives in all countries. Offering a clean and ethical investment is also important to the organizations, whereas creating an extra income for the members is rather unimportant. The case studies showed three different motivations to join a cooperative, among them people who prefer and follow an environmental and sustainable lifestyle. Based upon the survey, the motivation to establish a cooperative seems to be linked to this particular lifestyle. This argument can be supported by the fact that financial aspects in general appear to be less important.

4. Decision making and supervision

Regarding the processes behind the decision making and the supervision of the cooperative, the interviews showed the basic structures, but did not cover the relation between management board, supervisory board and general assembly. As mentioned above, differences in the legal system are the main reason why in Germany cooperatives have a supervisory board – since it is mandatory – whereas in Sweden and Denmark only a minority employed such a structure. In Germany, the supervisory board is elected by the general assembly and is authorized to choose the members of the management board.

All cooperatives have a management board although clear differences between the countries are observable. In Denmark and Sweden, the management boards have more members than the ones in Germany, but at the same time they tend to meet less often. In the Scandinavian countries, the members of the board are elected by the general assembly.

The case studies pointed out that all cooperatives have an annual meeting which is open to all of the cooperatives' members. Interestingly, the questionnaire survey showed that the actual number of participating members is sometimes rather low, ranging on an average from 17 to 34 percent. This poses an interesting perspective on the democratic aspects of cooperatives. Generally, the structures of the cooperatives are highly professional by using institutions such as management boards. Decisions on day-to-day activities are made by a small group of people, whereas the general assembly only meets once a year to make decisions on large projects and to approve the respective boards' actions.

The online questionnaire has provided more insights into the decision making and the structures attached to the cooperatives. Interestingly, the theoretical framework named several reasons why cooperatives should be founded – based on the research in the field of energy cooperatives. The analysis shows that energy cooperatives have a well-developed system of supervision which prevents opportunistic behavior. Normally, such a system should be quite costly, but the subsequent chapter shows that those cost factors are seen as important.

5. Costs

As with the motivation to establish a cooperative, many different reasons have been named in the case studies affecting the cooperatives' operations. The survey helped to prioritize the cost factors. It is noticeable from Figure 13 that the costs which can be attributed to the actual energy facilities are the most important ones, i.e. purchasing the facilities, installing them and connecting them to the grid as well as maintenance costs. Moreover, costs for licenses and permits as well as information costs for potential new sites play a role. Contrarily, costs for the supervision of the cooperative, auditing costs and administrative expenses are seen as unimportant. Even the highly developed structures of German cooperatives do not seem to lead to significantly higher expenses. This is important with reference to the theoretical background, since normally those governance structures would lead to higher costs. Therefore, the costs related to the internal activities of the organization are rather low, whereas the main focus lies on the expenses for the energy facilities. An interesting connection can be drawn to the statements made above. The cooperatives in Denmark and Sweden have a stronger focus on wind power which requires a higher capital investment than small scale applications of solar power or biomass as installed in Germany thus leading to higher costs for establishing a cooperative.

6. Advantages

The case studies identified several possible advantages of energy cooperatives, among them the democratic structure and possibilities for participation, working towards a greater independence from conventional energy producers, being an owner of a RE facility and lastly financial aspects such as risk sharing and tax advantages when distributing dividends. Those items have been tested in the survey with the results presented above.

With reference to Figure 14, all cooperatives in the three countries rate the positive environmental impact as the most important benefit. Other very important aspects include the fact that members become owners of RE facilities, the limited liability of each member, the local value creation as well as the democratic structure and the equality of members. The items tax advantages, creating an extra income for members and the idea that cooperatives are easy to establish are neutral to the cooperatives. Generally, German cooperatives think of the items named as most important with the exception of the ownership, creating an extra income for members and the simplicity of establishing a cooperative. The last two aspects are the least important ones from a German perspective. Danish cooperatives rate the items generally

as less important than cooperatives from the other countries. Still, the response values show on an average that the cooperatives agree with the benefits or at least mostly not disagree. Since the possible advantages of this organizational form have been named by the cooperatives themselves, the survey results are not surprising. Nevertheless, it is a strong statement that the most important factor for cooperatives is the positive environmental impact and not financial aspects. Moreover, the variety of almost equal advantages underlines the significance of positive arguments for founding a cooperative, which also mirror the cooperative spirit.

Interestingly, another advantage which has not been mentioned in the case studies is trust which was therefore not included as an item for this specific question. The notion of trust was nonetheless tested – all cooperatives agreed that trust plays a crucial role in their organization. This is an important result which complements the case studies' findings and links back to the theory presented above. Trust is the crucial factor in lowering agency costs and preventing an opportunistic behavior.

7. Disadvantages

Referring to the case studies, the interviews focused on the costs of operating the organization, the necessary financial sum to finance the energy facilities, the fluctuation of the electricity price as well as political decisions. Especially the latter point seems to be important since the high number of newly founded cooperatives due to supportive legislation is mirrored in the survey results.

Contrarily to the results regarding the advantages of a cooperative association, most participants valued the items proposed as rather unimportant, except for the items that a cooperative may be dependent on the members' commitment, may experience insecurity towards the development of electricity prices as well as insecurity towards the development of the regulatory framework. German cooperatives neither value the statements as important or unimportant, whereas Danish and Swedish tend to the rate issues as unimportant. The most important conclusion from analyzing the potential disadvantages is that the cooperatives think that the disadvantages lie outside of their scope, whereas the internal factors seem rather unimportant. This is of particular interest since the cooperatives mentioned the disadvantages in the interviews, but do not confirm these statements on a broader scale in the survey.

6.3. Application of transaction cost theory

Chapter 2 gave an overview on the general beliefs and underlying concepts of the new institutional economics such as methodological individualism, bounded rationality and opportunism. These beliefs are reflected in the transaction cost theory which can be categorized in varying ways such as ex ante or ex post costs as well as market or managerial transaction costs. The determining factors of transaction costs are specificity, uncertainty and the frequency of transactions.

As pointed out above, the reason to establish a cooperative from a theoretical perspective can partly be seen as an attempt to challenge existing power structures and to counteract excessive market power. This motive could be confirmed in the case studies and the survey although it is not prevalent reason to establish a cooperative. Although the theory has been linked to the analysis in the previous chapters where a connection could be seen, the following paragraphs tightly link the theory to the analysis.

With respect to the market transactions costs, the costs are of medium importance. The most important factors influencing the market transactions costs are search and information costs as a result of finding suitable locations for the energy facilities. The costs were valued as

important by the cooperatives. The most important expenses of the energy cooperatives are the purchase of the energy facilities and closely related costs. Since investments in energy systems are highly specific and have a low frequency, the transaction costs regarding the purchase of the equipment would be rather high. Due to the inherent trust among members and the knowledge within the organization, the transaction costs are not significantly. Stakeholders that have a strong position in the market might be able to lower the actual costs for the energy equipment, but that does not affect the market transaction costs.

Due to the specificity and the low frequency of the purchase of the equipment, the managerial transactions costs are traditionally of high importance. The costs of setting cooperatives up were described as low in the interviews, but the survey showed that this is not an important advantage of the cooperative. In theory, it should be hard for cooperatives to make decisions due to the democratic structures in place. Both case studies and the survey have underlined that this is not the case for energy cooperatives. Contrarily, the structures are highly professional with respect to decision making and the supervision of these. No opportunistic behavior could be detected, although the financial sums involved would pose an incentive to foster such a behavior. As a result of the trust among members, free riding is prevented and low transaction costs arise for the actual supervision of the cooperative as well as administrative expenses related to it.

All in all, energy cooperatives have low transaction costs since the organizations are mostly run in a professional manner. Information costs cannot be found as being significantly higher compared to other market players. Trust and the individual members' commitment can be seen as two significant reasons why the transaction costs are low. The members' preferences remain unclear as they were not the main focus of the survey, but still no notion of divergent preferences could be found in the interviews. Moreover, most cooperatives were found to be rather small scale so that decision making is easier compared to large scale organizations. On the other hand, the small scale can also be a disadvantage as portrayed in the interviews. Larger organizations have greater financial capabilities and can therefore finance projects with a financial scope that would be hard for cooperatives to finance. As a result, cooperatives can be seen as hybrid mode organizations that combine the benefits of voluntary and democratic organizations at low and efficient cost. With reference to the analysis above, this explains why trust and the individual commitment are so important. Since this study focused on existing cooperatives, the failing approaches could not be covered. This will be further elaborated in the discussion.

7. Discussion

The subsequent chapter presents a discussion of the research results as well as answers the research questions posed in chapter 1.3, asking for the main benefits and challenges associated with energy cooperatives as well as their relation to each other.

- What are the main benefits connected with energy cooperatives?

As shown and discussed above, the main benefits with energy cooperatives are the positive environmental impact coming from the desire to help renewable energies as well as local value creation, ownership aspects and the fact that the individual liability is limited. These benefits are the motives why cooperatives are founded in the first place and commonly known by the literature (Bonus, 1986; Hansmann, 1996; Huybrechts and Mertens, 2014; Yildiz *et al.*, 2015). Accordingly, energy cooperatives share these reasons, although the positive environmental impact is probably unique. The main advantages of energy cooperatives as presented in chapter 1.1 could be confirmed.

- What are the major challenges that can be attributed to energy cooperatives?

The challenges related to energy cooperatives can be clearly attributed to factors outside of the cooperative. Since the energy sector is subject of international as well as national legislation, the most difficult challenges could be attributed to changing legislation and the volatility of the electricity prices. The only challenge inside the cooperative is the question of the members' commitment. Costs play a secondary role in the challenges attributed to cooperatives – although the cooperatives operate with relatively large amounts of money and highly specific and infrequent decisions are made, transactions are low. This is due to the proven structures in place and the trust among members. Challenges in the literature that focus on heterogeneous interests, free riding and enforcement costs for the monitoring activities as well as organizational costs (Ménard, 2004; Bomberg and McEwen, 2012; Yildiz, 2014; Yildiz *et al.*, 2015) could not be confirmed in this study.

- How are the benefits and challenges related to each other?

Regarding the relationship between benefits and challenges, the benefits named outweigh the challenges. The claim can be supported by the fact that the average weighting of the statements posed shows a higher appraisement towards the advantages than the disadvantages of cooperatives. This conclusion needs to be critically reflected upon. All interview partners and participants in the survey were involved in cooperatives – consequently they expressed their positive view on this organizational form in the talks and the questionnaire. The bias is reflected in the results, but is an inherent problem. As described above, the negative aspects of cooperatives fall a bit short which is mainly due to two reasons. First of all, the participating organizations both in the case studies and the online questionnaire are currently operating so that potential failures and the subsequent cannot be covered. Secondly, all representatives of the cooperatives were very dedicated, but did not express any internal incidents that should shine more light on the negative aspects of this organizational form. Conventional energy producers were asked to state their opinion towards energy cooperatives but refused to answer. Still, the extensive interviews confirmed that especially political decisions have a strong impact on the development of cooperatives, as seen in Denmark with the "20 percent cooperatives" and in Germany, where the boom of cooperatives focusing on solar power has been stopped for now due to the recent legislative changes as portrayed above.

Both the case studies and the online questionnaire revealed similar legislative preconditions in the three countries with respect to establishing the cooperatives, but also the actual promotion of RE facilities. Since the formalities to found the organization proved to be rather negligible,

the energy sources employed become the crucial factor. The empirical data revealed that the Scandinavian organizations mostly focus on wind power, whereas German cooperatives had a diversified portfolio including solar power and biomass. This finding can be supported by looking at the results of chapter 4 as well as already existing studies on energy cooperatives in Germany (Yildiz *et al.*, 2015. These two options could pose interesting opportunities for the future development of Danish and Swedish energy cooperatives, since the capital requirements are lower. As the installed capacity of solar power is increasing fast in Sweden, this is an interesting field for the country's cooperatives. As for the German case, the development of cooperatives focusing on small-scale solar power applications has become more difficult due to the described legislative changes. Nevertheless, a remarkable chance lies in the field of focusing on biomass applications, especially combined heat and power systems which do not just provide electricity, but also district heating. Although there are already cooperatives in that sector, it could be a chance to meet the changed market requirements. Secondly, organizations can try to offer more services along the industry value chain, i.e. move away from the actual generation of electricity and to direct marketing of the electricity (Viardot, 2013). A focus on biomass would furthermore diversify the cooperative's portfolio, since heat could be offered as a complementary product.

This study contributes to the broader perspective of sustainable development through providing an answer to the question how to realize a local and sustainable energy supply. Cooperatives are a possible organizational choice; especially the positive environmental impact can be of high importance to individuals planning to engage in a project securing a local energy supply. The benefits stated above contribute to the idea of a sustainable transition towards a renewable energy supply.

The main limitation of the study is the relatively low number of participants in the online questionnaire. Reasons for that remain unclear. A non-response analysis does not reveal a strong bias. Since the survey is anonymous, no conclusion can be drawn on which cooperative participated and which did not. To still conduct a non-response analysis, the features of the cooperatives in the study can be compared to the known population of organizations. The German cooperatives are well-reflected in the study (Yildiz, 2014), whereas no comprehensive studies are available for Denmark and Sweden. The issue of numbers of respondents was already mentioned in the theoretical remarks on the online questionnaire. Questions on the survey had been answered by email so that it was not a matter of misunderstanding. Almost all participants who decided to answer the questionnaire finished it also. Because of the low response rate, the generalizability and validity of the findings is limited. Since the results of this study are based on interviews as well as the survey, at least the validity of the results is acceptable because the interviews' findings were tested in the survey. Nonetheless, this leaves a potential for future research to test and verify this study's results.

With reference to the delimitations of the study presented above, both the unit of analysis and the theory can be seen as limitations of the study. Still, the unit of analysis worked well in the study although another study could broaden the scope. Interestingly, the theoretic approach proved to play a minor role. Transaction costs turned out to be a subordinate factor when it comes to energy cooperatives. This approach has been valid for agricultural cooperatives, but it does not appear to be a prevalent factor for energy cooperatives. Cooperatives can be seen as a hybrid organization (Ménard, 2004) with low internal transaction costs which gives reason to form them. Economic motives are rather insignificant, whereas trust and individual commitment are the most important features of the cooperative. These two aspects have also been found in earlier studies (Walker *et al.* 2010; Sagebiel et al., 2014). Therefore, another study could focus on analyzing the organizations from a behavioral economics perspective to

create further insights. This is of particular importance because this study focused on the members of the governance structures as interview partners, who might not be representative for the whole cooperative. Thus, a further study could focus on the cooperatives' members which would provide a very interesting perspective.

8. Conclusions

The EU has set a target for 2020 to reach at least 20 percent of RE in the final gross energy consumption. To reach that goal, a variety of measures has to be taken. This study has focused on the electricity sector where energy cooperatives can play an important role. The organizational form is not new, but has a long history, especially in the agricultural sector or as a credit association. Based on values such as self-help, democracy or equality, energy cooperatives realize RE projects.

Although comprehensive research has been conducted on the benefits and challenges of agricultural cooperatives, the majority of the literature relevant for this study focuses on Germany. Furthermore, the applicability of the transaction cost theory has not been reviewed yet. Thus, this study has analyzed the benefits and challenges of energy cooperatives in Denmark, Germany and Sweden using a transaction cost approach with the aim to assess the applicability of the transaction cost theory for energy cooperatives.

Both case studies and the survey revealed that the type of energy source used varies in the three countries. While Denmark and Sweden focus on wind power, German cooperatives use a more diversified portfolio. The differences are due to national legislation and affect the total installed capacity as well as membership numbers. Another current difference between the countries is the future strategy: German cooperatives tend to focus on growth, whereas the Danish and Swedish cooperatives rather maintain the status quo. Although the individual motives to join a cooperative vary, the reasons to establish a cooperative clearly show an underlying motivation to support renewable energies. The most important benefits associated with this organizational form are the positive environmental impact as well as local value creation, ownership aspects and the limitation of the individual liability. Contrarily, most of the disadvantages discussed concern factors lying outside of the cooperatives such as the change of regulatory frame conditions and the insecurity towards the development of the electricity price. Transaction costs are low since professional governance structures are in place and the trust among members prevents opportunistic behavior which explains why individuals like to form cooperatives and get engaged in these organizations. A future possibility for the cooperatives in Denmark and Sweden lies in the development of solar power and biomass capacities. German cooperatives could meet changed national legislative conditions by focusing also on biomass, engaging in the district heating sector and trying to move away from the actual electricity generation, but rather engaging in various activities along the value chain. Consequently, these results can lead to direct practical implications because it offers new opportunities for cooperatives or individuals interested in the energy market.

This study has provided first insights in the Danish and Swedish market of energy cooperatives. Future research could focus on those two countries and generate in-depth knowledge. Moreover, an analysis using behavioral economics could be highly interesting.

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Appendix

Appendix 1

1. Statistical data (year founded, type of energy production and number of members, cost of one share)
2. Members
    a. Structure of members such as local businesses, farmers/agricultural holdings, communal authorities
    b. Are you open to new members?
    c. How stable is your member base? Is there significant drop-outs or new memberships?
    d. Is there a difference between membership and ownership in the cooperative?
    e. What are the current major drivers to be a member in your cooperative?
3. What was the original motivation behind founding the cooperative?
4. Has the "business model/cooperative model" changed in any way over time, in that case how?
5. How are decisions made?
    a. What questions are discussed most intensively at the cooperative's meetings or other forums?
6. What the governing structures? How many people are involved?
7. What are the main perceived benefits with founding and operating the cooperative?
8. What are the main perceived challenges with founding and operating the cooperative?
9. What are the future plans for your cooperative?

Appendix 2

Andreas Bauer, 23.02.2015

Friedrich-Wilhelm Raiffeisen Energie eG, Germany

- The cooperative was founded in 2008, operates solar panels and has 280 members. The minimum investment is one share of EUR 100 plus EUR 1,900 as a subordinated loan, making it in total an investment of EUR 2,000.

Friedrich-Wilhelm Raiffeisen Energie eG Hohenroth, Germany

- The cooperative in Hohenroth was founded in 2010, focuses also on solar energy and has 108 members. The financing scheme is the same as above.

Friedrich-Wilhelm Raiffeisen Energie eG Großbardorf, Germany

- This cooperative was founded in 2009, produces solar energy and operates a local heating system. The cooperative has 173 members and uses the same financing scheme as the two cooperatives above.

All three cooperatives have the following in common:

- The members of the cooperative are private persons and companies, but mostly private individuals.
- They are open to new members, but due to political decisions, the cooperatives have been disadvantaged so that actually no new members are accepted, because otherwise profits would be shared among more members, although the new ones did not take on any risk. There is no difference between membership and ownership in the cooperative.
- There are two major factors behind founding a cooperative: economic interests, but also intrinsic values that try to preserve the environment and save energy.
- The business model will be enhanced; a future focus will lie on direct marketing of energy and possibly storage (existing cooperatives). Recently founded cooperatives will merge to use scale effects. Future possibilities lie in the field of local or small district heating system, especially due to biogas plants.
- Every member has one vote. The general assembly should be the principal body of decision-making, but in practice the cooperative has a managing board that decides issues in the day to day business without always consulting the general assembly. Those decisions are reviewed by supervisory board (board of directors). Examples for those decisions are the change of a telephone plan or internet provider. New projects are presented in the general assembly and consequently put to a vote. The general assembly meets at least once a year.
- Most cooperatives have two managers, whereas the supervisory board has to consist of at least three persons, and then can be increased to more members, but just with uneven numbers (five, seven, nine, etc.). The normal case would be five. It is important to have a good mix of members, a technical expert, a financial expert. The general assembly normally presents a good mix through society. The charter of each cooperative defines the rotation scheme of the managing board, for example one year or three years.
- Accountability is one of the main benefits to found a cooperative, one-member-one-vote can be seen as a disadvantage, but we see it as an advantage. Moreover, one actually owns a part of a renewable energy system and the risk is shared. Furthermore, there are tax advantages when it comes to the payout of dividends for the subordinated

loans.

- The interest rates for the investment amounts to five percent plus x. There is the possibility of a bonus depending how sunny the year was. Since we calculated the bonuses carefully in the first place, sometimes the interest rates can be even seven or eight percent.
- Disadvantages are the costs for operating the cooperative such as insurance, tax accountant or service providers. The one member one vote approach in a cooperative can also be a disadvantage – not so much for the decision-making but rather creating unsettledness.
- Future plans focus on storage, local district heating and direct marketing of the electricity.

Sebastian Sladek, 23.02.2015

Elektrizitätswerke Schönau, Germany

- The cooperative has 4000 members, a capital stock of EUR 35 million and has several subsidiaries. It has 155,000 to 160,000 customers and a total staff of 97 employees. The EWS was founded in 1994 – but not as cooperative, but as a partnership under the Civil Code.
- The cooperative is still open for new members; one has to buy five shares to become a member with a price of EUR 100 each, making it an investment of 500 total. The maximum is having an investment of EUR 10,000. We rather have a lot of members with small investments than having few members with large investments. This would create a dependency. If a person with a huge investment would threat to drop-out, this would be leverage for the member which contradicts that cooperative philosophy. All members are private individuals. The number of members increased during the last years, in the beginning there were around 650 partners. There is no difference between membership and ownership.
- The motivation behind being a member in the cooperative is mostly to bring forward the energy turnaround. Other discussions at the general assembly meetings focused on interest yield per share. The interest rate is now around four percent, because we have huge investments in front of us, but also because of the political decisions made.
- Every member has one vote. The general assembly takes place at least once year, by law in the first half of the year. The general assembly approves the activities of the management as well as supervisory board and is allowed to decide on the interest yield. Other issues discussed focus on projects, but overall energy issues are not part of the general assembly.
- The management board includes four people, where the supervisory board has six. The supervisory board is elected by the general assembly and is allowed to choose the management board.
- I don’t think that the full remunicipalisation, i.e. the transition of infrastructure from private to public institutions, of energy supply or energy grids is the solution. But neither are stock corporations. Therefore, the cooperative is the symbiosis of the two: The business spirit comes together with grassroots democracy. And we really like this model. I don’t know any organizational form that would fit the purposes better. One should not be afraid of democratic approaches – it should be rather the normality. Especially in the context of the energy turnaround, we strongly advocate public participation. The energy turnaround has the potential of being a democratic turnaround.
- The main disadvantage of a cooperative is for example that one has double costs for auditing since the cooperative is audited by an auditing firm as well as by the cooperative association. Another one could be that if business performance might be poor over a few years, the general assembly meetings could be rather rough. The costs are the main disadvantage. People like the grassroots democracy, but it might not be the best solution for small-scale projects.
- Our vision is that the energy turnaround has to be successful, apart from all the systemic and political failures. Although we would like to have our share of the business.

Anders Pettersson, 24.02.2015

Hycklinge vind, Sweden

- Founded in 2010 by an information meeting that I held for the residents of Hycklinge. We then decided to form "Hycklinge vind ekonomisk förening" in 2012. We planned to build two wind turbines of 2.0 MW on Göran Nilsson's land. We worked on an environmental impact assessment, building permit documents and documents concerning the environment. The building permit was granted but was appealed to the County Board. County Board dismissed the appeal and gave us the right. The decision was appealed to the Land and Environment Court which also dismissed the appeal. A share should be equivalent to a consumption of 1,000 kWh / year and costs SEK 6,000. 1,500 shares are planned to be sold. The remaining amount will be provided by a bank loan.
- The members are primarily meant to be people from the site Hycklinge Horn. If there is no interest, we will move on to all residential customers in the area. The cooperative is open to new members. It had to account for a loss of two members. One member can have several shares, but one member has only one vote. There are two drivers to become a member in the cooperative. If the price for electricity goes up, the cooperative has more money. If the price goes gown, it costs less for the members. We hope that net metering will become reality soon.
- The underlying motivation to found the cooperative was the ability to produce the electricity one consumes and to contribute to an environmental profile of the investment.
- The business model has not changed yet, since the cooperative waits for net metering.
- Decisions on day to day issues are made by the management board, whereas major issues are discussed by the general assembly.
- The management board has five members; the general assembly consists of all members.
- As said above, the main advantage is if the price for electricity goes up, the cooperative has more money. If the price goes gown, it costs less for the members. We hope that net metering will become reality soon. Moreover, the environmental benefit is pleasant and showing that consumers can help to create an independent energy production.
- The main challenges remain to receive all formal permissions and appeals.
- The future plans for the cooperative are to create an independent energy production, to arrange a nice cohesion with the residents in the community who share the same interests and to contribute to a more environmental-friendly energy production.

Björn Larsson, 03.03.2015

Göteborgsvind Nr. 1, Sweden

- The cooperative was founded in 1993 and it was started up by the local energy company Göteborg Energi, but it was given to the consumers as soon as the board was in place. In the beginning, it was three small turbines of 225 kW each; in 1996 there was an extra machine of 600 kW. This power was split up into shares, so every share is worth 1,000 kWh and had a cost of SEK 3,000 in the beginning. During the time, it was somewhere between 900 and 1,000 people involved, so they own one up to ten shares. The reason is that you can't have more shares than you consume. This is the rule for energy cooperatives, otherwise we would electricity producers and would pay a different amount of tax.
- The members are only private individuals. In order to be a cooperative member, no companies were allowed. Principally, the cooperative is open to new members, but the cooperative has a total of 3300 shares and to be a member you need to buy a share. We have the same amount of shares all the time, so to become a member, you need to buy the share from a current member. On our website, we have a buy and sell section. Therefore, there is no difference between membership and ownership.
- A major driver to be part of the cooperative was to be part of building up renewable energy capacities and supporting the technology. But furthermore, it has been a good profit also.
- The cooperative model has not changed over time. Other cooperatives in the beginning had a more progressing way of avoiding tax. So maybe we could have been more profitable, but then again we never had any problems with the tax authorities.
- Every member has one vote, it doesn't depend on the amount of shares. We haven't changed much, mostly practical things. One issue that has been discussed lately, are the locations of wind turbines. The contracts for the land on which the wind turbines stand are for 30 years, but after a while some members had received the payback for their investment and consequently expressed the wish to build new turbines and to keep the organization longer. The idea was turned down by the annual meeting. We only want to run the organization for a limited time. Moreover, new members would need to pay more for 1,000 kWh than the old ones did which would create difficulties. To invest in new turbines, you have two options. Either you buy an already existing turbine, which are quite expensive, or you look for new places which is cheaper but it puts your money at a risk because the investigation could show that the location cannot be used for wind power.
- We have six plus two persons in the board that are elected at the annual meeting. The board members meet almost every month to discuss new issues. The board also checks upon the contract with the power company Din El. All members in the cooperative are customers of the company and buy the electricity back. The board also decides on the price for the electricity. The price is split up into ten parts and locked in every month depending on the energy production in that month, except for June and July. The board has six plus two members, because the minimum is five, but we have six and we have two back-up persons if people are abroad or get sick.
- The main benefit is the production of "clean" electricity in an economic way. Or at least we have been doing it. The electricity price has decreased which is good for the members that have only one share and buy the rest from the electricity company. Now we have a price of öre 38.6 per kWh. The bottom limit is below öre 30 per kWh, afterwards it's not profitable anymore. Some years ago, we had a price of öre 95 per kWh which was really good. If we now had a fault in a gearbox, it could be possible if

decided to change the gearbox, that we would never be able to break-even the investment.

- The main challenge with the cooperative is the price fluctuation of the electricity price.
- Concerning the future plans of the cooperative, the main problem is the location of the turbines. The three small turbines stand on a small island that is connected to the main land, which in the beginning was owned by Shell refinery. The agreements for the lease could be principally terminated every year, because they have expired. Still, they are renewed every year. For the larger wind turbine, the lease expires in 2016. We will operate the wind turbines as long as we are allowed to use the land. But principally, the organization could be closed down each year now.

Hans Chr Soerensen, 10.03.2015

Lynetten, Denmark

- Lynetten was founded in 1995/1996, consists of seven turbines with 600 kW each. 3,600 shares were issued to 902 members. The price per share was EUR 604. The setup was organized in a way that the cooperative cooperated with the local utility company, where the utility company owns three of the seven turbines.

Middelgrunden, Denmark

- Middelgrunden was established in 2000 with 20 turbines of 2 MW each. 40,500 shares were issued to more than 8,500 members. The price per share was EUR 570. The setup is similar to Lynetten, while the cooperative owns ten turbines.

Hvidovre, Denmark

- In 2009, three turbines with 3.6 MW each were built in Hvidovre. 10,700 shares at a price of EUR 670 were given out to approximately 2,300 members. For this cooperative, the majority of the turbines is owned by the utility company.

Prøvestenen, Denmark

- The youngest of the cooperatives is the one in Prøvestenen which has been founded in 2013. Three turbines with 2 MW each have been installed, while more approximately 4,000 shares have been issued to more than 1,800 members. One share is valued EUR 663– the ownership structure is the same as for Hvidore.

All cooperatives have the following in common:

- The cooperatives have a mixed membership structure, but there is no data available on the owners of the share. Still, communal authorities are never owners of the organization since the law doesn't allow that. This can be solved creating a new organization, such as the case of Samsoe. In Copenhagen, besides individuals the teachers union and some divisions of metal workers union own shares equal to the use of electricity in their buildings. The cooperatives are principally open to new members, but this is up to the shareholders – shares can be bought and sold. The member base is quite stable, in most cooperatives shares are only traded by divorce or death, very few sell their shares. There is no difference between membership and ownership. The main driver to by a member in the cooperative is having a "greener consciousness", but also having an economic return, although this is not the most reason for most people.
- The main reason to create energy cooperatives was due to Denmark's energy strategy focusing on renewable energies, especially after the oil embargo in 1973, which should lead to a stable and secure energy supply. For the case of Copenhagen, the Agenda 21 [strategy for local and regional urban sustainability] opened the eyes of people on how to produce electricity.
- Over the last 20 years, the regulations have changed, but not in the favor of cooperatives. In the beginning, the shares being equal to the electricity consumption were tax free. In the late 1990s, environmental impact assessments were required for wind turbines which posed higher barriers for the cooperatives. Moreover, wind turbines became big business and therefore more money was involved. The renewable energy law from 2008 required a minimum of 20 percent local ownership to be offered citizens within 4.5km of the turbines and compensation schemes as well as

subsidiaries. Consequently, the original cooperative projects are more seldom, whereas the 20 percent projects are taking over.

- At the general assembly, decisions are made using a simple majority. Every member has one vote which is the key element in the Danish cooperative model. Issues discussed include for example the economic situation of the cooperatives as well as details of the production and technical details.
- The cooperatives are led by five to seven people selected every two years by the general assembly. The board members are not paid a fee.
- The main benefits associated with founding and operating a cooperative are that local communities are involved earlier and profits stay within the area.
- Contrarily, the disadvantages today are the size and the initial costs – the one who first gets to a landowner, has the right to use the land.
- For Lynetten, the plan is to repower the plants. Middelgrunden is planned to exist for 25 more years after 2025. The question is which turbines can be on the foundations. Moreover, an extension of life for the existing turbines is also possible.

Micha Jost, 27.03.2015

Energiegenossenschaft Starkenburg eG, Germany

- The cooperative was founded in December 2010 by 13 individuals. The focus was not a specific community, but rather a region. Among the founding members, there was a high diversity of backgrounds such as engineers, tax accountants and administration secretaries. Now the cooperative has 720 members. The minimum investment is two shares of EUR 100 each plus EUR 1,800 as a subordinated loan, making it in total an investment of EUR 2,000. The subordinated loan is dedicated to one project and has a project specific return and retention period. Until now, 12 solar panels, two wind power turbines and two interests in wind turbines have been realized. Lately, also a biomass plant was bought. The start was a wind power turbine.
- The members of the cooperative are mostly private, but can also be other energy providers, municipalities or even a bank. New members are only accepted when new projects are established which should secure a steady return of investment. The number of members has steadily increased since the establishment of the cooperative, in 2014 by 120. A couple of hundreds are on a waiting list, although people close to a potential new project would have priority. For the members, three different reasons have motivated them to become a member. The first group has always been interested in a sustainable lifestyle but especially the Fukushima catastrophe gave reason to become part of the cooperative movement. The second group contains of people that are in favor of the cooperative approach – doing things together, being able to finance even huge investments that enjoy the self- efficacy of people. The last group consists of people who favor an ethical and clean investment and who also are interested in the return of an investment. The first group is probably the largest with 40 percent of the members belonging to it and the other two groups have an equal share of 30 percent each, although the third one is increasing while the first one is decreasing.
- The underlying idea behind founding a cooperative is to create acceptance or pacification for when the projects are realized, especially wind power. Our mantra is: Who has to look at wind turbine, should profit from it.
- The supervisory and management board have collective meetings once a month and share information on these occasions. In a case of emergency, decisions can be made by a circular resolution. The issues discussed are new projects and the business model itself. It is a huge advantage when you get along well with the people in the boards which is a precondition to work successfully. Moreover, there is a general assembly once a year. The management board consists of two, the supervisory board of four individuals. Furthermore, there is a project group of interested members that supports the management board.
- The main advantage of the cooperative form is to engage a large number of people in projects. It is a symbol of participation and democratic procedures. Moreover, all members are equal despite their initial investment. On the other, the cooperative uses a lot of personnel for the administrative structures, other forms such as a limited partnership with a limited liability company as general partner would be leaner. Still, we like the mixture of all the elements in our cooperative.
- The challenges are to dedicated people in the beginning that even bring along some money to invest in the cooperative. Moreover, you need a project in the beginning to start with; you cannot just establish an organization which is the problem at the moment. Before, photovoltaic was the easiest way to start a cooperative but due to changed laws this has changed. Starting with a wind power plant is not recommendable. The large number of new established cooperatives will sink significantly soon.

- In the future, we would like to continue to grow. We still have wind power projects that we would like to realize, hydro power and direct marketing of electricity.

Appendix 3

Welcome!

My name is Jan Christoph Bohnerth and currently I am studying the master program in „Sustainable Development“ at Uppsala University and the Swedish University of Agricultural Sciences.

My master thesis compares energy cooperatives in Denmark, Germany and Sweden with a special focus on the costs of operating such an organization. A lot of research has been conducted on agricultural cooperatives, but just little on energy cooperatives. I have already interviewed some energy cooperatives in the different countries which have helped me in creating this survey. I am interested in the motivation to join a cooperative as well as the actual benefits and challenges.

The survey will take around 10 to 15 minutes, almost all of them are multiple choice questions which will help to compare the findings in the different countries. If you are interested in the study's findings after completion, please send me an email, since this study is anonymous.

For every respondent who completes the survey I will invest 5 SEK in a crowdfunding project that will finance the development of renewable energies in Great Britain [https://www.abundancegeneration.com/projects/#!/open).

If you have any questions, please contact me via email: jabo3400@student.uu.se.

Thank you very much for your time and help in advance.

Jan Christoph Bohnerth

Page 1 of 9: This part of the survey focuses on the statistical data of your cooperative.

1) When was your cooperative founded? [dropdown, one choice]
    a. Before 1980-2015 [each number is an individual option]
    a. Don't know
2) How many members does the cooperative have? [one choice]
    a. 1 - 10
    b. 11 - 20
    c. 21 - 50
    d. 51 - 100
    e. 101 - 200
    f. 201 - 500
    g. 501 - 1000
    h. 1001 and above
    i. Don't know

3) Which type of energy production do you have? [multiselect]
    a. Onshore Wind
    b. Offshore Wind
    c. Solar
    d. Biomass
    e. Other [specify]
4) What is the total installed capacity of your project [one choice]
    a. under 500
    b. 500 - 1000
    c. 1001 - 1500
    d. 1501 - 2500
    e. 2501 - 5000
    f. 5001 - 10000
    g. 10001 - 25000
    h. 25001 - 50000
    i. 50000 and above
    j. Don't know
5) What is the cooperative's yearly production (in kWh)? Please enter a number. [field to enter]
6) What was the overall investment in all of your energy production facilities [in the local currency]? [field to enter]

Page 2 of 9: This part of the survey focuses in depth on financial aspects concerning your cooperative.

1) What is the minimum financial commitment of one member [in the local currency]? Please enter a number. [field to enter]
2) Is there a maximum capital contribution? [one choice]
    a. Yes
    b. No
    c. Don’t know
3) How did you finance the membership? [multiselect]
    a. Saved capital

b. Bank loan

c. Don't know

d. Other [specify]

4) Are you selling the electricity only to your members? [one choice]

   a. Yes

   b. No

   c. Don’t know

5) Does the price of one share resemble a certain energy consumption? [one choice]

   a. Yes

   b. No

   c. Don’t know

6) What is the price of one generated kWh [in the local currency]? Please enter a number. [field to enter]

7) Does your cooperative have members from other countries? [one choice]

   a. Yes

   b. No

   c. Don’t know

Page 3 of 9: Please allow a few follow-up questions. If you are unsure, please leave the textboxes empty.

1) How many customers outside the cooperative do you have? Please enter a number. [field to enter] [shows up, if the participant answered “yes” on question 7, page 2]

2) How much energy consumption does one share resemble in kWh? Please enter a number. [field to enter] [shows up, if the participant answered “yes” on question 5, page 2]

3) What is the maximum financial commitment in [local currency]? Please enter a number. [field to enter] [shows up, if the participant answered “yes” on question 2, page 2]

Page 4 of 9: This section will explain the terms management board, supervisory board and general assembly. “Management board” means a group of people in charge of the cooperative’s day to day business. “Supervisory board” describes a board that supervises the management board and checks upon its activity. The “general assembly” is open to all members of the cooperative and makes important decisions.

1) Does your cooperative have a management board? [one choice]

   a. Yes

b. No

2) Does your cooperative have a supervisory board? [one choice]

   a. Yes

   b. No

3) Does your cooperative have a general assembly? [one choice]

   a. Yes

   b. No

Page 5 of 9: Please allow a few follow-up questions on the aspects of corporate governance. This data will be used to analyze whether cooperatives differ a lot in their organizational structure from regular companies.

1) How many members does your management board have? [dropdown, one choice] [shows up, if the participant answered "yes" on question 1, page 4]

   a. 1-9 [each number is an individual option]

   b. 10 and above

   c. Don't know

2) Are your management board members being paid for fulfilling that function? [one choice] [shows up, if the participant answered "yes" on question 1, page 4]

   a. yes

   b. yes, but they only receive an expense allowance

   c. no

   d. I do not want to answer

   e. don't know

3) How often do the management board members meet? [one choice] [shows up, if the participant answered "yes" on question 1, page 4]

   a. weekly

   b. monthly

   c. bimonthly

   d. semiannually

   e. annually

   f. don't know

4) The management board members are chosen by [one choice] [shows up, if the participant answered "yes" on question 1, page 4]

a. the general assembly

b. the supervisory board

c. They are not chose, but have constituted themselves naturally

d. not applicable

e. don't know

5) How many members does your supervisory board have? [dropdown, one choice] [shows up, if the participant answered "yes" on question 2, page 4]

a. 1-9 [each number is an individual option]

b. 10 and above

c. Don't know

6) Are your supervisory board members being paid for fulfilling that function? [one choice] [shows up, if the participant answered "yes" on question 2, page 4]

a. yes

b. yes, but they only receive an expense allowance

c. no

d. I do not want to answer

e. don't know

7) How often do the supervisory board members meet? [one choice] [shows up, if the participant answered "yes" on question 2, page 4]

a. weekly

b. monthly

c. bimonthly

d. semiannually

e. annually

f. don't know

8) The supervisory board members are chosen by [one choice] [shows up, if the participant answered "yes" on question 2, page 4]

a. the general assembly

b. the management board

c. They are not chose, but have constituted themselves naturally

d. not applicable

e. don't know

9) How often does your general assembly take place per year? [one choice] [shows up, if the participant answered “yes” on question 3, page 4]

   a. 1

   b. 2

   c. 3 and above

   d. don't know

10) Which percentage of all cooperative's members takes part in the general assembly? one choice] [shows up, if the participant answered “yes” on question 3, page 4]

   a. Scroll bar between 1 and 100 percent

Page 6 of 9: This part of the survey focuses on the motivation to found a cooperative and special aspects.

Which factors were most relevant when joining/founding the cooperative?

	Very important	Important	Moderately Important	Unimportant	Very unimportant	not applicable
Generate an income	□	□	□	□	□	□
Be independent from the energy producers	□	□	□	□	□	□
Have an ethical investment	□	□	□	□	□	□
Local interaction within in the community, bring people together	□	□	□	□	□	□
Change role of consumers in society	□	□	□	□	□	□
Generally support renewable energies	□	□	□	□	□	□
Increase local acceptance for renewable energies	□	□	□	□	□	□

Please state whether you agree or disagree with the following statements.

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	not applicable
Trust plays a crucial role in our cooperative.	□	□	□	□	□	□
Due to the democratic structure, it is sometimes difficult to make decisions.	□	□	□	□	□	□
There can be conflicts between older and newer members of the cooperative because they have taken own different risks.	□	□	□	□	□	□

Page 7 of 9: This page asks for your opinion on cost items and the impact of issues on your cooperative's future.

Please rate your views on the impact of the following cost items on your cooperative.

	Very strong	Strong	Moderate	Little	Very little	not applicable
Costs of the energy facilities (incl. installation)	□	□	□	□	□	□
Investigating potential sites	□	□	□	□	□	□
Maintenance of the equipment	□	□	□	□	□	□
Administrative expenses	□	□	□	□	□	□
Auditing costs	□	□	□	□	□	□
Costs for licenses or permits (e.g. building permits)	□	□	□	□	□	□
Supervision of the cooperative	□	□	□	□	□	□

Please rate your views on the impact of the following items on the future of your cooperative.

	Very hIgh	High	Medium	Low	Very low	not applicable

Ability to find new projects	□	□	□	□	□	□
Development of number of members	□	□	□	□	□	□
Members' demand for high dividends	□	□	□	□	□	□
Political decisions on regulatory frame conditions	□	□	□	□	□	□

Page 8 of 9: Almost done: This complex asks for the advantages and disadvantages as well as the attitude towards regular energy producers.

The following items are generally considered benefits of cooperatives. Please value them with respect to your cooperative.

Very important	Important	Moderately important	Unimportant	Very unimportant	Not applicable	
Creating an income for members	□	□	□	□	□	□
Cooperatives are easy to establish	□	□	□	□	□	□
Limited liability	□	□	□	□	□	□
Positive environmental	□	□	□	□	□	□

impact						
Local value creation	□	□	□	□	□	□
Being an owner of a renewable energy facility	□	□	□	□	□	□
Equality of members	□	□	□	□	□	□
Democratic structure	□	□	□	□	□	□
Tax advantages when it comes to the financial pay offs (dividends)	□	□	□	□	□	□

The following items are generally considered challenges of cooperatives. Please value them with respect to your cooperative.

	Very important	Important	Moderately important	Unimportant	Very unimportant	Not applicable

Insecurity towards the development of regulatory frame conditions	□	□	□	□	□	□
Costs of administration	□	□	□	□	□	□
Difficulty for decision making (one member-one vote)	□	□	□	□	□	□
Costs of supervision	□	□	□	□	□	□
Lacking of expertise in the cooperative	□	□	□	□	□	□
Dependent on members' commitment	□	□	□	□	□	□
Insecurity towards the development of electricity prices	□	□	□	□	□	□

1) How does your cooperative relate to regular energy producers? The same question will be asked to regular energy producers and helps to determine the future role of energy cooperatives. [field to enter]

2) Do you have any additional comments? [field to enter]

Page 9 of 9: Thank you very much.
If you have any further questions or remarks, please contact me using jabo3400@student.uu.se.
Best wishes
Jan Christoph Bohnerth


S. ACADE
ATIAE
RITAS