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100% Renewable Energy Regions in Europe

A comparative analysis of local renewable energy development

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Table of Contents

Abstract

Since the mid 1990s a growing number of regions in Europe have started to develop a local energy supply based on 100 percent renewable energies. This Master's thesis analyses what motives underlie the initiatives and what the enabling factors have been in the local implementation of renewable energy in four case studies. The regions of Dardesheim, Varese Ligure, Samsø and Lüchow-Dannenberg were among the first regions that opted for 100 % local renewable energy supply and today they can draw upon more than ten years of experience. Engaged local pioneers, a high degree of citizen participation and a structurally weak local economy have proven to be crucial success factors in the renewable energy transformation in all of the four regions.

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1 Introduction

Over the last two decades the renewable energy sector in the European Union has developed remarkably. Today about 8.5 percent of the energy consumed in the EU originates from renewable sources, and renewable energies play a significant economic role in many EU member states.[1]

This expansion has been systematically promoted by top-down as well as bottom-up initiatives. Top-down promotion of renewable energies has mainly been driven by EU directives and national support schemes, amongst which EU Directive 2001/77/EC[2] stands out. The directive obligates all EU member states to significantly improve their share of renewable energies by 2010 and as a result most member states have established support schemes for renewable energies (Reiche 2005).

At international climate negotiations the European Union also acts as a driving force for renewable energies, promoting their use and expansion as a means to both reduce the impact of energy production on the climate and to strengthen the economy. In a clear signal of its continued climate protection efforts, the European Commission on the 23rd of January 2008 put forward a legislative package to fight global climate change with the so-called "20/20/20 by 2020"- goals[3]. In addition to cutting greenhouse gas emissions and raising energy efficiency by 20 percent, the consumption of renewable energies is to be increased to at least 20 percent in 2020. In order to reach this goal a "burden sharing" programme with legally binding national targets has been negotiated. In December 2008 the European

1 http://www.euractiv.com/en/energy/eu-states-handed-ambitious-renewable-energy-targets/article-169799 [19-08-2009].

2 Directive 2001/77/EC of the European Parliament and of the Council of 27th September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market; download: http://eur-lex.europa.eu/pri/en/oj/dat/2001/l_283/l_28320011027en00330040.pdf [19-08-2009].

3 http://ec.europa.eu/climateaction/docs/climate-energy_summary_en.pdf [19-08-2009].

Parliament adopted the package and fixed a trajectory for the period of 2013- 2020 with annual monitoring and compliance checks.[4]

Top-down policies and in particular the design of national support schemes are without a doubt of essential importance for the development of renewable energies in the European Union (Reiche 2005: 28f.).

However, the implementation of renewable energy plants is primarily a local matter. In particular applications of photovoltaic and solar heat are highly decentralized and often installed by private owners. Likewise, decisions regarding wind energy sites, biomass plants and other renewable energy applications are taken by political and administrative bodies at the local level.

The impact of the renewable energies also tends to be local. Effects such as the impact of the wind energy turbines on the landscape or the unpleasant smell of biomass plants are perceived locally. Yet on the other hand, renewable energy plants provide many local benefits such as increased job opportunities, added local value and a clean living environment.

The local context generally provides good opportunities for environmental bottom-up initiatives and in particular for renewable energy projects (Potenagel 1998: 7ff). In fact, local engagement in renewable energies in many European towns and municipalities has proven to be highly influential. A multitude of bottom-up projects have been initiated to promote the production and consumption of renewable energies.[5]

Since the 1990s a number of municipalities and districts in Europe have even decided to set the ambitious goal of becoming 100 percent self-sustaining using renewable energies. The

4 http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1998&format=HTML&aged=0&language=EN&guiLanguage=en [19-08-2009].

5 See an overview on local renewable energy initiatives in the EU on the website of the 'Association of European local authorities promoting local sustainable energy policies': http://www.energie-cites.eu/ [19-08-2009].

municipalities of Dardesheim (Germany) and Varese Ligure (Italy), the Danish island of Samsø and the district of Lüchow-Dannenberg (Germany) were among the first to rise to the challenge of supplying all three energy sectors (electricity, heating and transport) with renewable energies. Today they can draw upon experiences of more than ten years.

Over the last few years more and more European regions have followed in the footsteps of these pioneers. A recent research project identified 88 "100% renewable energy regions" in Germany alone (deENet 2009: 65f.). Equally comprehensive studies have not yet been carried out in other EU countries which makes it difficult to estimate the total number of European 100%-renewable-energy-regions[6]. However, several regions have set up networks such as ISLENET (European Island Network on Energy and Environment: 28 islands and island groups from 13 EU member states[7]), FEDARENE (European Federation of Regional Energy and Environment Agencies: 48 regions from 15 EU member states[8]) or RES-e Regions (a project that aims to boost the production and use of green electricity in eleven European regions[9]). These regions not only provide evidence of local renewable energy developments across Europe but also demonstrate a rising level of cooperation and the diffusion of the concept of the 100%-RE-region.

1.1 Definition: What are 100%-RE-regions?

Defining what is meant by "100%-RE-region" within the context of this study is admittedly somewhat complicated. Firstly this is because three different countries' administrative structures are involved and secondly, because the areas differ in size and scope. The only feature that clearly unifies all these areas is their ambition to locally produce the amount of

6 See definition of "100%-RE-region" in the following chapter 1.2.
7 http://www.europeanislands.net/ [19-08-2009].
8 http://www.fedarene.org/ [19-08-2009].
9 http://www.res-regions.info/ [19-08-2009].

energy that is consumed using renewable energy sources (RES). As it is difficult to determine the boundaries of my research subject, a flexible and open definition is required. With reference to deENet who discuss the same issue in their study (2009: 14f.) I include the following definitions:

"Region" is defined as a spatial entity that is larger than a neighbourhood or a quarter and smaller than a state or a province; a municipality, a town or a district.

A "100%-RE-region" is a region that has decided upon a strategy to produce 100 percent (or more) of its energy consumption using local renewable energy sources.

1.2 Research Design

1.2.1 Objectives and Research Question

This study will focus on European regions that were among the first to set the goal of locally satisfying their energy needs using renewable energy sources. These pioneer regions started the 100%-RE-region projects more than ten years ago. What most of them also have in common is a rural environment. A further similarity is the choice of bottom-up strategies to achieve their renewable energy goals. Yet, these pioneer regions are also distinct in three main respects. Firstly, they are exposed to different geographical and socio-economic influences. Secondly, they vary to some extent in size and administrative scope. Finally, they differ in their degree of advancement; some of these pioneer regions have already realized their goals to a large extent, whilst others are still in the process of implementation. For this reason, I have decided upon an in-depth analysis of four pioneer regions that cover a wide spectrum of these differences; Dardesheim, a small town in eastern Germany, Varese Ligure, a mountainous municipality in northern Italy, Samsø, a Danish island in the

Baltic Sea and Lüchow-Dannenberg, a district in the North German Plain.

The main focus of this study is to find out which specific requisites allowed these regions to achieve a local full supply using renewable energies. The research question therefore is:

What are the main factors that have enabled the four regions of Dardesheim, Varese Ligure, Samsø and Lüchow-Dannenberg to become front-runners in the organization of a local renewable energy supply?

In accordance with the theoretical background of this study[10] I will introduce and probe the following four hypotheses:

1. The existence of local and influential pioneers is crucial for the successful organization of a local renewable energy supply.
2. A second decisive factor in the transformation process towards a 100 percent renewable energy supply is a high degree of citizen participation.
3. It is easier to organize a local full supply with renewable energies in a smaller region than in a larger region.
4. It is easier to gain external attention and influence as a larger 100%-RE-region than as a smaller one.

One important aim of this study is to compare the findings of the four case studies and present the lessons learned. It will be of value to identify the main variables, the similarities and the differences in the four transformation processes and to determine to what extent renewable energies can be promoted by bottom-up initiatives. This will be of interest not only from a scientific perspective, but also for protagonists in other European regions who aim to develop renewable energies.

10 See chapter 1.2.3 Theoretical Framework.

1.2.2 Methodology

The core of this study is the analysis and comparison of four case studies. The main source of information is eight qualitative interviews with protagonists of the renewable energy transformations in the four regions. The interviews were conducted during visits in the regions. I spent two weeks on Samsø and two days each in Dardesheim and Lüchow-Dannenberg. Unfortunately it was not possible to arrange a visit in Varese Ligure because none of the local protagonists speak English and a translator could not be organised. Many thanks go to Roberta Casapietra from the Regional Energy Agency of Liguria who provided me with useful information which enabled me to include Varese as a case study nevertheless. Although this case study will be somewhat less comprehensive I decided to include the municipality as a representative from southern Europe.

According to Punch (2005: 146) in case study research the output is hypotheses. Punch's conclusion is applicable to the 'lessons learned' that will be presented in chapter 3 as the regions analysed and their renewable energy strategies are too singular and too small in number to induce general conclusions about how to develop a 100%-RE-region. Yet the comparison of four case studies can provide assistance and reference for other regions that are in the process of implementing a renewable energy transformation or plan to do so.

In preparing for the interviews and assessing the findings I studied scientific literature, visited the regions' websites and read other media sources such as newspaper and magazine articles. In addition, I took several theoretical approaches into account in order to classify the case study findings from a scientific perspective (see the following section 1.2.3).

1.2.3 Theoretical Framework

Referring back to a theoretical framework is valuable for this case study analysis for two reasons in particular. I expect that the successful organization of a local renewable energy supply depends on a complex interplay of social, political, economic and geographical factors. Here, a theoretical foundation can provide orientation regarding which variables to focus upon in the investigation. Furthermore, a theoretical integration ties the study and its findings to the current scientific debate, which can be built upon in future research.

In this study I will refer to two theoretical approaches, as they suggest suitable variables to analyse local transformation processes: Rogers' "Diffusion of Innovations"- model (2003) and Putnam/Feldstein's concept of "Social Capital" (2003).

In "Diffusion of Innovations", Everett M. Rogers analyses why new technologies and new ideas spread out in a certain context at a certain time, while others get stuck or are rejected. Rogers defines an 'innovation' as "an idea, practise, or subject perceived as new by an individual or other unit of adoption" (Rogers 2003: 12) and 'diffusion' as a "process in which an innovation is communicated through certain channels over time among the members of a social system" (ibid.: 5). For this case study analysis the organization of a local full supply with renewable energies can be classified as such an 'innovation', as well as its implementation as a 'diffusion' process in accordance with Rogers' definition.

The already proven[11] and in my opinion the best way of applying of Rogers' diffusion model to the organization of 100%-RE-regions is to focus on the diffusion process of renewable energies inside the regions. The context (Rogers uses the term "social system") is the respective region and the decision-making units are the inhabitants that adopt renewable energy systems.[12]

11 This application of Roger's diffusion approach was recently used in a study on local ownership and social acceptance on Samsø (Jakobsen 2008).

12 An alternative application will be suggested in chapter 4 of this study.

Rogers states that many innovations never become accepted or they need many years to become widely adopted, even when they have obvious advantages. The reason is that the diffusion of an innovation is a "social process, even more than a technical matter." (ibid.: 4) According to Rogers' findings it is a challenge for individuals and organizations to leverage the diffusion and to speed up the rate of adoption of an innovation (ibid: 1).

Therefore, Rogers highlights a high degree of social compatibility of an innovation and the existence of charismatic leaders as determining factors of success of an innovation-decision process.

Rogers assumes that in addition to the relative advantage that adopters expect of a new technology or new idea, an innovation's diffusion depends on its compatibility with the people's needs, values, beliefs and past experiences (ibid.: 4, 246). Furthermore Rogers generalizes that the less complex an innovation is perceived by its adopters and the more an innovation can be tested and experimented with, plus the more an innovation and its results are observable, the faster the innovation is adopted by the members of a social system (ibid.: 257ff). Moreover, Rogers addresses the impacts of communication channels (e.g. mass media or interpersonal communication) and of the nature of a social system (e.g. norms and degree of network inter-connectedness) on the rate of adoption of an innovation (ibid.: 221f.).

The success of this social compatibility depends according to Rogers on the existence and engagement of charismatic leaders, so called "change agents". A change agent is defined as "an individual who influences client's innovation-decisions in a direction deemed desirable by a change agency." (ibid.: 366). Rogers assumes that the change agent's success in securing the adoption of an innovation is positively related to a "client-orientation rather than to a change agency orientation", in addition to his or her efforts in contacting the "clients" (the members of a social system) and to his or her "empathy" and "homophily"

(the degree to which individuals who interact are similar) with clients. Consequently, an innovation's implementation depends on the change agent's "credibility in the clients' eyes" and also on the extent to which he or she works with "opinion leaders". (ibid.: 373ff)

Applying these assumptions to the subject of the diffusion of renewable energies in 100%-RE-regions, it can be expected that an important factor of success is the existence of locally trusted pioneers that leverage and sustain the project. This assumption led to my definition of the first hypothesis as '*The existence of local and influential pioneers is crucial for a successful organization of a local renewable energy supply'*.

In order to raise the credibility of the project these pioneers should choose a strategy that comprehensively informs and highly involves the local citizens, leading to the second hypothesis: *A second decisive factor in the transformation process towards a 100 percent renewable energy supply is a high degree of citizen participation.*

Rogers deliberately designed the "Diffusion of Innovations" model to be applicable to the spread of new ideas and technologies in all areas: "The multidisciplinary nature of diffusion research cuts across various scientific fields. A diffusion approach provides a common conceptional ground that bridges these divergent disciplines and methodologies." (Rogers 2003: 103f.). This multi-disciplinary orientation is very beneficial in the analysis of the findings of the case studies as I anticipate that the factors affecting the organization of a 100%-RE-region will span several scientific disciplines. However, the application of Rogers' diffusion approach to the case studies has a certain limitation. It provides a very helpful insight into the individual adoption of renewable energy systems inside the regions, but it is less beneficial in the analysis of the common aspects of a joint 100%-RE-region project. For the successful organization of a local full supply using renewable energies a high level of cooperation is needed, as many of the renewable energy systems such as wind turbines and district heating systems are cooperatively owned and their erection has an

impact upon neighbours or even on the whole community.

This shortcoming in Rogers' approach can be compensated by including Putnam and Feldstein's sociological concept of "Social Capital" into the case study analysis.

As indicated in the title of their standard work "Better Together. Restoring the American Community", Putnam and Feldstein focus on bottom-up developments in communities in the United States and in particular on local projects that have created "social capital". "Social capital" is somewhat vaguely defined as "social networks, norms of reciprocity, mutual assistance, and trustworthiness" (Putnam/Feldstein 2003: 2) and will be thus interpreted as persistent forms of social cooperation. According to Putnam and Feldstein, social capital is "necessarily a local phenomenon", as "trust relationships and resilient communities generally form through local personal contact" (ibid.: 9). The concept's central assumption is that social capital is highly beneficial for all kinds of joint projects on the local level. Putnam and Feldstein have further observed that many projects expand the existing social capital and not only the project members benefit from this new social capital but also the whole community (ibid.).

Putnam and Feldstein have identified two different kinds of social capital: Firstly, "bonding social capital", which evolves in networks of people who are similar in crucial aspects and tend to be inward-looking. "Bonding social capital" thus strengthens the social cohesion of a network, as a kind of "sociological Super-Glue". Secondly, "bridging social capital", which is created in networks of different types of people that tend to be outward-looking. It brings people from different backgrounds of a society together and thus functions as a "sociological WE-40" or lubricant. According to Putnam and Feldstein, "bridging social capital" is harder to create than "bonding social capital", but it is at the same time highly significant in increasingly diverse societies. (ibid.: 2f.)[13]

13 A similar assumption can be found in Rogers diffusion approach when it comes to the relationship between the pioneers and the other local citizens: He argues that the higher the degree of "homophily" is between the change agent and his/her clients, the more effectively they can communicate. Though, Rogers

Putnam and Feldstein, like Rogers, highlight leadership and citizen participation as important factors to bond and bridge social capital in the local organization of projects. Leadership is mainly referred to when a project's success depends on financial support or on political decisions: "[I]f the goal you are working toward requires major investment or political access, it helps to be blessed with "true believers" in positions of power: individuals committed to grassroots participation who will follow the social capital route through all its apparent meanderings." (ibid.: 274.). A high level of citizen participation has been of benefit to all of the local projects that Putnam and Feldstein researched: "On the other hand, in all the cases studied, interpersonal connections and civic engagement among ordinary citizens were essential to making participatory democracy work." (ibid.)

In addition to leadership and citizen participation Putnam and Feldstein introduce the variable of size and scope as a third factor of success of local projects. According to their empirical findings, "social capital is higher in smaller settings" (ibid.: 275f.), because direct communication and trust are more easily achieved in smaller settings, and the small size makes individual responsibility for the project "intensely clear". (ibid.) Their findings have however also shown that in local projects "bigger is better for critical mass, power, and diversity". Large scale projects and settings have proven to be helpful for gaining attention and influence beyond the local project (ibid.: 277f.). Applied to the four case studies of this thesis, the variable of size and scope suggests that social capital and its benefits are easier to achieve in relatively small communities like Dardesheim and Varese Ligure where most people know each other personally, than in a district like Lüchow-Dannenberg where personal contact is much less close. On the other hand, the influence of a district like Lüchow-Dannenberg in the external promotion of its concept of local renewable energy use should be stronger in comparison to that of smaller communities. The variable of size and

states that change agents usually differ from their clients in many respects which can be an obstacle in the diffusion process (Rogers 2003: 381f.).

scope will be tested by the third and fourth hypotheses '*It is easier to organize a local full supply with renewable energies in a smaller region than in a larger region.*' and '*It is easier to gain external attention and influence as a larger 100%-RE-region than as a smaller one.*'.

As presented in this chapter, Rogers' diffusion approach and Putnam/Feldstein's "Social Capital" concept are useful frameworks from which to deduce hypotheses for the analysis of 100%-RE-regions. However, the main objective of this study is not to challenge these two theoretical approaches. As mentioned before, the hypotheses will serve as guidelines in the analysis and comparison of the four case studies. The research focus is thus empirical and the aim is to generate new hypotheses regarding the main factors in the organization of 100%-RE-regions in Europe.

1.2.4 Current Research Status

The hypotheses generated by this study could significantly contribute to the current scientific debates. To my knowledge, there has not been any published research which compares several 100%-RE-regions throughout Europe using an in-depth case study analysis.

As the research subject is a relatively new phenomenon, the analysis of 100%-RE-regions is an emerging field of research and the majority of the scientific literature on this topic was published in the last five years.

Of the four case studies, only Samsø has been subject of in-depth research, so far. Ina Jakobsen wrote her master's thesis on the local ownership and social acceptance of wind energy on the Danish island (Jakobsen 2008). Furthermore a number of single case study

analyses on 100%-RE-regions have been published: Marin et al. provide an overview of renewable energy island communities (Marin 2005). Likewise, Keppler et al. (2009) and Khan (2004) offer rewarding case study analyses on the bottom-up development of renewable energies (even if their subject is not 100%-RE-regions).

As mentioned earlier, the German "Competence Network on Decentralized Energy Technologies" (deENet) recently presented the first attempt of a comprehensive comparison of 100%-RE-regions in Germany (deENet 2009). The study is based on written interviews with protagonists from 54 100%-RE-regions regarding local strategies, potentials and restrictions. According to the findings, an important factor of success has been the political decision to pursue 100 percent renewable energy. The main obstacles identified by the protagonists were the acquisition and coordination of subsidies. However, the authors emphasize that most regions in the study are still at the initial stage of the transformation process, which makes it difficult to generate general conclusions. (ibid.: 3f.) Comparable studies on 100%-RE-regions in other European countries have not yet been carried out.

Recently, the three organisations, REN21 Renewable Energy Policy Network for the 21st century, Institute for Sustainable Energy Policies (ISEP) and ICLEI – Local Governments for Sustainability, published a promising working draft of the "Global Status Report on Local Renewable Energy Policies" (Martinot et al. 2009). The report provides information about policies and activities to promote renewable energies at the city and local levels all over the world. Furthermore the authors aim to give a comprehensive overview of best practise examples of renewable energy regions worldwide.

The challenge of making generalisations on the basis of the experiences of single 100%-RE-regions is also highlighted by Mez et al. who stress the needs of smaller municipalities in particular for practical advice on how to develop renewable energies in their community.

Mez et al. refer to the manual "Auf dem Weg zur 100%-Region" [On The Road Towards a 100%-Region] (Tischer 2006) that is currently being used as a guide by two Bavarian 100%-RE-regions, but appears not to be transferable to other regions (Mez 2007a: 155ff). A number of other handbooks on local renewable energy development have made the effort of bridging the divide between case study findings and generalizable practical advice (Potenagel 1998; Wehnert 2007; Ruppert 2008; Hopkins 2008).

Generally, scientific literature on renewable energy development on the local level is rather limited. Top-down policies in the promotion of renewable energies and in particular national support schemes have attracted much more scientific attention. Thus, the renewable energy promotion systems of Denmark, Germany and Italy which are relevant for this study, have been well researched (Mez 2007b; Reiche 2005).

1.3 Outline

In Chapter 1 the background and research design of this study were introduced. In chapter 2 the findings of the case study analyses of Samsø, Lüchow-Dannenberg, Dardesheim and Varese Ligure will be presented and probed according to the four hypotheses. In chapter 3 the common and distinct factors in the four 100%-RE-regions will be summarized into lessons learned. Chapter 4 will provide questions that remain unanswered and suggestions for future research. Finally, in chapter 5 the study will be evaluated and conclusions drawn.

2 100% Renewable Energy Regions in Europe

2.1 Case Study: Dardesheim, Germany

The city of Dardesheim is located in the eastern state of Saxony Anhalt in Germany. With only about 970 inhabitants it is one of Germany's smallest cities. Dardesheim was an independent municipality until 2003, when it merged with six neighbouring communities into the municipality of Aue-Fallstein. However, Dardesheim still has an own mayor and some degree of autonomy, especially when it comes to the organisation of the local renewable energy supply.

The development of renewable energies in Dardesheim started in 1993, when local pioneer Karl Radach erected a small 80-kilowatt wind turbine. The turbine was one of the first to be built in Saxony Anhalt after German reunification and thus attracted investors in wind energy from all over Germany. One of them was Heinrich Bartelt, who had delivered the turbine. Bartelt recognized the excellent wind conditions on the nearby "Druiberg" hill. Together with Radach he built three further 250-kilowatt turbines and in 1995 he decided to attempt to construct an entire wind park on the Druiberg. Due to the lengthy planning process and Bartelt's desire to involve and inform the local citizens as much as possible, it was not until 2004 that the first 2 megawatt (MW) turbine was erected at the "Windpark Druiberg". During the following two years a further 27 turbines of the same model and one 6 MW turbine were built. The wind park has thus reached a capacity of 62 MW and produces up to 40 times the amount of electricity that is consumed by the city of Dardesheim.[14]

Wind turbines are definitely the basis of the renewable energy project in Dardesheim, yet both the political protagonists (local mayor Rolf Dieter Künne in particular) and investor

14 For a chronological history of the Windpark Druiberg see: http://www.energiepark-druiberg.de/index.php?id=vorgeschichte [19-98-2009]

Bartelt are aiming for a broader and more comprehensive renewable energy mix. A total of nine photovoltaic applications have already been installed on roofs in Dardesheim since 2005. The modules produce one third of the amount of electricity that is consumed by the households in Dardesheim. Moreover, pilot projects have also been initiated in the transport sector. Two of the wind park's company cars have been converted to drive on local plant oil and in June 2008 Saxony Anhalt's first electric vehicle filling station supplied by local wind and solar energy was opened in Dardesheim. Furthermore an evaluation was carried out in cooperation with the Technical University of Braunschweig to investigate the possibility of building a district heating system using local biomass and solar energy. However, due to increasing commodity prices in wood it has not yet been implemented.[15]

Factors of Success and Obstacles

What were the key factors in the successful organisation of a local renewable energy supply in Dardesheim? The first hypothesis of this thesis highlights the role of local and influential pioneers. In fact, Dardesheim's renewable energy project would not have come into being without the involvement of local citizen Karl Radach, a fact emphasized by both interviewees Rolf-Dieter Künne and Thomas Radach.. Karl Radach had already been fascinated by wind energy before German reunification, when whilst living in the former GDR he was able to see wind turbines in neighbouring West Germany. Shortly after the wall fell and wind energy technology also became available in Eastern Germany, Radach decided to build a turbine himself in Dardesheim. When the turbine was approved and erected in 1994, Radach could feed the electricity into the grid and thereby benefit from the fixed tariffs of the German renewable energy support scheme.[16] Although, according to his

15 For an overview of the status of renewable energies in Dardesheim see: http://www.energiepark-druiberg.de/index.php?id=realisierungsstand [19-08-2009]

16 The first German feed-in tariff system ("Stromeinspeisegesetz") was established in 1991, it guaranteed owners of renewable energy applications fixed prices for electricity (Reiche 2004).

son and current technical director of the wind park Thomas Radach, pioneer Karl Radach's primary focus was not to generate profit with his pilot turbine, the application provided evidence of the profitability of wind energy on the local Druiberg hill. Together with investor Heinrich Bartelt three further turbines were erected and paved the way for the whole wind park: “The wind park that exists today developed from the operation of these initial pioneer plants” Thomas Radach states. Karl Radach invited the citizens of Dardesheim to visit the turbines and campaigned in local pubs for the further extension of wind energy. Mayor Rolf Künne characterizes Karl Radach as a “lucky strike” for Dardesheim. Heinrich Bartelt confirms that without Karl Radach the project would not have come so far and highlights Radach's persistence in convincing the public authorities to support the plan: “Radach was one of those who always came back in again through the back door of an office if he had been sent out of the front door with a rejection.” (as cited in Höhne 2007).

Likewise, Heinrich Bartelt can be pointed out as an important pioneer for Dardesheim. Bartelt had been engaged in wind energy projects for many years before he started the wind park project in Dardesheim. He was one of the founders of the German Wind Energy Association (BWE) in the 1980s and later one of its presidents (Höhne 2007). As a consequence, Bartelt was not merely focused on making profit by building the wind park in Dardesheim. He highly supported the idea to develop the small city into a role model for a local renewable energy supply. Bartelt opted for a a strategy that would comprehensively inform and involve the citizens in his wind park project and also promote the use of other renewable energies in Dardesheim.

In addition to Radach and Bartelt, the interviewees Rolf-Dieter Künne and Thomas Radach can also be placed in the group of engaged pioneers. Rolf-Dieter Künne has been the mayor of Dardesheim for 30 years and has been engaged in the the renewable energy transition

from the project's initiation. Together with Thomas Radach he has also been involved in much of the increasing public and media relations activities.

Both Künne and Thomas Radach moreover highlight that good relations between all protagonists have been a crucial factor for the successful implementation of renewable energies in Dardesheim.

Künne and Thomas Radach also corroborate the second hypothesis that a high degree of citizen involvement is a decisive factor in the transition towards a 100%-RE-region.

Some of Dardesheim's citizens were in fact skeptical when the wind park project began. In a neighboring community even a citizens' initiative evolved in opposition to the the wind park.[17] Bartelt responded to these doubts and resistance by disclosing his plans to the city council at a very early stage where it was discussed in many sessions. Most of these sessions were open to the public. In addition, Bartelt organized several public meetings to inform the citizens about the likely impacts and benefits of the wind turbines and responded to the citizens' concerns. This cautious approach held up the project for several years, but it was worth it as Bartelt reflects today: “It took us a long time. We were perhaps slower than others but today we have the advantage that the whole region stands behind the wind park.”[18] Thomas Radach confirms:

> “The crucial thing is to tell the people beforehand what they will be confronted with. One has to be very open, for example one should tell them that the Druiberg hill won't look the same as it did five years before, when the first small wind turbine was built. And not to throw the people in at the deep end.”

17 http://www.kommunal-erneuerbar.de/de/detailansicht/article/352/dardesheim-beteiligung-ist-noch-besser-als-akzeptanz.html [19-08-2009]

18 As cited in: http://www.kommunal-erneuerbar.de/de/detailansicht/article/352/dardesheim-beteiligung-ist-noch-besser-als-akzeptanz.html [19-08-2009].

In order to convince the local citizens of his project, Bartelt organized excursions to the wind turbine factory in Magdeburg and also to Jühnde, a village in Lower Saxony that covers its entire electricity and heating consumption by means of a local biogas plant and a biomass heating plant. The aim of these excursions was to raise the acceptance of renewable energies and to reduce prejudices, Thomas Radach explains: "We wanted to let the people know what is done elsewhere. Because it is better when the people are taken there and can see how it is with their own eyes. And can talk themselves with citizens that already use renewable energies."

Radach adds that it was also important to be willing and flexible enough to adapt the initial plan to the citizens' concerns:

> "When there is simply no common denominator, one sometimes has to waive things. I guess that is the most important thing. Not to push everything through obstinately, but to accept: OK, the people don't want this, or we won't get a majority for this, then we leave it be. Or we will do it in a different way."

Radach hereby refers to the choice of the sites for the wind turbines which were rearranged in such a way that allowed as many citizens as possible to have a share in the rent revenues. Bartelt explains this decision:

> "Initially we wanted to build the wind park in a geometrically neat manner, with regular intervals between the turbines. But the city did not place great value on this. Instead, they said we should focus on involving everybody as equally as possible. Today almost every third household in the town is included."[19]

Bartelt supports the town's approach to get local citizens financially involved in the wind park project in order to strengthen their personal connection to it. For this reason he also

19 As cited in: http://www.kommunal-erneuerbar.de/de/detailansicht/article/352/dardesheim-beteiligung-ist-noch-besser-als-akzeptanz.html [19-08-2009].

offers shares with a minimum rate of return of eight percent to the citizens of Dardesheim and neighboring municipalities: "Our aim is to involve as many households as possible. Participation and involvement are at the end of the day even better than mere acceptance."[20] The wind turbines are thus not financed by external investors, but to an increasing degree by local citizens. Thomas Radach explains:

> "We offer shares only to people from the region. Not to people from elsewhere who do not have a connection with the wind park. If one does it this way, it creates acceptance amongst the population. They see that the park is here, but that they can financially profit from it themselves and the money stays in the region."

Yet, as many locals lack the financial means to buy shares, the interest is still limited (Höhne 2007). Indirectly however all the citizens of Dardesheim profit from the wind park revenues. Currently the city receives 100,000 euros of industrial tax every year, and from the year 2010 on the tax revenues will increase to one million euros per year (Uken 2007). The local council has used this money to invest in the infrastructure of Dardesheim. Künne explains that "The municipal area has seen a great deal of development. In the center, all the squares and streets have been renovated.". Furthermore, Bartelt provides the local associations with one percent of the annual turnover of the wind park amounting to some 70,000 euros.

Thomas Radach emphasizes that as a result of the financial participation an atmosphere of cooperation has evolved amongst the local citizens and the wind park owner:

> "One should not misinterpret the offerings as an indirect payoff. There is rather a sense of give and take here. The wind park operator gives something, but also receives things for it in return. And not because he demands it, but often because it just happens of its own accord."

20 As cited in: ibid.

According to Radach the successful integration of citizens is a general precondition for the realization of local projects: “I think this can be applied to many things. If one has a reasonable political environment and talks to the people reasonably, one can do many things.” Mayor Künne likewise concludes: “One always has to keep this in mind. Our citizens have to be in the same boat. And they need to have the feeling that they can even join in rowing - everybody according to his or her potential. That they can integrate, that is very important.”

Thus, according to the interviewees Künne and Radach, engaged local pioneers and a high degree of citizen participation have been the most important factors for the successful renewable energy transition in Dardesheim; there were however further determining factors involved

The third and fourth hypotheses highlight the influence of the size of a 100%-RE-region.

As Dardesheim is the smallest of the four case studies in both population and geographical size, hypothesis three suggests that it would be easier for Dardesheim to organize a local full supply with renewable energies than for the other three 100%-RE-regions. The reason for this is, Putnam and Feldstein argue, that in a small community “social capital” is more easily created, as the people's personal connections are closer (see above). The interviewees agreed with this assumption. In Dardesheim, many of the 970 citizens know each other personally. The flow of information is thus short and fast. Furthermore, people are interested in what is going on in their small city. These conditions enabled wind park owner Bartelt to vigorously involve the citizens in the implementation process. When he invited the local citizens to a meeting where he informed them of his plans and discuss their concerns, a great deal attended. Likewise many citizens participated in the excursions to Magdeburg and Jühnde. Moreover, the benefits of the wind park taxes in the form of

infrastructure improvements were obvious to Dardesheim's citizens due to the town's small size.

Proximity effects play an even more important role, Thomas Radach emphasized. As Putnam and Feldstein observed, people often trust the opinions of their neighbours more than the advice of "experts'". Radach confirms: "Usually, it goes like this: people visit their neighbours and see: 'Obviously it works for them. So now I am also interested.'"

The town's small size has however not been an obstacle for the external promotion of the project, as hypothesis four suggests. Dardesheim is very well recognized in German and international renewable energy circles. Every year around 1000 to 1500 researchers, politicians and other visitors come to Dardesheim to learn about the town's renewable energy achievements. These include numerous diplomatic delegations from all over the world that aim to transfer the experiences of the local energy transition in Dardesheim to their home countries. In 2008 Dardesheim was awarded the "German Solar Price" in the category "100 percent municipalities" by the European Association for Renewable Energies, Eurosolar.[21]

In addition to leadership, citizen participation and small size the interviewees highlight five further factors that have influenced the organization of Dardesheim as a 100%-RE-region.

The first factor is a cooperative political and administrative environment. Mayor Künne points to the generally cooperative atmosphere in the town council of Dardesheim. According to his statement, as in most other political issues there has been no party political influence upon decisions regarding renewable energy development. Künne states: "I have never been in a party and I don't know who [amongst the council members] is in which party." In 2006 the council officially set the goal to become the "City of Renewable

21 http://www.eurosolar.de/de/index.php?option=com_content&task=blogcategory&id=139&Itemid=262 [19-08-2009]

Energies" and to provide all energy consumed using local renewable energies.[22] Bartelt confirms that the mayor, the town council and also the district council, who is the regulatory authority, have been positive with regards to his renewable energy plans from the very beginning of the project on.[23] Also the administration which can be a decisive local barrier for the implementation of renewable energies[24] has been no obstacle in Dardesheim.

A second factor is the structural weakness of Dardesheim's economy. Like many rural areas in Europe Dardesheim suffers from the effects of structural change. The city is located in a traditionally agricultural region. After German reunification, the agrarian sector broke down and most of the jobs that were lost could not be replaced. As a consequence, unemployment increased and many citizens left Dardesheim to work in the cities, especially the town's young people. A general advantage of renewable energies is that they fit well into rural and structurally weak areas, as there is enough low price land available, the population density is relatively low and the citizens are looking for new economic opportunities. Dardesheim's pioneers realized these potentials for their community very early on. Thomas Radach states:

> "It is a problem everywhere in the countryside. The young people move to places where the industry is and offers jobs. That is bleeding the land. We wanted to abate this development. And we have managed to create eight full time jobs in this structurally weak region. All for young people who would have left otherwise. That does not sound much, but it is only an example. And many renewable energy projects create many jobs."

As a future project, the pioneers are considering the possibility of completely disengaging Dardesheim from the grid (see below). If that was the case, all citizens could be offered low

22 http://www.eurosolar.de/de/images/stories/pdf/Regenerativ_Kraftwerk_Harz.pdf [19-08-2009].
23 Interview of Bartelt at the information platform of Germany's Renewable Energy Agency (in German): http://www.unendlich-viel-energie.de/de/panorama/koepfe-der-branche/heinrich-bartelt.html [19-08-2009]
24 See case study Lüchow-Dannenberg.

energy prices, which would make the city more appealing, as mayor Künne hopes: “Cheap energy prices for heating and electricity could also attract new citizens.”

As a consequence, relations with the grid operator are a third determining factor. According to the interviewees, local grid operator Eon Avacon has up until now not been an obstacle for the establishment of renewable energies in Dardesheim. Even talks regarding an eventual grid disengagement have been constructive. Legally, Dardesheim can withdraw from the concession contract with Eon Avacon and disengage from the grid in 2011/2012, if by then the town has achieved reached energy autonomy. One reason for the good relations with Eon Avacon is the major project “Regenerative Model Region Harz” which aims to prove that the whole Harz region can be independently supplied with local renewable energies[25]. Representatives from Dardesheim and Eon Avacon participate together in this project and as a result are now on first-name terms. However, according to Thomas Radach the discussions about grid disengagement could still end in a lawsuit.

A fourth factor is the network with other 100%-RE-regions. There have been a couple of meetings with citizens and representatives from other German 100%-RE-regions. As mentioned before, wind park owner Bartelt organized an excursion to the village of Jühnde in order to convince the citizens of Dardesheim to support his renewable energy project. Furthermore protagonists from Dardesheim and the city of Wolfhagen have exchanged their experiences with one another. Wolfhagen is a city in Northern Hesse that has already re-purchased the local grid and aims to become self-sufficient with renewable energies by 2015.[26] Representatives of Wolfhagen visited Dardesheim to learn more about how the renewable energy transformation has been realized there. Thomas Radach:

> “They came here due to the fact that wind power utilization works so well here and they wanted to take a look at it. They came with the whole town council and as a

25 See: https://www.regmodharz.de/ [19-08-2009].
26 http://www.kommunal-erneuerbar.de/en/kommunalatlas.html [19-08-2009]

result of their visit here in Dardesheim they already decided on the bus journey home that they too wanted to build wind turbines in Wolfhagen."

In return, Wolfheim's protagonists have provided advice on how to disengage Dardesheim from the grid.

External factors form the fifth determinant in Dardesheim. So long as electricity from renewable energy sources remains uncompetitive, operators of renewable energy applications have to rely on financial support. As mentioned above, many European countries have established national support schemes to provide this financial compensation. Germany has set up a feed-in tariff law (the Renewable Energy Law, or EEG) which guarantees rather attractive minimum prices for renewable energy (Grotz 2005: 146ff). Especially in the initial phase the fixed prices have been crucial for the development of renewable energies in Dardesheim. To date, all the owners of the wind park turbines and photovoltaic applications in the town profit from the EEG tariffs.

The other important external factor is resource prices. In Dardesheim the plans for a local district heating system based on renewable raw materials have not yet been realized, because the prices for biomass resources have strongly increased over the last few years. At the same time, the price of oil has fallen which makes the district heating system currently uneconomical. The prices for conventional energy are also highly relevant for Dardesheim's decision regarding a complete grid disengagement for heating and electricity.

Résumé

As identified above, eight factors have positively influenced the renewable energy transformation process in Dardesheim: (1) the existence of engaged and charismatic pioneers, (2) a high degree of citizen participation, (3) the small size of the city, (4) the

cooperative political and administrative environment, (5) Dardesheim's structural weaknesses (6) the good relations with the grid operator, (7) the network with other 100%-RE-regions and (8) the German support scheme for renewable energies. The only major obstacle has been the high price of renewable raw materials which has up until now hindered the establishment of a local district heating system.

In the media, Dardesheim has often been praised as a role model for the participation and involvement of local citizens in the organisation of the 100%-RE-region project.[27] The approval rate for local renewable energies has risen remarkably, according to Thomas Radach, between 90 and 95 % of Dardesheim's citizens now support the project. Likewise, resistance from neighbouring municipalities has disappeared and many of these municipalities now also want to build wind turbines. In Dardesheim the development of renewable energies is also set to continue. In addition to the local district heating system, the grid disengagement and the project "Regenerative Model Region Harz" the focus will be on the extension of electro mobility. Furthermore, the construction of an information and theme park about renewable energies is due to be complete in the next few years.

2.2 Case Study: Varese Ligure, Italy

Varese Ligure is a mountainous municipality of about 2,200 inhabitants in the province of La Spezia in the north-west of Italy. The municipality consists of the main village Varese and 27 hamlets and is quite isolated with a small mountain road forming the only access point. (Dunmall 2005a; 2005b)

In 1991 mayor Maurizio Caranza decided to improve the local environment as a chance to

27 See http://www.kommunal-erneuerbar.de/en/detailansicht/article/352/dardesheim-beteiligung-ist-noch-besser-als-akzeptanz.html [19-08-2009]; Husmann 2007; Uken 2007.

promote and resurrect Varese Ligure. He therefore started the initiative to develop Varese Ligure into a sustainable community by renovating the historical centre and promote organic farming and renewable energies.[28] The organisation of a local full supply with renewable energies is thus one of three main goals in the sustainable transformation of the municipality. Since 2000 four wind turbines have been installed. They produce four million kilowatts of electrical power annually, which is alone more than the municipality itself consumes. Caranza: "This is three times the amount of electrical energy the village needs. We sell the rest to the national grid which earns us 30,000 euros a year"[29]. Moreover a hydroelectric dam was built that provides enough electricity for about 3,000 households.[30] Furthermore a number of solar panels were installed on the roofs of the town hall, the middle school and a hotel in Varese. They provide about half of the electricity that is used in these buildings.[31] In order to increase the use of renewable energies for heating the municipality encourages the local production of wood pellets[32] and has installed a solar heating in the local swimming pool (Burgermeister 2007).

Factors of success and obstacles

Mayor Caranza has been an important driving force for the 100%-RE-region project in Varese Ligure. Caranza and his successor as mayor Michaela Marcone can be regarded as pioneers and leaders of the whole sustainable transformation process. They realized in the early 1990s that Varese's structural conditions (geographical isolation, the lack of modern industry, the run-down property and antiquated local farming techniques) should be seen as

28 http://www.procuraplus.org/fileadmin/template/projects/procuraplus/files/CD-ROM/Case_Studies/Electricity_Varese_Ligure_Italy_01.pdf [19-08-2009].
29 As cited in: http://www.adnkronos.com/AKI/English/Business/?id=1.0.1069653230 [19-08-2009].
30 http://ipsnews.net/news.asp?idnews=34326 [19-08-2009].
31 http://www.greenlabelspurchase.net/Varese-Ligure.html [19-08-2009].
32 http://www.procuraplus.org/fileadmin/template/projects/procuraplus/files/CD-ROM/Case_Studies/Electricity_Varese_Ligure_Italy_01.pdf [19-08-2009].

a chance for renewal rather than a reason for resignation (Dunmall 2005a). During the following years, Caranza and Marcone managed to convince the city council and the local citizens of the project's potential. According to Marcone it was Caranza's charisma in particular that helped to persuade the locals: “He could talk to a stone.” (as cited in Dunmall 2005). Caranza also found out that a municipality could be certified with the two international environmental management systems of DIN ISO 14001 and Eco-Management and Audit Scheme (EMAS). He applied for both and in 1999, Varese Ligure was the first European municipality to obtain the certifications.[33] This provided Varese with extra financial incentives and media recognition and was an important factor for the further positive development of the project (Sauer 2007). Caranza also recommends the application for environmental management schemes in other 100%-RE-regions: “Many public administrations don’t even know that these provisions and schemes exist” (as cited in Dunmall 2005b).

The two pioneers Caranza and Marcone have worked in close collaboration from the beginning of the transformation process on. When Marcone succeeded Caranza as mayor in 2004 she thereby took over the main responsibility for the project. Such a transfer of leadership can be a big challenge in long-term projects, yet in Varese the process was managed rather smoothly (Dunmall 2005a; 2005b).

Comparable to Dardesheim and in accordance to the first hypothesis, the existence of engaged and charismatic pioneers has been highly important for the successful implementation of the 100%-RE-region project in Varese Ligure.

Like the pioneers in Dardesheim, the mayors Caranza and Marcone also decided to inform and involve the local citizens from the beginning of the project on. The people of Varese

33 http://ec.europa.eu/environment/emas/casestudies/varese_ligure_en.htm [19-08-2009].

Ligure are generally conservative and many were sceptical about the idea to transform their village into a sustainable community (Dunmall 2005b). Yet Caranza was convinced that due to the economic decline of the municipality, changes were inevitable and he persuaded the citizens by making them a deal: if his public administration obtained EU funding to rebuild the local infrastructure, they in return would have to renovate their houses. For these renovations Caranza also organized EU incentives. Successively more and more citizens became interested and in 2005 about 200 houses had already been renovated. Caranza likewise managed to receive EU funding for the replacement of the local water supply and for the wind turbines. (Dunmall 2005a) Moreover, he arranged regional and local funds for the financing of photovoltaic installations.[34] The citizens of Varese are not directly involved in the ownership of the renewable energy applications which are financed by the municipality and the local electricity company[35] but – as in Dardesheim – they profit from the money invested in the municipality's renovations.. In order to receive the ISO 14001 and EMAS certifications numerous efforts were made to raise the citizens' ecological awareness. Among other things an "Environmental Education Centre" has been established and the local middle school participated in the EU project "Force Energetique par les Enfants" (FEE) to improve the pupils', their families' and local stakeholders' knowledge of energy and environmental issues.[36] Furthermore the municipality regularly organizes information events to inform the citizens on the proceedings of the sustainability project (EMAS Helpdesk 2006: 2).

Even if the citizen participation in the local renewable energy development seems to be less intensive compared to Dardesheim (where the citizens were more involved in ownership, decision making and the siting of the wind turbines), the approval for the

34 http://www.greenlabelspurchase.net/Varese-Ligure.html [19-08-2009].
35 http://www.adnkronos.com/AKI/English/Business/?id=1.0.1069653230 [19-08-2009].
36 http://www.procuraplus.org/fileadmin/template/projects/procuraplus/files/CD-ROM/Case_Studies/Electricity_Varese_Ligure_Italy_01.pdf [19-08-2009].

project has now become equally high among the citizens of Varese. Mayors Caranza and Marcone are broadly supported by their voters who have regularly re-elected them with majorities of about 65 %. Yet we still have to take into account that the development of renewable energies has been only one part of the sustainable transformation project in Varese Ligure. In particular the very successful establishment of organic farming as the municipality's main industry[37] has strongly increased acceptance of the whole project. (Dunmall 2005a; 2005b) It is therefore difficult to assess the direct impact of citizen participation on the introduction of renewable energies. However, what can be ascertained is that a high degree of citizen participation has been crucial in the realization of the whole transformation process to develop Varese into a sustainable community.

Evaluating the impact of the size variable for the 100%-RE-region project of Varese Ligure is equally difficult as the literature on Varese does not go into much detail about this factor. There is one indicator for the third hypothesis, that a 100 percent renewable energy project can be more easily realized in a smaller region like Varese Ligure. Mayor Caranza believes that his deal with the citizens only succeeded because of close neighbourhood contacts. In the beginning, only about 20 percent of the people agreed to renovate their houses. But then a process occurred that Rogers and Putnam and Feldstein often observed in their research of local projects. The first citizens that carried out Caranza's deal and renovated their houses (according to Rogers the "early adopters" of the new strategy) became role models for the other citizens of Varese. Caranza calls it a "virtues circle": "If you go to someone's house and it is much nicer and cleaner than yours, then when you go back to your home you realize you want to improve it too." (as cited in Dunmall 2005a) This positive influence of neighbourhood relations on a local project is obviously stronger in a small and

37 In 2007, 108 organic farms produced more than 98 percent of the consumed food of Varese Ligure, see: http://ec.europa.eu/environment/emas/casestudies/varese_ligure_en.htm [19-08-2009].

rather closed community than in a larger region with many municipalities (Putnam/Feldstein 2003: 9).

On the other hand, the EMAS evaluation of Varese Ligure addresses the small size of the municipality as a main challenge for the implementation of the environmental management system, because of a "deficiency of economic and human resources".[38] In fact, the development of renewable energies in Varese stands or falls with the engagement of the pioneers Caranza and Marcone and their ability to obtain external funds. The dependency on only two individuals is a risk for the further development of the 100%-RE-region as well as the whole sustainability project. Caranza is aware of the fragile situation and describes Varese Ligure as a "transplant patient who you worry about at the slightest cough" (as cited in Dunmall 2005a: 4).

Consequently, hypothesis three is neither clearly sustained nor weakened by the case of Varese Ligure.

Again comparable to Dardesheim, the relatively small size of Varese Ligure has not been a disadvantage for external recognition and influence as a 100%-RE-region, as hypotheses four suggests. In particular the fact that the municipality was the first in Italy to be certified according to EMAS and ISO 14001 provided Varese with "overwhelming" media attention, Marcone recalls (as cited in Sauer 2007). As a result, the "Valle del biologico" ("Biological valley") of Varese Ligure became known as one of the most ecological villages in Europe and was recognised as a "good example of sustainable development" by the World Wide Fund for Nature (WWF).[39] For its achievements in renewable energy development Varese also became the first Italian municipality to win the European Energy Award in the category "100% renewable energy community – rural" (EMAS Helpdesk 2006: 2). The awards and the growing media attention have boosted tourism in Varese. Accommodation

38 http://ec.europa.eu/environment/emas/casestudies/varese_ligure_en.htm [19-08-2009].
39 http://ec.europa.eu/environment/emas/casestudies/varese_ligure_en.htm [19-08-2009].

numbers have increased sixfold since the early 1990s and many visitors come just to learn more about the renewable energy transformation (Burgermeister 2007). Moreover, Varese's sustainability project has become a model for more than 40 other Italian municipalities that have been certified by ISO 14001 and EMAS so far. For several years, the former mayor Caranza has been president of the "Associazione Qualitambiente" ("Association for the Environmental Quality"), a network of Italian municipalities that have been certified by an environmental management system.[40]

In Varese Ligure three further factors have highly influenced the transformation process into a 100%-RE-region.

The first of these factors is the structural weakness of the municipality. As in Dardesheim, the project to develop Varese Ligure into a 100%-RE-region was started in a period of economic and social decline. In the early 1990s Varese, like many other small municipalities in the mountainous hinterland of Italy, suffered from economic weaknesses: no or very little industry, scarce productivity, subsistence farming, unemployment and an insufficient communication infrastructure. A further disadvantage was the isolation of the village. Caranza: "It's been difficult [...] because inland areas are not very popular in Italy, so they must have a very strong identity if they're going to attract people at all." (Dunmall 2005b) As a consequence, many citizens had moved to the nearby urban centres. Due to economic weaknesses and depopulation the village's very existence was in danger.[41] Caranza: "Ten years ago, Varese Ligure's population had shrunk from 6,000 to 2,250 people. We realised the only thing to do to prevent the village from dying was to protect the environment and rehabilitate the agriculture sector."[42] Marcone confirms: "The environment

40 http://ec.europa.eu/environment/emas/casestudies/varese_ligure_en.htm [19-08-2009].
41 http://ec.europa.eu/environment/emas/casestudies/varese_ligure_en.htm [19-08-2009]
42 As cited in: http://www.adnkronos.com/AKI/English/Business/?id=1.0.1069653230 [19-08-2009]

was the only resource we had, and the only thing we could exploit."[43] From today's perspective the decision to turn Varese into a sustainable community has proven to be highly valuable. According to Marcone, 140 new jobs have been created by the whole transformation project, as both tourism and trade have increased (Sauer 2007). The only hotel in Varese reopened and several guest houses, bed and breakfast places and restaurants have sprung up. Moreover, a number of new shops have opened (Dunmall 2005a). As a result, less citizens now leave the village and many people have moved back from the cities, so that since 2004 the migration balance has been positive for the first time in decades (Sauer 2007).

A second factor is the high costs of connection to the national grid. According to Caranza one major obstacle for the local renewable energy development in Italy are the enormous costs of connecting renewable energy plants to the national grid. Varese Ligure had to pay 450,000 euros to the electricity supplier ENEL who had initially even asked for a payment of 900,000 euros. Additionally, Caranza bemoans the fact that it took a whole year to finally get the wind turbines connected.[44]

External factors form the third determinant in Varese Ligure. Aside from the EU subsidies that Caranza successfully applied for, other external conditions have been more obstructive in the development of renewable energies in Varese Ligure, especially those on the national level. The support scheme for renewable energies in Italy is based on a mixture of instruments and contains both minimum feed-in tariffs and quota obligations for energy companies. Due to uncertainty concerning the remunerations and periods of payment it is perceived as fragile and risky by investors. (Di Nucci 2007: 322ff). Even more challenging is the unclear division of responsibilities between the federal, regional and local levels of administration and difficult authorization procedures for renewable energy plants (ibid.:

43 As cited in: http://ipsnews.net/news.asp?idnews=34326 [19-08-2009].
44 http://www.adnkronos.com/AKI/English/Business/?id=1.0.1069653230 [19-08-2009].

327ff). When asked about the major obstacles for the development of renewable energies in Varese Ligure, Caranza highlights the costs for grid connection, bureaucracy and the lack of funding on the national level for the hydroelectric dam and for private photovoltaic applications.[45]

Résumé

As stated out above, a definite assessment of the factors that have enabled the organisation of the 100%-RE-region project in Varese Ligure is somewhat difficult. The development of renewable energies is part of a more comprehensive sustainability project that also includes organic farming and urban planning. What can be determined however is that the renewable energy transformation has been positively influenced by the pioneers Maurizio Caranza and Michaela Marcone, the region's general structural weakness and financial support from the European Union. It is also evident that the main obstacles to the local development of renewable energies have been the high costs of connecting the wind turbines to the grid and the lack of financial support from the national government. The lower degree of citizen participation in comparison to Dardesheim is however of minor significance, as acceptance among the citizens of Varese Ligure arose to a large extent from the organic farming and city renovation projects. Finally, the small size of the village has been in part advantageous (concerning the creation of social capital) and in part risky (with regard to the dependency on the pioneer's engagement) for the 100%-RE-region project. Yet its small size has not prevented the project from gaining media attention or influencing other 100%-RE-region projects..

To a greater extent than the other four case studies, Varese Ligure is a paradigm for how local sustainable development can resurrect a rural and structurally weak region. The

45 http://www.adnkronos.com/AKI/English/Business/?id=1.0.1069653230 [19-08-2009].

economic decline has been stopped and the demographic trend has even been reversed in the last years. The process of turning the municipality into a 100%-RE-region has been an important part of its development into a sustainable community, in particular with regard to media recognition.

However, the project has not yet been completed, especially as the heating and transport sectors have not yet received sufficient attention. Though, a program to promote private wood pellet heating has been initiated. In addition the environmental management systems ISO 14001 and EMAS encourage the municipality to continually improve its environmental performance.

2.3 Case Study: Samsø, Denmark

Samsø is an island of 114 km^2 in the Danish Baltic Sea. About 4,300 inhabitants live in 22 small villages spread over the whole island.[46] Samsø is thus larger than Dardesheim and Varese Ligure in both population and size, but smaller than Lüchow-Dannenberg (see below). The 22 villages are incorporated into one municipality that is governed by a mayor and a local council in the main village Tranebjerg.

The process to develop Samsø into a 100%-RE-region started in 1997, when the island won a competition run by the Danish government to become the Danish "Renewable Energy Island". A precondition for the winning of the contest was the presentation of a master plan of how the island could be supplied with 100 percent renewable energies within ten years, using local renewable energy resources and the given Danish market conditions for renewable energies. Furthermore, a high degree of citizen participation was requested. (Jørgensen 2007: 7)

46 See map of Samsø in the appendix.

The supporters of the project had already informed and involved the inhabitants of Samsø to a large extent in their preparatory planning, so they could start the implementation process soon after winning the contest. According to project leader Søren Hermansen the initial master plan was followed rather strictly between 1997 and 2005, when the electricity and heating sectors were transformed into renewable energy use. As in Dardesheim and Varese Ligure the electricity demand is now met almost completely with wind turbines. In the master plan Samsø's electricity consumption was estimated to be 29,000 megawatt hours (MWh), meaning a total production capacity of 11 MW was required. This is now provided by 11 turbines of one MW each that were erected and connected to the grid from the year 2000 on. Apart from the wind turbines only a few photovoltaic applications on the roofs of private houses and the Energy Academy produce green electricity on Samsø. (Jørgensen 2007: 21f.) Moreover, between 1997 and 2005 three district heating systems have been established, of which two are provided by straw-fired biomass plants and one by a combined woodchip and solar heating plant. Together with one previously existing straw-fired district heating system, they cover about 43 % of the heating demand on Samsø today. Furthermore, about 50 % of the private houses that have not been connected to the district heating systems have installed individual heating based on RES. Thus, overall around 65 % of the island's heating consumption is provided by RES (Jørgensen 2007: 11, 45f.). For 2005, the master plan scheduled the transformation of the transport sector by a large-scale introduction of electric vehicles with an offshore wind park providing the electricity required. The underlying assumption of the original plan was that by 2005 electric cars would have become very technologically advanced as well as economically affordable. As it turned out this was not the case. But the protagonists decided to build the wind park nevertheless. Ten offshore wind turbines with a capacity of 2.3 MW each were erected in the Baltic Sea south of Samsø and the electricity is at present fed into the national grid.

Thereby the energy that is used for transport on Samsø is compensated by the production of the equivalent amount of CO_2-free energy (Jørgensen 2007 : 21). Currently, the Energy Academy possesses one demonstration car which runs on electricity. Furthermore a few farmers have converted their private cars to run on plant oil combustion.

Factors of success and obstacles

On Samsø, as in Dardesheim and Varese Ligure, pioneers have played a crucial role for the successful implementation of renewable energies. Especially during the first years of the transformation the team of pioneers in Samsø was larger than those in the other three 100%-RE-regions. The whole process started out when Bent Schaloffsky, an engineer from Aarhus who worked on Samsø, read about the competition for the Danish Energy Island. Together with mayor John Sander Petersen, who was interested because of the business opportunities it would offer Samsø, and a few other islanders Schaloffsky drew up a master plan and submitted it.

When Samsø, somewhat surprisingly, won the competition a team of engaged protagonists was put together to implement the renewable energy goals. One of the members was Birgit Bjornvig, a local politician and former member of the European Parliament. According to Bjornvig the team combined broad knowledge and skills: Søren Hermansen, a local energy advisor and environmental teacher had the ability to convince and inspire people from different backgrounds and bring them together; Bent Schaloffsky and Aage Johnsen Nielsen, a local engineer, had the technical knowledge that was required for the broad introduction of renewable energies and Bjornvig herself was experienced in political lobbying at the national and international level. Bjornvig emphasizes that collaboration within the group was positive: “We had a very good team and we liked to work together.”

Among the pioneers Søren Hermansen stands out. Hermansen was the first salaried employee and successively became the head of the project. In particular his ability to bring the local opinion leaders and citizens together and convince them of the project has been highly important for the success of the renewable energy transition on Samsø. Local farmer Mogens Mahler highlights Hermansen's ability to create trust among the citizens: “He is born and has lived on the island for many years. So everybody knows him, and everybody knows that he is not doing it for his private [sake], but he is doing it for the island.” Putnam and Feldstein and Rogers emphasize the special challenge of communicating a local project (or an innovation) to people from different backgrounds. Hermansen together with the other pioneers has successfully mastered this challenge of “bridging social capital” on Samsø. Birgit Bjornvig also attests to how Hermansen managed to gain the people's confidence:

> “The reason that we succeeded so much as we have done is that we were successful in changing the people's approach to the whole project. And there, Søren [Hermansen] was fantastic. We had citizens' meetings in all the villages around and most of them were farmers. And when they got a little stubborn, Søren could switch into the local dialect and he just had them”.

To date, Hermansen is one of the main protagonists of project. When the main renewable energy goals were accomplished by 2005, Hermansen in 2006 was appointed director of the Energy Academy. In this function he promotes the project to politicians, journalists and visitors that come from Denmark and abroad to learn about the renewable energy transition on Samsø. Hermansen furthermore advises other 100%-RE-regions and campaigns about the concept at national and international workshops and conferences. In 2008, he was named a “Hero of the Environment” by “Time Magazine” for his engagement in renewable

energies on Samsø and abroad.[47]

In conclusion the engagement and achievements of the pioneers for the 100%-RE-region Samsø once again confirm the first hypothesis.

The same applies for the second hypothesis regarding citizen participation. One important reason for Samsø winning the Renewable Energy Island competition was the concept of the intensive involvement of the citizens of Samsø in the transformation process. However, pioneer Hermansen explains that the main reason for this focus on citizen participation was not the competition, in his eyes it was the only way to ensure the long-term success of the project:

> "I know from my experiences as an islander that this is a key factor here: you need the back-up from the local population. Otherwise you have a lot of problems. It takes time, there is a lot of meetings involved. You have to debate these things, and you have to be open-minded and listen to what people say and think. [...] Or you can make one project. But it will be your last project. Because if you force it through and say: 'This is the right way to do', and everybody will disagree with you, it is very complicated to make a new project. [...] Participation of citizens is the key factor of success, if you want the project to last"

Hermansen remembers that at the beginning of the project there was high enthusiasm among the citizens: "Winning the competition was a euphoric experience for Samsø. Just seeing the mayor on the news, describing the project, thrilled at the prospect of support from the Danish Energy Authority." (as cited in Stubkjaer 2008) But the real task was to make the people on Samsø understand the role which they were going to play:

47 http://www.time.com/time/specials/packages/article/0,28804,1841778_1841782_1841789,00.html [19-08-2009].

> "The great challenge, as the project had to have local involvement, was to transform the process from being a top-down one, devised by politicians and specialists, into making it a local project where all citizens on Samsø could see their own potential in making the project come together, not only for the whole of Samsø, but also for each individual with his or her own specific energy needs. From that point on, the main task was to communicate, again and again and at several meetings, in order to make sure that the people had enough information to take the next step." (as cited ibid.)

In the case of the onshore wind turbines, the pioneers decided on an exclusively local ownership scheme. At a number of public meetings the investment conditions were presented to potential local investors. Several farmers soon became interested in erecting a wind turbine on their land. According to Birgit Bjornvig more farmers were willing to invest than were really needed for the eleven onshore turbines: "The farmers found out that actually they could make money on having wind power stations. And then they began quarrelling about who would have the right to have these, because it was a limited number." As in Dardesheim, the solution on Samsø was to spread the wind turbine sites over several farmers' land. Yet, some protests arose among the neighbourhoods of the favoured sites. As a result three turbines were relocated. Furthermore, the pioneers convinced the investors to involve their neighbours in the ownership of the turbines. Jan Jantzen, academic advisor at the Energy Academy, explains the effect of local ownership on the erection of wind turbines: "It always helps if the neighbours own a share of the wind generator. Then the sound of the wind generator becomes very sweet all of a sudden." In fact, the spreading ownership improved the citizen acceptance of the wind turbines (Jørgensen 2007: 21). Local Mahler, who owns one turbine himself and hosts one further cooperative one, highlights the importance of local ownership: "You can have a lot of good

visions, but after some years they go down. People here get money out of it and they keep thinking that it is a good idea: get energy from the wind and get money from it."

For the establishment of district heating systems on Samsø close collaboration with the citizens was a precondition. In order to make the district heating systems economically viable, the vast majority of the households had to take part. Hermansen and other members of the pioneer team successfully chose a very cautious approach to convince the citizens in the three areas where the heating systems were to be introduced. They presented the concept of the district heating systems at regular citizen meetings and then left it to the citizens to collect the required signatures and even organize the funding for it. In fact, in all three areas local citizens established working groups in order to realize the projects. The first new district heating system was built in Nordby-Maarup in the north of the island. A group of local inhabitants arranged a cooperation with the Danish energy provider NRGi to build a plant that produces heat through a combination of the burning of woodchips and a 2500 m^2 solar thermal system. In the village of Onsbjerg a local working group convinced the company Kremmer Jensen ApS to assume the ownership of the straw-fired heating plant and then sign contracts with about 80 households and institutions, so that the plant could be opened in 2003. In the neighbouring villages of Ballen and Brundby, the local working group likewise decided on a straw-fired system and in 2004 they successfully implemented a cooperative ownership model in a limited liability association with the participation of 232 households and institutions. (Jørgensen 2007: 11f.) However, further district heating systems to cover the other villages or houses in the open countryside of Samsø could not be realized. For these houses the pioneer group promoted individual heating installations based on renewable energies. This was done by organizing renewable energy education programs to certify local blacksmiths. Over the following months and years, the blacksmiths worked as multipliers convincing numerous locals of the benefits of

solar thermal or biomass heating. According to blacksmith Ole Hemmingsen, the training has paid off and the blacksmiths' energy consulting has led to an increase in the people's knowledge and trust in renewable energy heating systems:

> ”We've had a lot of information meetings and open house events after the first systems were installed. People on Samsø are now very well informed about renewable energies. In the beginning we were often met with questions such as whether it would pay off, over how many years, and how durable it was. Today, these issues are hardly discussed at all.” (as cited in Stubkjaer 2008)

Also when in 2005 the offshore wind park was built, many local actors were actively involved in the planning and all citizens could participate in the ownership of the turbines. As the initial costs for the large offshore turbines were high, only one of the ten turbines could be financed by private investment by the citizens of Samsø. This cooperatively owned turbine is the last one to be disconnected from the grid in times of overproduction. It is also the closest one to the coast of Samsø, thus the most visible to the people of Samsø. In order to further strengthen the connectivity of the citizens to the wind park, the municipality of Samsø decided to finance five of the remaining turbines with a large investment. The council also determined that the profits of these turbines should be invested in sustainability projects on the island. External investment was only accepted for the remaining four turbines. (Jørgensen 2007: 21f.)

Partly financed by offshore wind park profits and by EU funds, the Energy Academy was built in 2007. The building provides a working space for the employees of the 100%-RE-region project and is used as a community hall for renewable energy concerns and other local projects. Furthermore the Energy Academy serves as a visitor and education centre as well as being a symbol in itself of sustainable construction featuring organic materials, low energy requirements and solar thermal and photovoltaic energy supply.

In less than a decade, the project to organise a 100%-RE-region has become part of the citizens' identity on Samsø, as all interviewees state. Birgit Bjornvig: “I think, when you ask people now, they would say: 'We are the energy island people'. It is not 'those' and 'us' [...] That is the way we feel altogether: This is our success. It is not a few people's success. It's most of us.” Local farmer and chairman of the Samsø offshore wind park Jørgen Tranberg: “In 30 years time, when the turbines have gone, we can sit and say to each other: 'Remember, when we put up the offshore park? That has something!'” (as cited in Stubkjaer 2008). Hermansen explains that the pioneer team's deliberate appeal to the people's sense of community was the the key to the success of the whole project: “It's a great feeling of taking part and be in charge of what is going on. That creates local pride. Future projects will be based on the local pride and power that lies in getting people involved and responsible for their own lives.” (as cited ibid.) Thereby, Hermansen confirms Putnam and Feldsteins assumptions about the creation and and value of 'social capital'.

Concerning the variable of size the interviewees highlight that Samsø's geographical features as an island have been more influential for the 100%-RE-region project than its size.

If anything, the relatively large size of the rural island has been advantageous for the project, as there is enough space for renewable energies, Hermansen states. Also, the larger number of inhabitants on Samsø (nearly twice the number in Varese Ligure and fourfold the number in Dardesheim) has not hindered the protagonists' efforts to comprehensively involve the local citizens. Thus, the third variable which suggests that the realization of a 100%-RE-region project is easier in a smaller setting is not confirmed by Samsø.

While the fourth variable (which draws a positive correlation between the size of a 100%-RE-region and its achievements in promoting itself externally) has already been weakened

by the case studies of Dardesheim and Varese Ligure, it could be slightly reinforced by Samsø. The island's bottom-up approach in the implementation of renewable energies has attracted international media attention and visitors from all over the world. Articles on the 100%-RE-region project of Samsø have been published in Time Magazine (Walsh 2009), The New Yorker (Kolbert 2008), The Observer (McKie 2008) and in many other international press publications. Additionally, numerous TV and radio broadcasting about Samsø have been aired.[48] Of the four case studies, the 100%-RE-region project on Samsø also attracts the most visitors. Since it was opened, the Energy Academy has annually seen visits by around 2000 politicians, private businessmen, students and other visitors plus a further 2000 pupils wanting to learn more about the project.[49] Furthermore, Samsø is very well networked with other 100%-RE-regions, for example the European Islands Network on Energy and Environment, ISLENET. There and elsewhere the protagonists are exporting their experiences. Hermansen concludes:

> "After we started this project, the '100 percent renewable energy island' concept has been announced at many different places. I think, we were one of the first islands to be 100 percent renewable energy focused. Many of the other islands had a focus on wind, or biomass or any other solutions, but not for 100 percent, because this is very ambitious. But now you can see more and more islands with a 100 percent focus."

It is Samsø's special conditions as an island that have been relevant for its renewable energy transition, the interviewees argue. Firstly, as Samsø is located in the centre of the Danish Baltic Sea the island enjoys outstanding wind conditions (Jørgensen 2007: 51). Secondly, energy prices on Samsø had been high before the renewable energy project was initiated because all fuel had to be transported to the island from the mainland (ibid: 30). Today, the district heating systems produce heating energy for cheaper prices and many citizens make

48 See for an overview the Energy Academy: http://www.energiakademiet.dk/front_uk.asp?id=100 [19-08-2009].
49 Website Energy Academy: http://www.energiakademiet.dk/front_uk.asp?id=35 [19-08-2009].

money with their shares in the local wind turbines. Thirdly, as an island, all imported and exported energy can be measured very easily. Hermansen states: “You can see the direct impact immediately. As a demonstration project, you can monitor the result, and do it in a very realistic way.”

The engaged group of pioneers, the high degree of citizen participation and the special island conditions have thus been important factors in the success of Samsø's development into a 100%-RE-region. However, other factors have also influenced the project.

The first of these factors is a cooperative local environment. On Samsø, local economic actors have supported the 100%-RE-region project from the very beginning. The farmers, trade unions and tourist board have closely collaborated with the pioneer team in the planning and establishment of the on- and offshore wind turbines and the district heating systems. Likewise the local municipal council has facilitated the project. According to Jantzen, at the beginning the right wing members of the council were more sceptical than the left wing members, yet today the whole council is a proactive actor in the transformation process, as all eleven members now support the project. The municipality is particularly engaged in the offshore wind park and by the end took out a large loan in order to purchase five of the ten turbines. Mayor Carsten Bruhn explains the motivation for this investment:

> “We decided to finance five turbines, both in order to support the project and get it off the ground, but also to create new job opportunities and know-how. The offshore turbines are now there, and we've invested 17 million euros. That's the equivalent of every islander investing 4,000 euros. But I think, every person on Samsø sees this as an exciting project. (as cited in Stubkjaer 2008)

Jantzen states that the local administration is also rather supportive. According to him, the

only barrier is the processing time, but there is no resentment towards renewable energies.

A second factor is the island's weak economic conditions. Traditionally, agriculture and tourism were the two main business sectors on Samsø. However, the island's economy has been challenged by structural change. Farming has been in decline for years, the local pork slaughterhouse with 70 employees was under pressure in the 1990s (eventually closing in 1999/2000) and the job losses could not be compensated by the stable tourist sector or the service sector which had seen slight growth. As a result of the rising unemployment, many people had to move away from Samsø to find a job on the mainland. (Jørgensen 2007: 8) In this period of economic decline, the renewable energies were perceived as a welcome opportunity for new business and new jobs, as pioneer Bent Schaloffsky states: "One of the reasons for entering this was to create more jobs on Samsø. It's been an incredible help, after the closing of the slaughterhouse. We've kept a lot of people employed." (as cited in Stubkjaer 2008). It is a little difficult to measure the exact number of new jobs that were generated or saved by the project's total investment of about 57 million euros. (Jørgensen 2007: 41) At least 20 jobs for local workers were created in the construction of the district heating systems and the wind turbines between 1997 and 2005 (Jakobsen 2008: 19). Furthermore, the local blacksmiths, carpenters and builders were provided with extra business and the farmers received better prices for their straw. Also local tourism is profiting due to the rising number of "professional tourists" visiting the island (Jørgensen 2007: 19). Finally, the number of employees who organise and communicate information about the project has increased: in 1998 two people were employed, in 2007 six people and currently the number of employees of the Energy Academy is continuing to rise. (Jørgensen 2007: 15, 41) Mette Løkke, director of the Samsø Development Office, hopes that the establishment of the Energy Academy will provide further job opportunities especially for well-educated young people:

> "The whole Energy Island project is a focal point, for Samsø in general, not just for renewable energy. That's why we at the Development Office support the project heartily and work towards setting up an academy for renewable energy. An Energy Academy can give us that which we lose in other areas. We gradually lose jobs for people with a higher education. But setting up the Academy, in collaboration with the academic world, we can re-establish that area. It gives us a new niche in which we can create new jobs." (as cited in Stubkjaer 2008)

According to Jantzen, the impact of renewable energies has already extended to the third economic sector on Samsø. Former politician Bjornvig concludes: "The project has created new jobs on the island. The cement factory made the foundations for the eleven land turbines. The blacksmiths have more work. [...] At a time when big is better it's important to prove that smaller entities can survive." (as cited ibid.)

A third factor was the protagonists' relations with the grid operator. Samsø's grid is part of a regional integrated network which grid operator NRGi rents. According to Jantzen there have not been any problems with connecting the wind turbines to the grid, as the operator is legally obliged to take the energy generated by renewable energy plants. An additional, and in Jantzen's opinion more important reason is the cooperative ownership model of the grid operator:

> "NRGi has lots of members, which are us, the users. So the users themselves decide what to do in a general assembly. That is a good thing, because it is not top down, it gives us the sensation of being able to decide ourselves. It is not pressed over us from above, from some power company that gets this idea: 'do this or do that'."

Grid operator NRGi is thus generally open to the integration of renewable energies into the grid and has also participated in the district heating systems on Samsø (see above). As the relations with the grid operator are good, and because it would be technically difficult to

disconnect from the regional grid, there have been no discussions on a disengagement in the future.

A fourth factor is the renewable energy network. As Samsø was one of the first 100%-RE-regions in Europe, the pioneers could not learn and benefit from the experiences of other regions with an equally comprehensive goal, when they started the project in 1997. However, Søren Hermansen explains how the protagonists looked at numerous individual energy projects in Denmark and Germany:

> "We learned something about wind power, we brought it to Samsø and got it in operation. We learned something about district heating, brought it to Samsø and got it in operation. So you could say: 'We had the recipes, but all the ingredients, we had from other projects."

Samsø not only profited from Denmark's long-term experiences of operating wind turbines which date back to the 1970s, but also from the tradition of open dialogue between politicians and scientists, plus bottom-up initiatives that has only enabled the successful large-scale implementation of renewable energies in Denmark (Hvelplund 2005: 83ff.). Hermansen: "This is an old, traditional model of cooperative organization. We modernized it and used it once again."

External factors form the fifth set of influences on the implementation of renewable energies on Samsø. In addition to the idea of the 100%-RE-region project which came from outside the island, the development of renewable energies on Samsø has been strongly influenced by another external parameter: the Danish support scheme for renewable energies. During the initial years the project benefited from the ambitious and stable promotion policies of the Danish government. Owners of onshore wind plants were guaranteed fixed and cost-effective feed-in tariffs of about 8 cent/kWh for a period of ten years. Furthermore the Danish Energy Authority provided Samsø with grants for the

establishment of the district heating systems amounting to 1.9 million euros and for the installation of individual heating systems totalling 400,000 euros. (Jørgensen 2007: 11, 21, 41) According to Hermansen the national support scheme was very important for the realisation of the project on Samsø but after the general election in 2002 the social democratic government was replaced by a liberal-right wing government that was less proactive towards renewable energies and the support decreased. Hermansen explains that the whole 100%-RE-region project was placed under serious pressure:

> "In the first four, five years, it was a flowing process. But then we had a new government in 2002 and it became more difficult to make projects, because the new government said: 'No, we are not going to support this kind of development, we think that everything should be done on market mechanisms in a liberal economy'. As a consequence much more calculations had to be done and also the research area suffered by a lack of financing. Now the government wants become "green" again, but they missed out on six, seven years. The project almost broke down because of these developments."

The European Union also provided support for the 100%-RE-region project on Samsø. Among other things the EU partly financed the building of the Energy Academy and the creation of one salaried position of plus a research study on the potential of a local biogas plant. According to Hermansen, the EU has become more and more interested in the Samsø project, because of a more ambitious energy policy. Hermansen: "We had some support from the EU, because they thought that Samsø was a good regional model which would inspire other projects in Denmark and in Europe."

Finally, a further external factor that has to some degree influenced the project is the international oil price. The rising oil price in the 1990s led to an increasing interest in the installation of the individual heating systems based on renewable energies amongst the

citizens of Samsø.

Résumé

In conclusion, nine factors have favoured Samsø's transition into the Danish Renewable Energy Island: (1) the high degree of citizen participation, (2) local and charismatic pioneers, (3) the special island conditions, (4) the cooperative local environment, (5) the structural weakness, (6) positive collaboration with the grid operator, (7) Samsø's renewable energy network, (8) EU funding and (9) rising oil prices. The influence of external factors was ambivalent; the Danish support scheme for renewable energies was very supportive in the first five years, but was then scrapped in 2002 jeopardizing the whole project. Another obstacle for the full accomplishment of the transformation process has been the slow progress in the field of electric car technology.

The 100%-RE-region project of Samsø stands out from the other three case studies for two reasons in particular. Firstly, the protagonists decided on the most intensive and comprehensive citizen involvement. Not only could the Samsø citizens participate in the whole decision making process and they also shared in the ownership of the renewable energy plants. In the case of the district heating systems the locals were even provided with core responsibilities to realize the funding of the systems. According to the pioneers, this extraordinary degree of citizen participation was crucial in the implementation of the 100%-RE-region on an island community like Samsø. Secondly, the achievements in the heating sector are likewise exceptional. Almost two-thirds of the heating demand is met by RES on Samsø, while none of the other three regions have yet succeeded in producing a notable share of heating from renewable sources.

Only in the transport sector have the initial goals on Samsø failed. However, as soon as the technology is affordable the large-scale introduction of electric and hydrogen cars will

begin. Other future projects have yet to be decided. It is however possible that the protagonists will build upon the educational activities in place, or introduce a zero-waste or organic farming initiative.

2.4 Case Study: Lüchow-Dannenberg, Germany

The German district of Lüchow-Dannenberg is located in the eastern part of Lower Saxony, on the former border with the GDR. In Germany, Lüchow-Dannenberg is in particular well-known for being home to an intermediate storage facility for nuclear waste located in the village of Gorleben and the protests against the transportation of atomic waste. The district encompasses an area of 1,220 km^2 where about 51,000 people live in 27 municipalities.[50] Based on its number of inhabitants, it is the smallest district in Germany. However, compared to the three other regions of this study, Lüchow-Dannenberg is by far the largest 100%-RE-region both in terms of its number of inhabitants and size.

The project to develop Lüchow-Dannenberg into the first German district to produce 100 percent renewable energies started in 1997. The district council applied for an EU-funded study from the ALTENER program to investigate the potential for a local renewable energy supply. A prerequisite for receiving the funding was a political decision to aim for 100 percent renewable energy supply by 2015. The decision was taken unanimously by the council and the study was carried out. In 2001/2002 the study was published, estimating Lüchow-Dannenberg's total energy consumption as 1.53 TWh. Furthermore, the study proved the feasibility of a full supply using local renewable energies, based on wind energy, biogas, photovoltaic, biomass, geothermal and some hydropower. (Lange 2005: 1f.)

In 2004 13 percent of the electricity demand was provided by RES, mainly by seven wind

50 http://www.energie-cites.org/db/luchow-dannenberg_140_de.pdf [19-08-2009].

turbines and twelve biogas plants. By 2008 the number of wind turbines had increased to 19 and by the end of 2009 a further 30 turbines will be erected. The share of regenerative electricity in Lüchow-Dannenberg will then reach 50 percent (Elbe-Jeetzel-Zeitung 2009). In the heating sector, a couple of private heating systems are fuelled by wood and solar energy.[51] No district heating systems have yet been established. Also, the share of RES in the transport sector is about three percent and is thus still small (Lange 2005: 6) but a couple of pilot projects have been developed, amongst them Germany's first commercial biogas filling station.

Factors of success and obstacles

As in the other three case studies, the 100%-RE-region project in Lüchow-Dannenberg was initiated and implemented by engaged local pioneers. The pioneers are closely connected and rooted in the anti-nuclear movement, and their primary aim in developing renewable energies in Lüchow-Dannenberg is to prove that an alternative energy supply without nuclear power is possible. Because of the district's long-term local engagement against nuclear waste transports the pioneers enjoy high credibility in the population, as energy advisor Dieter Schaarschmidt explains:

> "When a region xy says 'We go for 100 percent renewable energies' and some big energy company is behind it, then this is not as authentic as when a region like Lüchow-Dannenberg says 'We try to realize 100 percent renewable energies in a local and sustainable way.' Because people know that there are critical heads behind it."

According to Kurt Herzog, one of the initiators of the 100%-Re-region project and current

51 An overview is provided by a local travel guide on renewable energies: WendenEnergie (ed.): Hin zu neuer Energie. Ein Reiseführer zu Erneuerbaren Energien in der Modellregion Wendland, Hitzacker.

politician, the pioneers' persistence and focus on concrete and practical projects have been crucial for the implementation of the project: “Without these pioneers, everything would be still in its infancy here.” Herzog highlights the role of Dieter Schaarschmidt as the main protagonist of the 100%-RE-region project. In 2007 Schaarschmidt was awarded with the “German Solar Price” by Eurosolar for his more than 30-year-long personal engagement in renewable energies in Lüchow-Dannenberg.[52] Eurosolar pointed to Schaarschmidt's pioneer work with his company ReEnergie Wendland[53] and his society WendenEnergie e.V.[54] in renewable energy consulting for local firms and farmers and in realizing several renewable energy projects with public participation.[55] Schaarschmidt himself confirms that single, engaged pioneers have been important in the setting up of the project: “For the starting position it was decisive that there were several strongly engaged actors.” In the further implementation process there had also been phases when there was broader support. When the project was promoted as a model region by “Region Aktiv” for a couple of years, it was accompanied by a committee of local actors and politicians. Schaarschmidt: “Then, the project lay on the shoulders of a number of people and represented a good cross section of the active groups within the population.”

In addition, both Schaarschmidt and Herzog underline the idea that the pioneers' good relationships and in particular their shared motivation to present an alternative for nuclear power have been very beneficial in the organization of the 100%-RE-region project in Lüchow-Dannenberg. The first hypothesis is thus again confirmed by the case of Lüchow-Dannenberg.

52 http://www.eurosolar.de/de/index.php?option=com_content&task=view&id=791&Itemid=206 [19-08-2009].
53 See website: http://www.re-energie-wendland.de/ [19-08-2009].
54 See website: http://www.wendenenergie.de/ [19-08-2009].
55 Download at: http://www.eurosolar.de/de/index.php?option=com_content&task=view&id=791&Itemid=206 [19-08-2009].

Another similarity with the other three 100%-RE-regions in this study, is that the protagonists in Lüchow-Dannenberg also strive towards achieving a high degree of citizen participation. Particularly during the initial years the pioneers informed the locals intensively about the potential of renewable energies by holding workshops, presentations, excursions and other events. Most of them were provided for free, as Schaarschmidt emphasizes: "We have attached great importance to getting everybody involved and not only the privileged, or those who definitely wanted to implement a project themselves." Therefore, people who had not yet been involved in renewable energies could develop an interest and discover the opportunities they have to invest. Schaarschmidt: "We wanted transparency for the people and that they should invest their money in this." At the outset the interest amongst the local citizens was actually high. Schaarschmidt remembers that "people were queuing up for such projects, in our first wind turbines 180 families took a share, but we could have got twice as many people involved." Unfortunately, as Schaarschmidt states, more cooperative wind energy projects could not be realized because of the slow approval procedures. Furthermore, two larger photo-voltaic systems are cooperatively owned by local citizens and a couple of smaller photo-voltaic applications have been installed by private owners. Today, most of the new wind turbines are owned by external investors or funds and all the 30 turbines that are to be erected in 2009 are owned by one American large-scale investor. Schaarschmidt comments: "That is better than nothing, but initially I projected it differently. So that the majority of the value added would be kept locally." Herzog likewise criticizes the external ownership of the wind turbines: "This is getting out of touch with the locality." Both of them emphasize that the general conditions for stronger citizen involvement are actually better in Lüchow-Dannenberg than elsewhere in Germany, as, due to the anti-nuclear movement, the ecological awareness of the citizens is much higher than average. As a result, the majority of the people are

principally in support of the local development of renewable energies. However, local protests have impeded several wind energy and biogas projects during the last years. According to Herzog, this could have been prevented if the citizens had been provided with more comprehensive information. In the case of Lüchow-Dannenberg a number of cooperative projects have proven that a high degree of public involvement can push the implementation of renewable energy systems. At the same time it also provides several examples of where a lack of citizen participation has been an obstacle for the local development of renewable energies. Thereby also the case of Lüchow-Dannenberg supports the second hypothesis.

Lüchow-Dannenberg also serves as a good example of how the large size of a region can be a challenge for a 100%-RE-region project. It requires great effort from the pioneers to inform and convince the majority of citizens of the benefits of the project. Also collaboration with the industrial sectors including agriculture, building and tourism has not been straightforward. Schaarschmidt states:

> "It was difficult to communicate these supplementary sources of income: tourism, energy and of course energy tourism. But this is exactly the opportunity, if one looks at the conditions of agriculture and trade, and the slump in the building sector. Actually, there is no other opportunity."

Likewise Herzog states that the integration of the general population has turned out to be difficult and as a consequence there is not enough integration of the citizens: "The many conflicts here prove it." According to Herzog, the public administration has failed to introduce a centralized and comprehensive approach to getting the citizens involved in the project. As a result, Lüchow-Dannenberg's citizens identify with the 100%-RE-region project less than in the other three regions of this study. Schaarschmidt regrets that the

improved image that Lüchow-Dannenberg gained outside of the region, has not been perceived by the local public. The third hypothesis that suggests that it is harder for larger regions to implement a 100%-RE-region project is thus strengthened by the case of Lüchow-Dannenberg.

The indicators for the fourth hypothesis are more ambivalent. On the one hand, Lüchow-Dannenberg's 100%-RE-region project has won outside recognition and acceptance. Schaarschmidt explains: "Lüchow-Dannenberg has unique features in this area of renewable energies. That has helped us to make a name for ourselves in energy policy circles." Moreover, the protagonists of the renewable energy transition in Lüchow-Dannenberg have successfully applied for several subsidies from the national government. Amongst other sources of funding the project was provided with about three million euros when Lüchow-Dannenberg was selected as a model region by the German Federal Ministry of Consumer Protection's program "Region Aktiv". The money was invested in the biogas filling station and in many other small renewable energy projects. On the other hand, requests to the European Union and the German government for financial support to build a visitors centre on climate change and renewable energies have not yet been successful. Furthermore, Lüchow-Dannenberg was not taken into consideration, when the German government selected a number of model regions that will be promoted to achieve 100 percent self-sustainability with renewable energies.[56] Finally, compared to the other three regions in this study, the 100%-RE-region project of Lüchow-Dannenberg has attracted less interest in the national and international media. The fourth hypothesis is thus not confirmed by the Lüchow-Dannenberg case study.

In addition, the following five factors have influenced the 100%-RE-region project in

56 http://www.e-energie.info/de/modellregionen.php [19-08-2009].

Lüchow-Dannenberg.

The first factor is the local political and administrative environment. A distinguishing feature of Lüchow-Dannenberg is the high degree of general politicization due to the anti-nuclear movement. Schaarschmidt: "That is of course a unique feature that probably hardly any other energy region has." As a result, several alternative local parties have evolved and won seats in the district council. Since the last elections in 2007, five parties (social democrats (SPD), two green parties (Bündnis90/Die Grünen; GLW), an independent voters party (UWG) and the Liberals (FDP)) have formed a coalition as the "Group X".[57] The "X" is the sign for the anti-nuclear movement that is supported by all parties in Lüchow-Dannenberg – with the exception of the main opposition party, the conservative CDU that is pro-nuclear power. Today, all the parties, including the CDU, in principal support the local development of renewable energies. However, because of the heated debates about the local nuclear storage facility and the treatment of demonstrators the yearly protests, there is generally little cooperation between the parties. This "Gorleben divide"[58], as local politician Herzog describes the atmosphere in the council, has impeded the development of many renewable energy projects, especially at the beginning of the process. Herzog exemplifies that it took several years until the CDU started to support the building of wind turbines and biogas plants, even though their core voting base, the farmers, benefited from these renewable energies. Schaarschmidt agrees: "I was surprised that we managed to pass an unanimous resolution for the renewable energy project."

According to both interviewees, an even stronger obstacle tor the development of renewable energies in Lüchow-Dannenberg has been the local administration. The administration has been rather uncooperative, especially at the beginning of the 1990s, when the first renewable energy applications were to be installed, some time before the

57 http://www.luechow-dannenberg.de/index.htm?baum_id=5079 [19-08-2009].
58 Gorleben is the village, where the nuclear storage is built, see above.

start of the 100%-RE-region project. For instance, it took six years to gain permission to erect the cooperatively owned wind turbines. This hindered more cooperative projects, something Schaarschmidt criticises. In particular, the implementation of already approved projects was held up by the administrative bodies, Schaarschmidt also criticizes the fact that “The practical consequences often fell by the wayside. They were an extreme struggle for us. Some of the time it was very tiring.” Herzog states that the reason for the resistance was the general conservative attitude of the public officials and their scepticism towards renewable energies: “The local bureaucracy was and is very conservatively structured. I have always hoped that there must be at least some who are open-minded and realize the opportunity renewable energies provides.” Furthermore Herzog highlights the large influence that the administration exerts on local politics:

> “The administration has many means. One doesn't say for nothing: 'administration is always the biggest faction,' as in committees, often only a few politicians are well-informed about the issue. Therefore they generally agree with what the administration suggests. If the administration resists something it is generally also difficult to organize majorities against the administration.”

According to Schaarschmidt, the collaboration between the protagonists of the 100%-RE-region project with the administration has slightly improved in the last years. Still, both Schaarschmidt and Herzog point out that the local administration is the greatest obstacle to the renewable energy transformation process in Lüchow-Dannenberg.

A second factor is the the structural weakness of the district. Like the other three regions in this study, Lüchow-Dannenberg is exposed to structural changes and suffers from economic weakness. The agricultural sector in particular is in decline and as a consequence both unemployment and migration numbers have been rising for years. Like the pioneers of the other 100%-RE-regions, Schaarschmidt and Herzog emphasize that these conditions

generally provide good opportunities for the development of renewable energies. Schaarschmidt states:

> "The structural weakness is advantageous for renewable energies insofar as they can contribute to the value added in every location. It is also noticeable here, as it is normally very difficult to assert oneself economically because of the region's remoteness from markets. Renewable energies also utilize the fallow ground much better. As the production conditions are also cheaper here due to low wages, low rents and low living costs, this is doubly beneficial."

Herzog likewise regards renewable energies as a long-term and stable economic opportunity for the structurally weak district: "When you look at several local companies, like "Bosse & Dreyer", a producer of co-generators which is prospering, they started out as two home constructors about ten years ago and today are now a big company with 50 employees in Gorleben."

A third factor is the relations with the local grid operator. In Lüchow-Dannenberg, municipal energy suppliers owned the local grid until the 1980s. Today the grid is run by the same private operator, Eon Avacon, who also owns the local grid in Dardesheim. According to Schaarschmidt, Eon Avacon had a sceptical attitude towards renewable energies at the beginning of the transformation process in Lüchow-Dannenberg: "Today they try to act a little more sustainably. They do not work openly against renewable energies any more. Or they try to implement the projects themselves." Herzog adds that the grid operator generally complies with the legal regulations when it comes to the integration of private renewable energy applications into the grid: "Basically, I would not say that there is a strict counter attitude." Eon Avacon even collaborated for a long time with the pioneers in their application for the German model region for 100 percent reliable renewable energy supply. However, Eon Avacon decided to support Dardesheim and the region Harz and

abandoned the project in Lüchow-Dannenberg shortly before the application was submitted. As a result, Lüchow-Dannenberg missed out on this funding. Since then Schaarschmidt perceives the relationship with the grid operator as "tense". The protagonists of the 100%-RE-region project are still striving to repurchase the local grid, as the licence for the next 20 years will be decided upon this year.

A fourth factor is the renewable energy network. The idea to organize the 100%-RE-region project in Lüchow-Dannenberg was developed by the pioneers themselves but during the implementation process the protagonists worked together closely with other regions from Denmark, Sweden and Austria that shared similar goals. Schaarschmidt remembers: "We got in contact very early on and became mutually inspired after visiting one another and organizing joint seminars." According to Schaarschmidt the networking and exchange of experiences with national and international partner regions has been highly valuable, as in the beginning there were no other professional renewable energy projects in existence. Rather there were numerous interested amateurs that shared their experiences with one another in order to develop a comprehensive picture of the opportunities local renewable energies provided. Schaarschmidt concludes: "The network was very important, as [...] we would never had the heart to get them [wind energy and biogas] started here, if we had not benefited from the experiences of others."

The external factors form the fifth determinant also in Lüchow-Dannenberg. As in Dardesheim, the protagonists of the 100%-RE-region project in Lüchow-Dannenberg highlight the positive influence of the German support scheme for renewable electricity, the EEG. Schaarschmidt calls it a "stroke of luck" that in 2000 the EEG provided the financial support and security for regenerative power, so that the project at least in the electricity sector could advance well. Schaarschmidt compares it to the heating and transport sectors, where such a framework has not been established and thus the transformation in Lüchow-

Dannenberg has been much slower. However, Schaarschmidt criticizes the current prioritization of offshore wind energy which is provided with higher feed-in tariffs over onshore wind energy: “As offshore only engage the big energy companies, it is another energy area that is taken away from the citizens. The individual's responsibility is taken away, as is of course the profit.” Schaarschmidt further criticizes a multiplicity of regulations and legal constraints as “absurd” referring to the height limitations for wind turbines and higher taxation of straw heatings than wood heatings which have impeded several local projects in Lüchow-Dannenberg. In Schaarschmidt's opinion, a supportive external framework combined with individual's local engagement are the most important factors in the organization of a 100%-RE-region: “I think, such a project always requires a mix of pioneer spirit and the right framework, so that it can be well and quickly implemented.”

Résumé

In Lüchow-Dannenberg the following five factors have positively influenced the 100%-RE-region project: (1) engaged local pioneers, (2) citizen participation (where it could be realized), (3) the structural weakness of the district, (4) the renewable energy network and (5) the EEG German support scheme for renewable energies. In contrast, there are also five factors that have hindered a faster and more advanced implementation of renewable energies: (1) the low degree of citizen participation (in comparison to the other three regions in this study), (2) the large size of the region, (3) the uncooperative atmosphere in the district council, (4) the local administration and (5) external regulations. The local grid operator had positive and negative impact on the project.

Lüchow-Dannenberg is an example of the difficulty of implementing a 100%-RE-region

project in a larger region. In particular, the attempt to comprehensively involve the local citizens in the project has proven to be highly challenging. The case of Lüchow-Dannenberg also shows the problems that can arise when a 100%-RE-region project gradually converts from a bottom-up approach to a top-down one. The connectivity of the locals to the project is decreasing and protests against renewable energy installations are growing stronger.

However, the pioneers have not given up hope of at least partly reaching the goal of using 100 percent renewable energies by 2015. Both Schaarschmidt and Herzog are optimistic that the electricity sector will be fully supplied by RES by then. Schaarschmidt also expects a boost for the district heating systems during the next five years. In the transport sector the pioneers want to strengthen the region's position as a local frontrunner in biogas. A second biogas filling station will soon be opened in Dannenberg and a cooperation with Volkswagen to promote biogas motors has just begun.

3 Lessons Learned

What lessons can be drawn from the case study analyses concerning the factors that favoured or constrained the organization of a 100%-RE-region and what practical advice can be derived from these lessons for local decision makers in regions with similar goals?

Starting with the four hypotheses it is noticeable that in all of the four regions the existence of engaged and competent pioneers has been a determining factor for the success of the renewable energy projects.

In addition it is also notable that – with the exception of the investor Heinrich Bartelt in Dardesheim and Bent Schaloffsky, an engineer from Aarhus who worked on Samsø – all the pioneers were born and raised in their respective region.

Furthermore, the pioneers have all shown that they pursued more than just private economic goals. In Dardesheim, Karl Radach was driven by his personal fascination with wind energy technology and even the investor Bartelt regards the 100%-RE-region project not only as a business opportunity, but also as a model experiment for rural development using renewable energies. In Varese Ligure and on Samsø, the pioneers are primarily motivated to provide new economic opportunities for their structurally weak regions and in Lüchow-Dannenberg Dieter Schaarschmidt and his supporters want to prove that renewable energies can substitute nuclear power.

Additionally, most of the pioneers can be characterized as charismatic figures who have the ability to convince other citizens to join in their renewable energy projects. In particular Søren Hermansen on Samsø and Maurizio Caranza in Varese Ligure are distinguished by their skill in involving local citizens from various different backgrounds; their ability to "bridge social capital" (Putnam and Feldstein: 2003) has proven to be highly beneficial for

realizing the 100%-RE-region projects.

In all of the four regions the pioneers have also established good contacts with local politics. In the case of Varese Ligure the pioneers are themselves local mayors and in Dardesheim and on Samsø the pioneers have closely collaborated with the local councils. In Lüchow-Dannenberg the pioneer Schaarschmidt has convinced the district council to officially decide to pursue the 100%-RE-region project.

Another factor of success in all four regions has been the long-term commitment and engagement of the pioneers. On Samsø and in Lüchow-Dannenberg, the projects have been pushed by Hermansen and Schaarschmidt from the outset right through until today. In Dardesheim and Varese Ligure the project's leadership transition has passed smoothly from the initial pioneers, Radach and Caranza, to the current protagonists, Bartelt and Marcone, who were both already part of the pioneer team from the very beginning.

Finally, in all four regions the good personal relationships between members of the pioneer teams are highlighted as important for the successful realization of the 100%-RE-region projects.

A piece of practical advice that can be deduced from these lessons is that engaged local pioneers should be provided with high levels of influence on the implementation process of a 100%-RE-region project. In all of the four regions that are analysed in this study they have shown the enthusiasm and long-term commitment that such a project requires and furthermore they have acted as opinion leaders for the local citizens.

As suggested in hypothesis two, the second decisive factor for the organization of a 100%-RE-region project has proven itself to be a high degree of local citizen participation. All four regions initially opted to inform and involve the locals as far as possible.

The interviewees highlight that citizen participation has been a successful means to reduce local protests and resistance. In particular in Dardesheim and on Samsø the protagonists deliberately allowed a large amount of extra time in order to inform local citizens and convince them of the project's value. This cautious approach held the process up for several years, but today both regions are among the most advanced 100%-RE-regions in Europe.

The financial involvement of the local citizens has proven to be an especially important factor of success in three of the four 100%-RE-regions.[59] In these regions local protests against wind turbines decreased when the neighbouring households shared in their ownership. In Dardesheim and Samsø several wind turbines were replaced to ensure a broad ownership structure, even though it resulted in small efficiency deficits. In contrast, the example of Lüchow-Dannenberg shows how the connectivity of the local citizens to the 100%-RE-region project is fading away, as a participatory ownership structure was not arranged for the wind turbines that have been erected during the last few years.

So far, only Samsø successfully managed to implement district heating systems and a large number of individual heating systems. In comparison to the electricity plants even more individually-based decisions have to be taken for the installation of heating systems, so the pioneers on Samsø opted for two approaches in order to convince the local people of its benefits. In the case of the district heating systems they transferred the main responsibility for the projects to the local citizens. Furthermore, they educated local blacksmiths who then served as multipliers for the installation of individual heating systems.

Another means of increasing local acceptance for the 100%-RE-region projects has been shown to be the direct investment of the revenues from the renewable energies into the local infrastructure. In particular in Dardesheim and Varese Ligure the city centres have been restored which has created local pride and identification among the citizens.

59 Only in Varese Ligure the local citizens have had no opportunity to buy shares of the renewable energy plants.

As a result of the intensive efforts of citizen participation, approval rates for the 100%-RE-region projects are today very high in Dardesheim, Varese Ligure and on Samsø. In Lüchow-Dannenberg similar levels of approval have not yet been achieved.

Taking the findings of the four case studies into consideration, decision makers in other potential 100%-RE-regions are advised to adopt the comprehensive and time-consuming citizen participation approaches seen in Dardesheim and Samsø. Both regions have most definitely benefited from these efforts. However, if protagonists do not have the capacities for such an intensive citizen participation scheme, they should focus on activities to financially involve at least the households neighbouring the wind turbines or biogas plants.

The factor of size cannot be so easily assessed. The third hypothesis that correlates the small size of a region with an easier implementation of a 100%-RE-region project, was confirmed by Dardesheim and Lüchow-Dannenberg. In Dardesheim the interviewees Radach and Künne actually linked the success of the project to the characteristics of their small municipality, where people know each other personally, are exposed to proximity effects and perceive local improvements from renewable energy gains more directly. In contrast, there is a shortage of these local benefits for the renewable energy development in Lüchow-Dannenberg. As a result of the distance and the high number of citizens, the pioneers have not so far been able to reach and connect the majority of the local people to the project. In Varese Ligure the small size has had a similarly positive effect as that in Dardesheim, but at the same time the lack of human and financial resources made the whole project strongly dependent on only two pioneers and their ability to obtain external funds. On Samsø its larger size is perceived as an advantage rather than a constraint, as there is enough space for building of renewable energy facilities and yet the majority of citizens could still be involved in the project.. Samsø's geographical island conditions have

however been more influential on the 100%-RE-region project than its size.

The fourth hypothesis which suggests that larger 100%-RE-regions are more successful in gaining external recognition and influence has been rather rejected by the four case studies, as there seems to be no clear correlation between these factors.

On the whole, the findings of the four case studies are too different to draw recommendations on whether to launch a 100%-RE project in a smaller region or in a larger region. What can be learned from the case of Samsø (backed up by many other examples[60]) is that islands can provide very favourable conditions for the establishment of a 100%-RE-region project.

Additionally, a number of other factors have substantially affected the organisation of the four 100%-RE-region projects. They can be subsumed under the following five variables.

The first variable is the local political and administrative environment. In three of the four case studies the local political and administrative conditions have played a supportive role in the implementation of renewable energies. In Dardesheim, the local council as well as the administration have backed the development of renewable energies, in Varese Ligure the local mayors themselves have been the main driving force for the 100%-RE-region project and also on Samsø the local council has strongly supported the project, by amongst other things making a large investment in the offshore wind park. However, in Lüchow-Dannenberg the political environment has been more ambivalent, as the local politicians have proven to be generally open to renewable energies on the one hand, but on the other hand the non-cooperative atmosphere in the district council has impeded several renewable energy projects. According to both interviewees Schaarschmidt and Herzog the local administration has even turned out to be the strongest obstacle in the establishment of the

60 See http://www.europeanislands.net/ [19-08-2009].

100%-RE-region in Lüchow-Dannenberg.

The four case studies have shown that the organisation of a 100%-RE-region project is highly dependent on a supportive political and administrative environment. In particular the local mayors can act as influential agents liaising between the pioneers and the local citizens. One practical piece of advice could thus be to provide mayors interested in the topic with training about methods and opportunities offered by local renewable energy development.

A second variable is the local economic conditions. It is noticeable that in all four regions the 100%-RE-region concept was introduced during periods of economic decline. The regions were exposed to structural change with in particular, many jobs being lost in the agricultural sector during the 1980s and 1990s. As a result of rising unemployment the migration balance had developed negatively in all the regions and in particular many young and well educated citizens had been moving away.

In Varese Ligure and on Samsø the pioneers deliberately campaigned for the implementation of the 100%-RE-region projects as a means to address this economic decline. They rightly argued that renewable energies have proven to fit in well in structurally weak regions, as they can be used in a decentralized manner and wind and bio energies need space so face less resistance in areas with low population density. In fact, the local economies of all four regions highly benefited from the broad introduction of renewable energies. The 100%-RE-region projects created new employment in trade and tourism. Thereby, the migration numbers were reduced and in the case of Varese Ligure the migration balance has even turned positive during recent years.

Two methods in particular can be recommended to other 100%-RE-region projects in order

to help them create local added value and employment. Firstly, motivate the investors in renewable energy systems to get the installations built and maintained by local craftsmen (as the investor Bartelt did in Dardesheim). Secondly, provide renewable energy trainings for blacksmiths and other craftsmen so that they can carry out such work and further act as local multipliers for renewable energy (as successfully demonstrated on Samsø).

The third variable is the relations with the grid operator. Generally, the relations between the protagonists of the 100%-RE-region projects and the grid operator are of importance because the renewable energy plants have to be connected to the grid. In the cases of Dardesheim, Varese Ligure and Lüchow-Dannenberg, these relations were also important due to the discussions about the repurchasing of the local grid from the operator.

However, only in one of the four regions is the grid operator clearly perceived as an obstacle for the organisation of the 100%-RE-region, the protagonists in Varese Ligure criticise the expensive and slow grid integration of their wind turbines. In Lüchow-Dannenberg local grid operator Eon Avacon was sceptical about renewable energies at the beginning of the project but has become more interested in renewable energy development over the past few years. Today, the renewable energy plants' connection with the grid complies with regulations and the only area of conflict between the protagonists of the 100%-RE-region project and Eon Avacon is the discussion regarding a potential grid disengagement. Due to their joint involvement in the Model Region Harz project, relations between the pioneers and grid operator Eon Avacon are rather good in Dardesheim, although the debate about grid disengagement could eventually result in a law suit. On Samsø the protagonists in the 100%-RE-region project highlight the cooperative and proactive role of regional grid operator NRGi.

With the exception of Varese Ligure the grid operator has not turned out to be a decisive

factor for the establishment of the 100%-RE-region projects so far. This could however change in Dardesheim and Lüchow-Dannenberg, if the protagonists finally opt to disengage from the grid in the coming years. Generally, the findings indicate that with regard to grid integration, country-specific conditions require analysis. Protagonists from other potential 100%-RE-regions are therefore advised to look closely at the legal framework for the integration of renewable energies into the grid in their respective countries.

The fourth variable is the renewable energy network. As the four regions were among the first to pursue a 100 percent renewable energy supply, they could not refer to the long-term experiences of other 100%-RE-regions. However, the pioneers in Lüchow-Dannenberg did collaborate closely with pioneers from other regions throughout Europe in the development of the concept of the 100%-RE-region. Moreover, in the implementation of the first wind turbines and biogas plants the pioneers were backed up by the experiences of previously installed plants in other regions. Likewise the example of Samsø shows how pioneers learned from existing projects that focused on single renewable energy systems in Denmark and Germany, before bringing them together in the 100%-RE-region project. In Dardesheim the protagonists organized visits to other 100%-RE-regions at the beginning of the project in order to convince the local citizens and recently a concrete exchange of experiences with the 100%-RE-region of Wolfhagen was established. Only in Varese Ligure are the networking activities used solely to promote the sustainable community elsewhere in Italy rather than for the region itself to learn from others.

Three of the four 100%-RE-regions have thus deliberately made use of the experiences from other projects elsewhere for their local implementation of renewable energies. Today, these pioneer regions look back on ten or more years of experience and present themselves as models for other regions that adopt similar renewable energy goals. As previously

mentioned a number of official networks have been established during recent years where 100%-RE-regions can exchange knowledge and promote their projects (see chapter 1.1). Regions that plan to implement a 100%-RE-region project and also those that are still in the initial phase would be well advised to join these networks and learn from the pioneer regions' experiences.

The two external factors of support schemes for renewable energies and resource prices form the fifth variable. These top-down factors are not directly influenced by the regions but as my research suggests they can have a significant impact on the performance of the 100%-RE-region projects.

As renewable energies cannot yet compete with fossil fuels, 100%-RE-regions still strongly rely on external financial support. The two German regions of Dardesheim and Lüchow-Dannenberg benefited from the EEG which is a very ambitious and stable national support scheme for renewable energies. Until 2002, the Danish support scheme was similarly advanced, which enabled Samsø to start its 100%-RE-region project. But after a change in the ruling party after the 2002 election, support for renewable energy broke down and as a consequence the project almost had to be scrapped. The Italian support scheme for renewable energies provides rather unstable conditions and has been perceived as an obstacle by the pioneers of Varese Ligure from the beginning of the 100%-RE-region project onwards. The four wind turbines could only be financed because pioneer Caranza managed to obtain EU funding and close a direct deal with the local electricity company.

The profitability of renewable energy heating installations depends on the unstable resource prices for biomass (mainly wood and straw) and the international oil and gas prices. Due to the special island conditions the four district heating systems on Samsø provide heat at profitable prices. In Dardesheim and Lüchow-Dannenberg plans for district heating systems

have not been carried out so far due to high commodity prices for biomass. However, the new national Heat Act which was introduced by the government in January 2009[61] could improve the conditions for district heating systems in Germany. In reaction to the lack of national funding from the Italian government, the municipality of Varese Ligure has just started a project to promote the local production of wood pellets. Thereby, the pioneers aim to increase the number of individual heating installations based on renewable energies. The success of this project is still unconfirmed. However, the promotion of local biomass for heating installations could be the right means to minimise the impact of rising commodity prices not just in Varese Ligure but also in other 100%-RE-regions.

61 http://www.bmu.de/english/renewable_energy/downloads/doc/42351.php [19-08-2009].

4 Open Questions and Future Research

As previously stated, the output of this case study analysisare hypotheses. It was thus not the objective of this study to induce generalizable recommendations about the best ways to organise a 100%-RE-region. What can be derived from the lessons learned of the four case studies is an orientation about which variables should be focussed on, that could be of use for both protagonists in 100%-RE-regions as well as for researchers.

In order to consolidate the findings, more 100%-RE-regions have to be analysed. According to Jan Jantzen from the Energy Academy on Samsø, a useful piece of future research could be the development of a theoretical framework to investigate and classify 100%-RE-regions. DeENet (2009) rose to this challenge for Germany and similar projects in other countries could provide a database for a framework with broader scope. Thereby, an alternative application of Roger's Diffusion of Innovations model could serve as a theoretical foundation, focussing on the adoption of the strategy (or policy decision) in becoming a 100%-RE-region. In this case, the decision-making units are the regions and the social system is a national state or the European Union. The investigation could then look at which conditions aid the implementation of a 100%-RE-region strategy and how the strategy spreads across countries or the European Union.

A more comprehensive analysis of 100%-RE-regions can also clarify to what extent frontrunner regions, like the four in this study, can actually serve as role models. For instance, the early 100%-RE-regions that were analyzed in this study have been highly dependent on their pioneers' extraordinary personalities and engagement. They have furthermore benefited from high media attention which future 100%-RE-regions may find more difficult to attract due to the waning novelty of the projects. Can the experiences of

the early 100%-RE-regions still be used to generate guidelines that are also applicable to regions which lack such favorable leadership and media recognition?

Another emerging field of research is the development of local renewable energies in urban areas. The four 100%-RE-regions in this study are all located rurally and cover populations from less than 1000 inhabitants (Dardesheim) up to around 50,000 inhabitants (Lüchow-Dannenberg). The next step will be to provide cities with 100 percent renewable energies. As the energy demand for cities is much higher and space is limited, a full supply with renewable energies is much harder to achieve. Yet, in the last few years a couple of European cities have decided to pursue this ambitious goal.[62] An important research question will be whether the same variables in the rural 100%-RE-regions can be applied to these cities.

Of similar interest is whether it will be possible to achieve 100 percent renewable energies in a whole country or even a collection of countries such as the European Union merely through numerous bottom-up initiatives or whether top-down policies are required to achieve this goal, in other words: what are the limits of local renewable energy development? This question has already been in part addressed by this study. Even the four frontrunner 100%-RE-regions depend highly on government policies, in particular on ambitious and stable national support schemes for renewable energy. Furthermore, none of the four regions has yet been able to disengage from the regional or national electricity grids. Thereby, a controversial question is whether self-sufficiency should be the next step. Pilot projects like the Model Region Harz are evidence of a permanent full supply with renewable energies operating under real conditions. The experiences of these projects will have to be assessed to decide if the widespread grid disengagement of regions is

62 See http://www.energie-cites.eu/ [19-08-2009]. In March 2009, Copenhagen as the world's first capital decided to become CO_2-neutral by 2025: http://en.cop15.dk/climate+consortium/news/view+news?newsid=935 [19-08-2009].

technologically but also politically and economically feasible.

The underlying discussion is whether bottom-up or decentralized development of renewable energies is in the long term a more efficient approach to achieving 100 % renewable energies than an integrated European network of centralized renewable energy parks. Or how a mix of decentralized and centralized renewable energy systems can be realized.

The dependency of 100%-RE-regions on external factors is most obvious in the transport sector. The regions are too small to develop their own solutions, so they are reliant on technological progress, the future market orientation of car companies and on state funding.

A rewarding contribution to future research would also be an analysis of the conditions and potential of 100%-RE-region projects outside the European Union, in other industrialized countries as well as in developing and newly industrialized countries.

5 Conclusion

The four case studies of Dardesheim, Varese Ligure, Samsø and Lüchow-Dannenberg have shown how the ambitious idea of developing a 100 percent renewable energy supply can be successfully implemented. About one decade after the start of the 100%-RE-region projects, the levels of advancements are rather different. Yet, all four regions have managed to locally develop remarkable shares of renewable energy in their supply.

The aim of this study was to find out what the main factors are that have enabled the four regions to become frontrunners in a local renewable energy supply. Two of the four hypotheses that were deduced from the theoretical approaches of Rogers' Diffusion of Innovations and Putnam's and Feldstein's Social Capital are verified by the case studies. The positive role of engaged local pioneers (hypothesis one) and the high degree of citizen participation (hypothesis two) stand out as decisive factors of success in the regions analysed. The anticipated correlation between small size and a successful implementation of a 100%-RE-region (hypotheses three) is only backed by two of the case studies, while a coherence between large size and external influences on the 100%-RE-regions (hypothesis four) is not evident.

Beyond that, five other factors have proven to be influential for the four 100%-RE-region projects. They provide the basis for the additional hypotheses generated by this study.

1. The organization of a 100%-RE-region project depends highly on a supportive political and administrative local environment.
2. Structurally weak regions offer particularly favourable conditions for local renewable energy development.
3. A supportive legal framework on the integration of renewable energy applications

into the grid is more important for 100%-RE-region projects than good relations with the grid operator.

4. In the implementation of a 100%-RE-region project, protagonists strongly benefit from broad networking activities with other local renewable energy initiatives.
5. The success of a 100%-RE-region project still depends on external factors, in particular on ambitious and stable support schemes for renewable energies and on resource prices.

Finally, one remark regarding the data collection for the case studies which can be seen as both a a strength and a weakness of this study. The main source of information is eight expert interviews with protagonists from the 100%-RE-regions. Most of them have participated in the projects from the beginning on and are thus able to recapitulate very detailed information regarding the conditions affecting the decision and implementation of the 100%-RE-region projects. One could rightly argue that only actors have been consulted who principally support the projects, the reason for this is however that during my visits to Samsø, Dardesheim and Lüchow-Dannenberg I actually did not manage to find any public opponents of the 100%-RE-region projects who would agree to an interview. When I asked the members of the Energy Academy on Samsø if they could help me meet sceptics of the project I was told that journalists regularly ask the same question. Søren Hermansen then recounted the anecdote that some years ago they sent a journalist to a local citizen who they thought was the strongest opponent of the 100%-RE-region project. The citizen then called them later that day to somewhat indignantly state that he had been a supporter of the project right from the very beginning.

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Appendix 4: Maps and Pictures of Regions

Map of Germany with location of Dardesheim

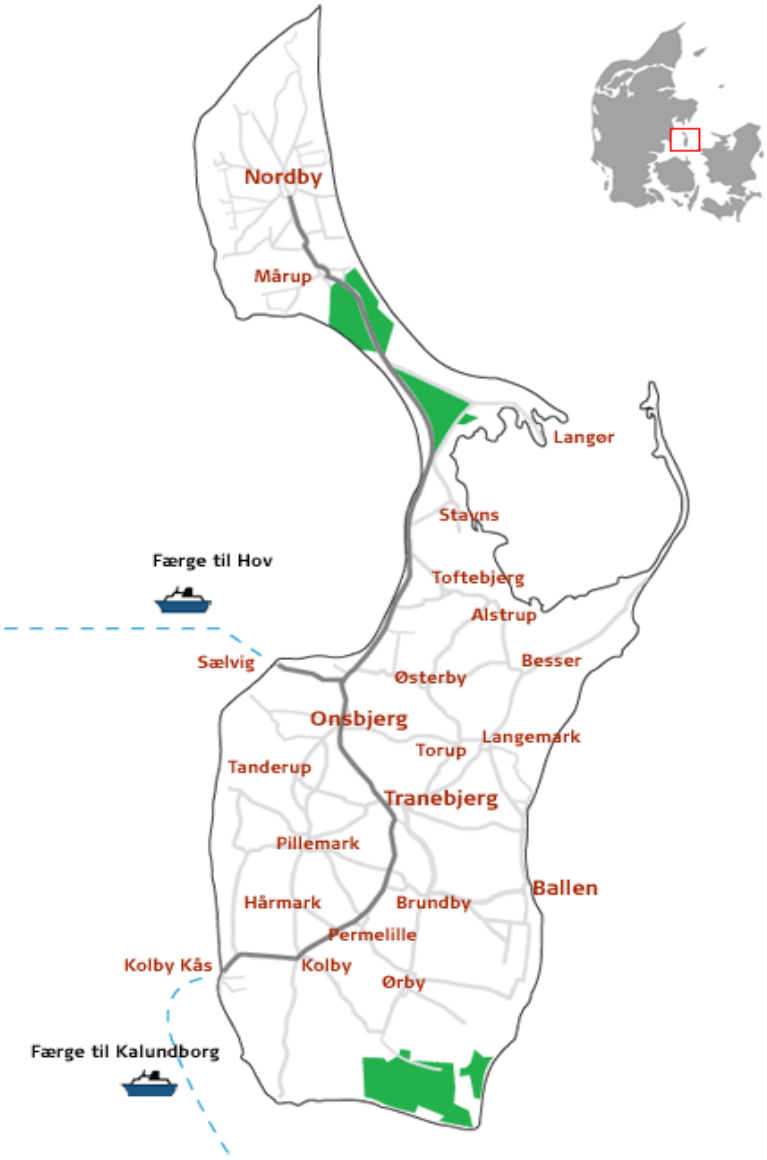
(www.spedition-kalbitz.de/index.shtml?anfahrt):

Picture of Dardesheim and the wind park "Druiberg"

(http://www.energiepark-druiberg.de/galerie.php?id=dardesheim)

Map of Samsø

(http://www.Samsøeturist.dk/index.php?page=om-Samsø):



Map of district Lüchow-Dannenberg in Germany:

(http://de.wikipedia.org/wiki/Datei:Lage_des_Landkreises_L%C3%BCchow-Dannenberg_in_Deutschland.GIF)