People-Powered
Local Energy Transition

Mitigating Climate Change with Community-Based
Renewable Energy in North Frisia

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People-Powered Local Energy Transition:

Mitigating Climate Change with Community-Based Renewable Energy in North Frisia

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Eidesstaatliche Erklärung

Hiermit versichere ich an Eides statt, dass die vorliegende Arbeit Ergebnis meiner eigenen Anstrengungen ist und lediglich unter Benutzung der aufgeführten Hilfsmittel von mir selbst verfasst wurde.

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Abstract

Climate change has been recognised as a societal challenge demanding transformation in our social and economic systems in order to adapt to expected climatic changes and to mitigate a temperature increase above 2 degrees Celsius. Discussions on mitigating climate change revolve around the question of how to enable low-carbon energy transitions based on renewable-energy technologies such as wind turbines, solar panels, biogas plants or geothermal plants. Such a transition initiates a physical (re)shaping of places and social change in communities. Individual households and communities are increasingly acknowledged as making important contributions in energy transition, driven by the emergence of community wind farms, energy cooperatives and initiatives etc. This growing recognition has led to the fact that *citizen's energy* and *community renewable energy* are high on the political agenda. Although 'community renewable energy' emerged as a grassroots-based innovation concept, the local places of energy transition and their underlying social processes and structures are insufficiently studied and often remain underestimated. What place-based social and geographic aspects enable communities to become the places of local energy transition?

The present research work encounters this question by applying a place-based perspective on mitigating climate change with renewable-energy technologies, seeking an in-depth understanding of the multifaceted and complex nature of the social phenomenon of community-based renewable energy. In order to analyse and deal with the complexity of the system, the investigation focussed on place, local agents and their relationships and interactions. A place-based approach considers climate change and renewables in people's localities; accounts for places as sources of experiences, memories, knowledge and innovation; and represents local benefits and challenges of mitigating climate change with community renewables. Along four main chapters, several analytical and theoretical concepts have been merged and their interdependencies analysed: these include place attachment (Manzo & Devine-Wright 2014); psychological distance of climate change (Milfont 2010; Spence et al. 2012); climate-change engagement (Lorenzoni et al. 2007; Whitmarsh et al. 2011); locally embedded entrepreneurship (Feldman & Kogler, 2010; Audretsch et al. 2012); adoption behaviour and innovation diffusion (Ajzen 1991; Rogers 2003); and the community benefits of renewables (Rogers et al., 2008; IZES, 2015). This conceptual approach enables the exploration of both climate change as a catalyst and also its materialisation in community renewables.

To study the social side of the development of local renewable-energy transition, this research involved empirical research in the district of North Frisia, Germany, with a special focus on the municipality of Reußenköge. North Frisia is a coastal region with both climate-change vulnerability and renewable-energy potential. In the last three decades, the coastal municipality of Reußenköge has developed from an average agricultural centre into a so-called model region for the generation of renewable energy, implying a transformation from agriculturalists into *energy*-culturalists. Reußenköge represents a recent case study for examining the social processes underlying the implementation of renewable-energy technologies in coastal areas. For this examination do be carried out, a mixed-methods approach was applied in the present research, which allowed the analyses of different facets of the phenomenon of community-based renewables and its interaction with the social system under consideration. Five different research methods were conceptually combined: review and analysis of the literature, policy documents and online news; semi-structured interviews; group discussions; a standardised household survey; and agent-based modelling. The employment of diverse and complementary methods for focusing on specific, emerging and dynamic themes revealed different developmental layers contributing to community renewables.

The empirical findings conceptually and empirically demonstrate the relevance of people's socio-geographic embeddedness for how they relate to and engage with climate change and community-based renewable energy. People's individual and shared place meanings are important ingredients bearing a decisive impact on the ways people make sense of climate change and the decisions to adopt or reject renewables. Common interest and participation in community-based renewable-energy projects, as well as the differentiated characteristics of the local entrepreneurs involved, appeared to be highly relevant for the acceptance and support of community-based projects. Recognising the findings, one can assert that an innovative place-based concept of community renewables provides essential benefits to individuals, the municipality and regions offering the potential to overcome social problems and to enhance sustainable regional development. Nevertheless, community-based actions have limitations, and it should be thus highlighted that support of regional and national governments is essential for long-term adaptation to and mitigation of natural and climate-change driven phenomena. Climate and energy policies, funding schemes and administrative structures should essentially recognise local socio-geographic elements, interactions and processes in order to enhance and foster a sustainable, place-based, socially embedded and decentralised energy transition.

Kurzfassung

Der Klimawandel stellt eine gesellschaftliche Herausforderung dar, die eine Transformation sozialer und ökonomischer Systeme notwendig macht, um sich an zu erwartende Klimaveränderungen anzupassen und einen Temperaturanstieg über 2 Grad Celsius zu vermeiden. Diskussionen zur Klimawandelabschwächung, der sogenannten Mitigation, verdichten sich zu der Frage, wie eine CO_2-arme Energiewende basierend auf Erneuerbaren Energietechnologien, wie Windanlagen, Solaranlagen, Biogasanlagen und Erdwärmepumpen, vorangetrieben werden kann. Eine solche Wende führt in den meisten Fällen zu einer physischen (Um-)Gestaltung von Orten und einem sozialen Wandel in Gemeinden. In diesem Kontext hat die Bedeutung individueller Haushalte und Gemeinden in der Energiewende zunehmende Aufmerksamkeit erlangt, wozu die Entstehung von Bürgerwindparks, Energiegenossenschaften und –initiativen etc. maßgeblich beigetragen haben. Dies führte dazu, dass die Bürgerenergie als auch „Erneuerbare Gemeindeenergie" (*community renewable energy*) deutlich an politischer Bedeutung gewonnen haben. Obwohl sich die Erneuerbare Gemeindeenergie als Graswurzel-basiertes (*grassroots-based*) Innovationskonzept etabliert hat, ist das Verständnis für die lokalen Orte der Energiewende und die zugrundeliegenden sozialen Prozesse und Strukturen unzureichend erforscht, so dass ihre Potenziale oftmals unterschätzt werden und unausgeschöpft bleiben. Es stellt sich also die Frage, welche ortbasierten sozialen und geografischen Aspekte es Gemeinden ermöglichen zu den Orten einer lokalen Energiewende zu werden?

Die vorliegende Arbeit widmet sich dieser Frage unter Anwendung einer ortsbasierten (*place-based*) Perspektive zur Vermeidung des Klimawandels mit Erneuerbaren Energietechnologien. Ziel ist es, ein tiefgreifendes Verständnis über die vielseitige und komplexe Natur des sozialen Phänomens der Gemeindebasierten Erneuerbaren Energie zu erlangen. Ortskonzepte, lokale Akteure sowie deren Beziehungen und Interaktionen unter- und miteinander standen als analytische Ansatzpunkte im Fokus der Untersuchung, um die Komplexität des Systems zu verstehen und um mit ihr umzugehen. Insofern konzentriert sich ein ortsbasierter Ansatz auf die Örtlichkeit der Menschen, veranschlagt Orte als Ursprung von Erfahrungen, Erinnerungen, Wissen und Innovation und erforscht lokale Möglichkeiten und Herausforderung, die mit der Klimawandelabschwächung durch Gemeindeenergie einhergehen. Im Rahmen der vorliegenden Arbeit werden theoretische und analytische Konzepte von Ortsbindung (Manzo & Devine-Wright 2014), psychologischen Distanzen von Klimawandel (Milfont 2010; Spence et al. 2012), unterschiedliche Relationen zum Klimawandel (Lorenzoni et al. 2007; Whitmarsh et

al. 2011), lokal verankertes Unternehmertum (Feldman & Kogler, 2010; Audretsch et al. 2012), Adaptionsverhalten und Innovationsverbreitung (Ajzen 1991; Rogers 2003) sowie Gemeindenutzen von Erneuerbaren (Rogers et al., 2008; IZES, 2015) konzeptionell zusammengeführt und deren Wechselwirkungen analysiert. Diese Vorgehensweise ermöglichte es Klimawandel als Katalysator und dessen Materialisierung in Erneuerbarer Gemeindeenergie zu erforschen.

Um die soziale Dimension der Entwicklung einer lokalen Energiewende zu untersuchen, wurde eine empirische Forschung in Gemeinden im Kreis Nordfriesland, Schleswig-Holstein (Deutschland) und im Speziellen in der Gemeinde Reußenköge durchgeführt. Nordfriesland ist eine Küstenregion zwischen Klimawandelvulnerabilität bzw. -verwundbarkeit und Erneuerbaren Energiepotential. In den letzten drei Jahrzehnten hat sich die Region von einer ursprünglich landwirtschaftlich geprägten zu einer sogenannten Modellregion der Erneuerbaren Energien entwickelt und damit einhergehend einen Wandel von Landwirten zu Energiewirten erfahren. Aus diesem Grund eignet sich Reußenköge dafür, die sozialen Prozesse, die die Umsetzung von Erneuerbaren Energietechnologien in Küstenregionen mitbestimmen und antreiben, zu untersuchen. Ein Methodenmix (*Mixed-Methods Approach*) ermöglichte es, die diversen Facetten des Phänomens der Gemeindebasierten Erneuerbaren Energien und deren sozialen Aspekte für das System Reußenköge zu analysieren. Fünf verschiedene Forschungsmethoden kamen zum Einsatz und wurden konzeptionell miteinander verknüpft: eine Analyse der Forschungsliteratur, von Politikdokumenten und online Neuigkeiten, semistrukturierte Interviews, Gruppendiskussionen, eine standardisierte Haushaltsbefragung und Agenten-basierte Modellierung. Zur Fokussierung auf im Forschungsprozess sich entwickelnde Themen wurden diverse und komplementäre Methoden verwendet, die verschiedene Entwicklungsebenen erforschen halfen, die zur Gemeindeenergie beitragen.

Die empirisch gesättigten und erarbeiteten Ergebnisse belegen die empirische Relevanz des sozial-geografischen Ansatzes für die Beteiligung an der Thematik des Klimawandels und Gemeindebasierten Erneuerbaren Energien. Individuelle und geteilte Ortsbindung sind wichtige Bestandteile, die eine ausschlaggebende Auswirkung darauf haben, wie Menschen Klimawandel wahrnehmen und Entscheidungen für die Einführung oder Ablehnungen von Erneuerbaren treffen. Ein gemeinsames Interesse und eine kollektive Partizipation in Gemeindebasierten Erneuerbare Energieprojekten sowie die differenzierten Eigenschaften von den lokalen involvierten Unternehmern sind – das zeigen die Ergebnisse – von großer Bedeutung für die Akzeptanz und Unterstützung solcher Projekte. Die vorliegenden

Ergebnisse deuten darauf hin, dass ein innovatives, ortsbezogenes Konzept von Erneuerbarer Gemeindeenergie einen wichtigen Nutzen für Individuen, die Gemeinden und die Region generiert und das Potential birgt, eine sozial eingebettete und nachhaltige Regionalentwicklung zu fördern. Trotzdem stellen Gemeindeaktivitäten kein Allheilmittel für die Implementierung erneuerbarer Energien da, da eine strukturell administrative und ökonomische Unterstützung durch regionale und nationale Regierungen unabdingbar für eine langfristige Anpassung an und Abschwächung von natürlichen und anthropogenen Phänomenen des Klimawandels ist. Klima- und Energiepolitik, Förderungsmaßnahmen und administrative Strukturen sollten daher insbesondere die lokalen sozialen und geografischen Elemente, Interaktionen und Prozesse genauer in Betracht ziehen, um eine nachhaltige, ortsbezogene, sozial eingebettete und dezentrale Energiewende zu fördern und zu stärken.

Community wind farm in Reußenköge, September 2014

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ABM(s)	Agent-based model(s)
CC	Climate change
CCS	Carbon capture and storage
COP	Conference of the Parties
EEG	Renewable Energy Sources Act
EU	European Union
GIS	Geographical Information System
IR	Interview Reußenköge
IN	Interview North Frisia and Kiel
IPCC	Intergovernmental Panel on Climate Change
SR	Survey Reußenköge
UN	United Nations

Raps field with windmills, Reußenköge (*Rapsfeld mit Mühlen*)
Acrylic paint by the regional artist Gesche Nordmann, 2015[1]

1   Introduction

Right now we are in a window where we can turn the crisis of climate change into an opportunity by pushing for an energy revolution on the scale of the industrial revolution, which could create a serious jobs bonanza and can give us a double win for the economy, jobs and climate.

Kumi Naidoo

This quotation from Kumi Naidoo (former Executive Director of Greenpeace International) highlights the relationship between climate change and energy. In line with Naidoo, scientific consensus has emerged over recent decades that climate change is a common threat to mankind, predominantly driven by anthropogenic greenhouse gas emissions which are largely caused by the energy supply sector (IPCC, 2011, 2014a; IEA, 2015). Thus, low-carbon energy transition appears to be an important solution to climate change, though a deeper and improved understanding of connected social transformations, circumstances and processes is imperative to encourage such a transition. To study the social side of energy transition, this doctoral thesis applies a mixed-methods approach for investigating place-based social and geographic dimensions affecting human perceptions and choices for local renewable-energy transition in a world of climate change.

1.1   Embeddedness of the study

Climate change is a slowly advancing and dynamic process which is scientifically and socially constructed through statistical observations of meteorological phenomena, quantification and measurements, and it also holds an important function in the context of human experiences, memories, learning's, norms and expectations about future climatic changes (Gifford, 2008; Hulme, 2009; Leyshon, 2014). Thus, climate change is a socio-physical phenomenon with widespread impacts on human and natural systems, such as the global warming of the atmosphere and oceans, declining ice caps and glaciers, rising sea levels and changes in extreme weather events affecting human security, social stability and natural resources (Scheffran et al., 2012; IPCC, 2014b). These actual and expected impacts of climate change induce non-linear and unevenly distributed changes that materialise on the regional level and considerably contribute to changes in the social fabric of regions, communities and places (Adger, 2006; IPCC, 2014b). Because climate change is altering both physical and social

systems, 'climate change [can also be treated as the] unfolding story of an idea and how this idea is changing the way we think, feel and act' (Hulme, 2009:xxviii). Regional framings of climate change are formed by different people in different places, and they are based on cultural, social, political and moral settings impacting mental representations proximate or distant, the engagement with climate change and the course of actions performed (Hulme, 2009; Milfont, 2010; Spence et al., 2012; Döring & Ratter, under review). Thus, the social challenge of climate change requires regional approaches and solutions in order to reveal the local relevance of climate change and to deal with climate-induced changes of place, such as rising water levels, drying soils and the like (Devine-Wright, 2014). While such place changes may alter the meanings and attachments people associate with those places, people's responses to climate change are considerably influenced by people-place relations. Research increasingly recognises the relevance of individual and shared place meanings and attachments for understanding individual and collective engagement with and response to climate change (Manzo & Perkins, 2006; Gee, 2010; Scannell & Gifford, 2010a; Devine-Wright et al., 2015b). Nevertheless, the opportunity and potentials of a place-based perspective for analysing and understanding human behaviours in the context of climate change, for example within the energy transition, remain to date fairly under-investigated and unused. Hence, this research investigates this potential by providing 'grounded' research on regional climate change.

'We have to solve the energy issue in order to solve the climate issue' is a common conviction urging the need for global *energy transition* (known as *Energiewende*). The recently confirmed stabilising of energy-related greenhouse gas emissions due to the critical increase in electricity generated by renewables has been stated as a boost for global climate actions, just few months after the 21st Conference of the Parties (COP21) climate agreement in Paris (IEA, 2015). On the COP21, 196 UN member states agreed on 'holding the increase in the global average temperature to well below 2° C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5° C above pre-industrial levels' (UN, 2015:22, Article 2). On the 22nd of April – the Earth Day – this Paris climate agreement has been signed by 175 countries (UN, 2016). To meet mitigation pledges, reductions of anthropogenic greenhouse gas emissions by 40-70% below current levels by 2050 are required (IPCC, 2014a). A transformation of the world's energy systems is therefore needed, based on decreased energy use, increased energy efficiency and increased use of renewable-energy sources, namely wind, solar, water, biogas or geothermics. Renewable-energy sources have much

potential to pave the way towards a decarbonised and more decentralised energy supply, and to contribute to sustainable development, energy access, security of energy supply and – finally – reductions of emissions-induced health impacts (WBGU, 2003; IPCC, 2011). Consequently, the transition from fossil fuels to renewable energy is one major issue in the climate-change debate, besides other challenges such as deforestation and increasing livestock farming (UN, 2015).

However, the transition towards a sustainable, low-carbon energy supply is not a straightforward and linear process but rather an adaptive and iterative endeavour. Energy transition encompasses technological, ecological, social, economic and institutional challenges. Overcoming these challenges requires creativity, innovation, technology, resources and action. While several studies show that energy transition is technically and economically feasible, it is rather conceived as a transformative challenge and socio-cultural issue (WBGU, 2003; IPCC, 2011; Henning & Palzer, 2015; Teske et al., 2015; Field, 2015). Reliance on technology alone is insufficient because their development and adoption basically require public support (Bows et al., 2006). Thus, beyond the technological innovation of renewable-energy technologies, the need to study social dynamics and processes remains, as these social factors create places of and for energy transition and communities with interest in renewables (Lowe & Feldman, 2008). This research addresses this knowledge gap by asking how such social innovation pathways and the empowerment of communities could be enabled and set in motion (Walker & Cass, 2007; BMUB, 2009; HM Government, 2010).

The 'energy (r)evolution' has already started (Teske et al., 2015). Energy independent islands, transition towns, community wind farms, energy cooperatives and initiatives, and energy self-sustaining households physically (re)shape and socially transform regions and places. However, for a successful energy transition, efforts in the spheres of politics, economy and society are required, involving different agents such as national governments, companies, non-governmental actors and local households. Energy transition is characterised by an agent diversity which mobilises a vast range of energy-users: from pure energy consumers to energy producers and 'prosumers'. Individual households and communities have been increasingly recognised in public discourse and policy for their important contributions to a sustainable and successful energy transition (HM Government, 2010; Ethikkommission, 2011; BMUB, 2014; DECC, 2014a). Mainly in the German context, the term *citizen energy* has been shaped by regionally located citizens (private individuals and commercial or agricultural sole traders) who became joint owners of wind or solar farms and undertook investments in locally

managed wind turbines (locally often named windmills), solar installations (photovoltaic or solar heat), biogas plants and geothermal plants (IZES, 2015). For example in Germany, almost 50% of the installed renewable-energy power is owned by citizens as private owners or through types of collective ownership (AEE, 2014). Due to this development, the noun 'community' has been increasingly associated with energy projects, energy initiatives and energy policies encompassing collective efforts (*com*, Latin: with or together) and individual initiatives (*unus*, Latin: the number one or singularity) (Delanty, 2010). *Community renewable energy*, or *community renewables*, has developed into a hyponym comprising small-scale and local renewable energy-generating social groups that can also be conceptualised as grassroots innovation for renewable-energy generation (Walker & Cass, 2007; Seyfang & Smith, 2007; Walker & Devine-Wright, 2008).

However, the transition towards local and decentralised renewable-energy generation was not always uncontroversial and quite often resulted in local conflicts. Although, historically, energy extraction has always (re)shaped landscapes – e.g. through deforestation or coal mining – a renewable energy–based transition causes new changes and challenges for communities and local places, which are not accepted, per se. On the one hand, people exhibit a general openness towards renewable forms of energy generation, while on the other hand, they show resistance to its implementation and expansion in their locales (Toke, 2005; Devine-Wright & Howes, 2010). For example, in Germany, up to 93% of the population supports the expansion of renewable energy technologies, and 63% even support electricity generation in their neighbourhood (AEE, 2015a). However, in regions where renewables and electricity grids are planned, local resistance is still a 'hot topic' in public and political debates. Thus, the acceptance of renewables has been identified as the main barrier to adopting an energy supply based on renewable energy technologies. The concept of *'not in my back yard'* (NIMBY) has been applied in social science research to explore objections on the regional and local scale (review by Burningham et al., 2006). However, the concept uses a rather *ex negativo* perspective and has been criticised as failing to explore how objection or support related to community renewables is embedded in socio-geographic places and local communities (Burningham, 2000; Devine-Wright, 2014). Consequently, I propose a shift towards a '*yes, in my back yard*' perspective, a perspective that frames place as a resource for initiating and supporting innovative and entrepreneurial activities, as well as transition processes towards community renewables and new energy landscapes. But how do local

places encourage and sustain a local energy transition? And how do the physical and social dimensions of these developments alter places and transform communities?

1.2 Objectives and guiding questions

Based on the aforementioned background and motivations for a climate-oriented energy transition, an analysis and understanding of the social and geographical aspects of the development of renewable energy technologies in local places and communities is pivotal to facilitate such transition. Thus, the overall objective of the present research is to investigate people's place-based perspectives on mitigating climate change with renewable energy technologies, in order to contribute to a better understanding of how local energy transitions could be enabled, facilitated and sustained.

To understand climate change–driven local energy transition as social phenomenon, the analysis centres on place, local actors, relationships and interactions on a community-level. In the analytical framework of this research, communities are considered complex and multi-layered units characterised by non-linear and dynamically twinned social structures and processes (Figure 1.1). This implies that community is considered as a social and complex system defined by different structural entities and their innate relationships, while a *process* is considered an 'ongoing flow of action/interaction/emotions [of agents] occurring in response to events, problems, or as part of reaching a goal' (Corbin & Strauss, 2008:247).
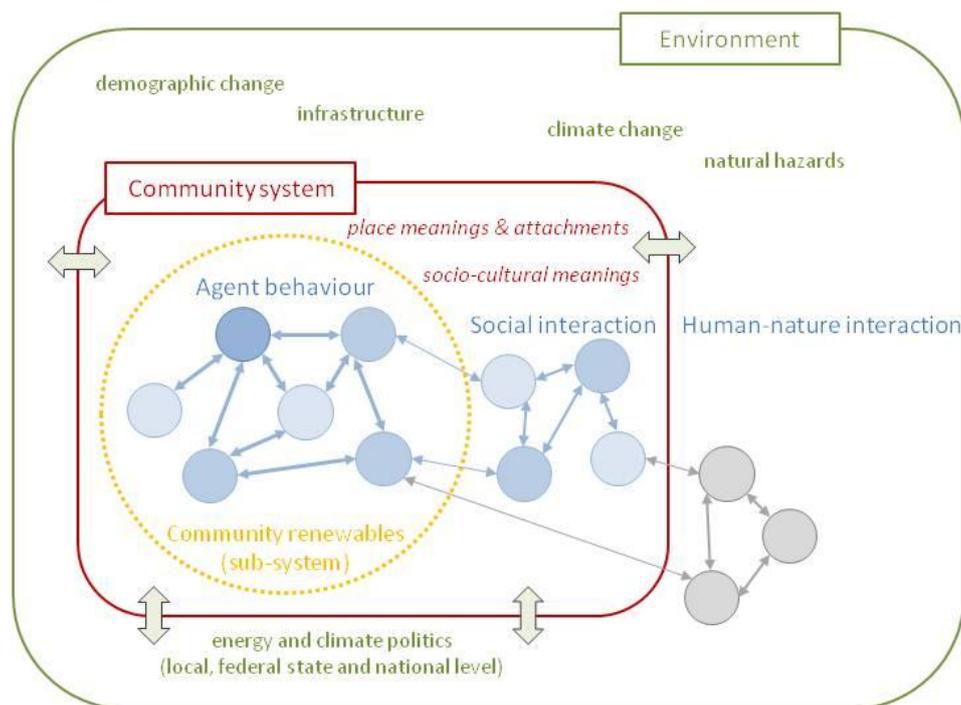
Figure 1.1: Investigated complex community system

To investigate the community system, an agent-based and a place-based approach have been explored and merged. An agent-based approach is conceptually informed by complexity theory, which provides a heuristic framework for studying system components, their interactions and the relationships between different subsystems and emerging phenomena. *Agents* are conceived as heterogeneous decision-making entities, typically individuals, firms, organisations or, as in the presented case, individual households. These individual households might be part of the sub-system named community renewables, whilst this association with it is assumed to be dynamic. Individual households act and interact with each other and are in exchange with their social and natural environment. Thus, households influence and are influenced by developments inside and outside the community system. A system perspective enables both the exploration of the social and complex nature of the individual behaviour of heterogeneous households who identify, evaluate and exploit the opportunities of renewable energy technologies, and the study of the emerging patterns and structures of local energy transition on a macro level.

To explore the community system embedded in a spatial dimension, a place-based approach to climate change and community renewables is applied because – so far – attention has rarely been devoted to local places and communities as spatial and analytical units (Devine-Wright, 2015a). This study thus contributes to recent research on community renewable energy and on the relevance of local places and communities in the energy transition, going beyond the methodological and analytical scope inherent in analyses of perceptions, descriptive opinion surveys or NIMBY-based studies. It addresses place meanings, emotional attachments, cultural values and social norms to investigate 'emplaced' meanings of climate change and renewable energy. The overarching research question can be thus formulated as follows:

What place-based social and geographic aspects enable communities to become the places of a local energy transition?

The main objective and guiding question are led by sub-questions represented in key themes which emerged in the course of the research process. These four themes form the chapters of the study. The first sub-objective addresses the ways people make sense of climate change and their situatedness in the local places. Here, theoretical insights provided by research on psychological distances and engagement combine with empirical evidence taken from semi-structured interviews and a household survey. The study used the method of *grounded*

theory (Charmaz, 2014; Corbin & Strauss, 2015) for the data analysis and theory development aimed to identify emerging themes and to provide 'grounded' data. The following guiding question was formulated:

1 How are people's ways of making sense of climate change affected by and embedded in local places and communities?

Because my analysis of the empirical data on climate-change meanings could reveal the local materialisation and regional relevance of renewable energy technologies, the focus on a community-based energy transition has been defined. To provide an in-depth analysis of this social phenomenon, the first objective was to conceptually and empirically merge and reveal the role of place and local entrepreneurship in the emergence of grassroots innovations in community renewables. The following, second, question was thus addressed:

2 How do place and local entrepreneurship affect the emergence of grassroots innovations in the context of renewable energy?

Next, a specific explorative value is presented by the development of an agent-based model to simulate and explore the process of households' adoption of renewable energy technologies and the societal diffusion of community-based renewables. Generally, it is attempted to explore and test the potential of the innovative and relatively new method of agent-based modelling in social science by applying it to the theme of community renewables grounded in empirical evidence based on the present research. For this to be done, the 'community renewable-energy transition (ComRET) model' was built in computer code using the multi-agent programmable modelling environment NetLogo (Wilensky, 2015). More specifically, the exploratory, or explanatory, model is used 'to describe the process of [household] decision-making and interaction in a more intuitive way' (Johnson, 2015:8) based on diffusion (Rogers, 2003) and social psychological theory (Ajzen, 1991) but also informed by empirical findings. Based on the findings of the semi-structured interviews and the survey in the case study municipality, the design of household behaviour and novel representations of household interaction have been identified and developed, respectively. By applying the model to the case study and observing the model's ability to reproduce observed patterns in the real world, the results of the experiments provide food for thought to reflect on the role of social interaction and local agents in the 'virtual laboratory' of an agent-based model (ABM). The following, third, guiding question was developed:

3 Can an ABM based on an existing framework of agents' behaviour and representing household interaction contribute to the understanding of households' adoption of individually-owned solar installations and collectively-owned wind turbines in the case study of Reußenköge?

The last sub-objective is devoted to people's reflections on experiences with community-based renewables and changes to the community structures. This devotion implies that in an *in-* or *ex-post* situation, perceptions, assessments and future visions should be explored. A mainly qualitative method was applied based on grounded theory in order to provide empirically structured data which could serve as a structured and empirical foundation for a conceptual framework. This part of the study aims to answer the following question:

4 How do people perceive and assess community-based renewables and the connected issues of an induced community transition?

As indicated by the explanation of the objectives, multiple methods have been applied and integrated within this investigation. Although a full description of the methods is provided in Chapter 2, it is important to mention here that the application of a mixed-methods approach was a specific goal of the research. To conceptually combine and integrate complementary methods is considered to be necessary to address the issue under investigation and to be a methodological strength for exploring a complex system. Qualitative research was conducted in order to gain an in-depth and grounded understanding of people's perspectives on climate change and related issues. In comparison to the interviews undertaken, the results of a quantitative household survey are less profound in scope and content but provide statistical data and a larger sample. Whilst interviews helped to develop the conceptual grounding of the model, statistical data informed parameters and values for the computational model. Agent-based modelling is one social simulation technique that has been increasingly recognised in social science and geographical research for being able to model simplified representations of human processes and thus the development of a complex system (e.g., Sobiech, 2013; Johnson, 2015). Understanding of the system's nature can be generated through the identification of patterns and the generalisation of model results. The methodological objective of the study is, thus, to empirically and experimentally explore and improve the understanding of the structures and processes underlying community-based energy transition.

The presented sub-objective and guiding questions have been investigated in the case study region of North Frisia and the municipality of Reußenköge specifically.

1.3 Case study of the municipality of Reußenköge and the district of North Frisia

Germany has become well known for declaring the *Energiewende* (energy transition) and is, subsequently, often publicly framed as country of hope, showing that a low-carbon energy supply is possible, even in a strongly industrialised country. This energy transition requires a fundamental transformation of the energy supply, including the transition towards 100% renewables. Since the beginning of the century, Germany has experienced a strong diffusion of renewable-energy technologies. This was politically encouraged by the introduction of the Renewable Energy Sources Act (*Erneuerbare Energien Gesetz*), which established a priority for renewable electricity and a feed–in compensation (EEG, 2000). Renewables provide nowadays about 30% of the electricity generated in Germany (AGEB, 1/2016). In the geographical context, the north of Germany is wind-richer and economically weaker, resulting in early investments in onshore wind farms. In contrast, the south offers a higher solar potential that is reflected in higher photovoltaic and solar thermal installations. The federal state of Schleswig-Holstein is one of the states with the highest renewable electricity production in Germany, with the district of North Frisia being its frontrunner (DGS, 2015b)

North Frisia is the most northern district of Germany and the third largest within the federal state of Schleswig-Holstein (Figure 1.2). The population of approximately 162,865 inhabitants consists mainly of German citizens, including North Frisian and Danish minorities (Statistisches Amt für Hamburg und Schleswig-Holstein, 2015) and diverse languages are spoken such as German, Low German, Danish and different North Frisian dialects. This area was chosen for its geographical position in the bilateral feature between coastal protection and renewable energy. North Frisia is nowadays an outstanding district for renewable-energy development, with a self-sufficiency in renewable energy of 350% or a supply of about three and a half times its energy demand (DGS, 2015b). The first official community wind farm in Germany was built there, and since then community wind projects in the form of private limited companies (GmbH & Co. KG.) and cooperatives (eG) have spread widely. 'The *Energiewende* is the number one project of the future in Schleswig-Holstein', states the minister Dr Robert Habeck on the website of his Ministry of Energy, Agriculture, the Environment and Rural Areas. At the same time, North Frisia's coastal areas are vulnerable to climatic changes. 'Humans against nature, dikes against floods', is a saying shaping the history of North Frisia (Kunz & Panten, 1997) because of its low-lying coastal landscape, which has been threatened by natural hazards for centuries and needs to be protected by a

comprehensive dike-line. The tradition of land reclamation and dike building has formed the typical patterns of the coastal landscape characterised by coastal protection based on a dike extending the coastal length of about 441 kilometres and polders across an area of about 2,000 square kilometres (Steensen, 2008) (Figure 1.2). Polders are low-lying marsh lands enclosed by dikes during land reclamation and drained by sluices at low tide. North Frisian's inhabitants live in 168 municipalities and cities (Statistisches Amt für Hamburg und Schleswig-Holstein, 2015), one of which is Reußenköge (Figure 1.2).
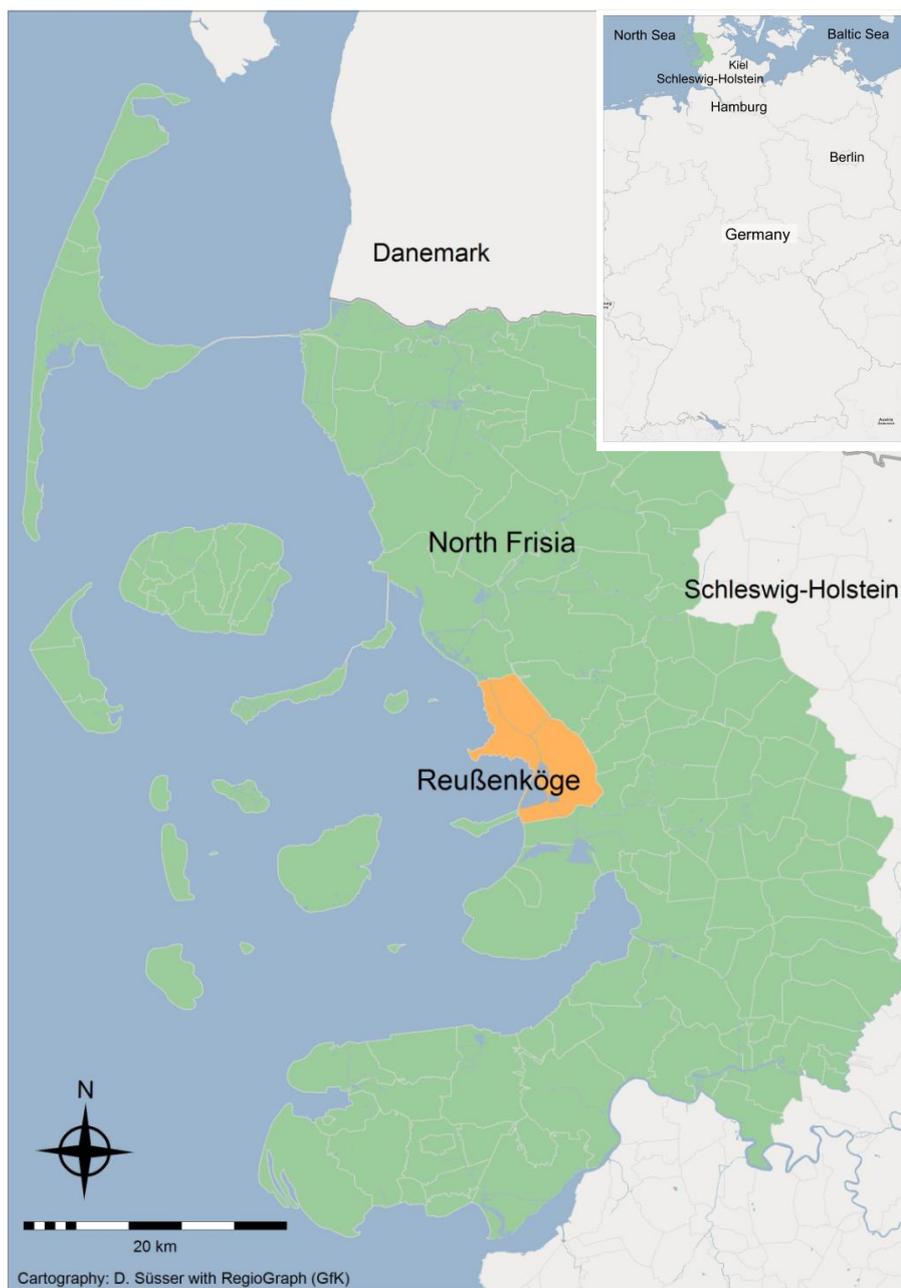
Figure 1.2: Case study area: Municipality of Reußenköge (orange area), and the district of North Frisia (green area) located in the federal state of Schleswig-Holstein

The coastal municipality of Reußenköge has been chosen as a research site for two reasons: Firstly, it is characterised by distinctive historical development which shapes today's *coastscape* between land and sea (Sibbers, 2002; Pingel, 2005; Döring et al., 2005). Secondly, developments in renewable-energy technologies convert agricultural practices from harvesting fields to harvesting energy and transform farmers from *agri*culturalists into *energy*-culturalists. Demographic change is affecting the municipality in the form of a population currently decreased to approximately 332 residents living in an area of about 46 km² (Statistisches Amt für Hamburg und Schleswig-Holstein, 2015). Reußenköge does not belong to a department within the federal state of Schleswig-Holstein, and it is, therefore, one of the two self-administrating municipalities in the district of North Frisia. This specific political setting implies full municipal responsibility, although Reußenköge has an association of administrations with the department of Middle North Frisia. Its municipal parliament is traditionally represented by the Free Voters *(Wählergemeinschaft)* of Reußenköge that represent the focus on community politics. Scenically, the municipality's landscape is composed of a 12-kilometre dike protecting the hinterland from flooding (Figure 1.3) and of six polders, of the island Hamburger Hallig, and of the northern part of the storage and nature protection polder Beltringharder Koog. The six polders – namely Sophien-Magdalenen-Koog, Desmiercereskoog, Reußenkoog, Louisen-Reußen-Koog, Cecilienkoog, Sönke-Niessen-Koog – were diked and settled between 1741 and 1925, according to the *Bredstedter Werk*, a regional plan for land reclamation (Kunz & Panten, 1997; Sibbers, 2002; Pingel & Steensen, 2009). The practice of land reclamation and the Wadden Sea – an intertidal zone and protected habitat – shape the typical coastal landscape. The fertile marshland traditionally resulted in an economy which was based mainly on agriculture and tourism. Due to its roots in agriculture, Reußenköge developed over the last three decades into a so-called model region for renewable-energy generation. One of the first wind turbines on the German North Sea Coast was built here in 1983 (Figure 3), even before the first electricity feed-in act (*Stromeinspeisegesetz*) was launched in 1991 (Pingel, 2005). This initial activity was followed by other developments which were mainly driven by the ideological choices of people who believed in an independent and environmentally friendly energy supply. Through the feed-in act and the later Renewable Energy Sources Act (EEG, 2000), private households and the municipality made use of the financial incentives of the central government resulting in one of the first community-owned wind farms in Germany (Pingel, 2005). Nowadays, 130 times more electricity than the community consumes (DGS, 2015a) is produced by the world's largest community wind farm, located in Reußenköge (a fusion of six previously independent

wind farms; Dirkshof, 2015), along with one solar farm and several solar and biogas plants on properties, barns and houses (Figure 1.3). The ongoing development of community-based renewable energies has opened up new fields of business: renewable-energy generation, consulting, planning and implementation of renewable-energy projects.

Figure 1.3: Reußenköge between coastal protection and renewable-energy generation; above left: view in the municipality on a 'solarised' house; above right: first wind turbine in Reußenköge); below left: middle dike line and 'line' of windmills; below right: main dike at the crossover between Amsinck-Haus (information- and service centre) and Hamburger Hallig

The described developments in North Frisia and Reußenköge provide interesting and important aspects of regional climate-related changes and represent an interesting showcase to explore societal and place-based renewable-energy developments.

1.4   Structure of the dissertation

The research is divided in eight interrelated and interconnected chapters. The main feature of the investigation is that it does not follow a traditional structure but rather an integrated and consecutive consideration of theory and empirics. Due to the emergent themes and stated objectives described above, it was decided to merge theoretical concepts and empirical

results in Chapters 3–6 in order to produce specific insights. In Chapter 3, people's meanings of climate change are explored, before the following chapters take the analysis a step further by concentrating on people's place-based perspectives on and experiences of renewable-energy technologies.

Chapter 2 introduces the mixed-methods approach informing this study. This approach is based on an in-depth literature analysis, qualitative interviews, a standardised household survey and agent-based modelling. The consecutive use and conjunction of multiple methods are presented, while the possibilities of qualitative and quantitative methods are outlined to empirically and experimentally explore and understand the key aspects of mitigating climate change with renewable-energy technologies.

Chapter 3 deals with people's engagement with climate change. People can be engaged with their minds, hearts and hands, and the chapter thus comprises individual perceptions, meanings of and behaviours related to climate change (Sub-question 1). How do people individually and collectively engage with the topic of climate change? How are meanings of climate change embedded in people's living environments? How do psychological distances and nearness bear an impact on people's place attachment and inform climate change? Conceptually, the chapter explores the interplay between climate-change engagement, psychological distances and place attachment, which are frequently discussed in the context of the gap between awareness of climate change and actual actions. By making use of the interview and survey data, results are presented and discussed. Because climate change materialised in community-based renewables, the perceptions, motivations and assessments of renewables are further elaborated upon.

Chapter 4 deals with the role of place attachments and meanings and local entrepreneurship permeating the social processes underlying the development of renewable-energy technologies (Sub-question 2). The multifaceted interplay between the concepts of place, local entrepreneurship and community renewable energy is shown. How do places impact local people, and how do the actions of people define the characters of places? What and how do socio-geographic settings and conditions contribute to a community-based energy transition? To empirically explore people's place-based perspectives on community renewable energy, Reußenköge has been used as showcase. The chapter reveals the importance of socio-geographic embeddedness and indicates the importance of common interest and collective participation motivating the development. Household decision-making and interaction are thus in the focus of the subsequent chapter.

In Chapter 5, agent-based modelling is introduced because of its potential to structurally formalise and conceptually discover household behaviour in the context of renewable-energy technologies (Sub-question 3). It is presented how an ABM has been developed and used within this study. The chapter outlines the model design based on two fundamental issues: theories of human decision-making and the empirical research results of the interviews and survey in the municipality of Reußenköge to answer the following questions: How do social interactions influence individual and collective behaviour? What is the role of innovators and change-agents in the diffusion process? The chapter presents the approach and findings of exploring households' behaviours in the context of a renewable-energy transition in an ABM, which implements existing frameworks of agents' behaviour and representations of household interaction. While the ABM could reproduce the importance of innovators and social interactions in the diffusion process, the next chapter will focus on the assessment of the present and past implementation of community renewables.

Chapter 6 shifts the focus to the perception, assessments and visions associated with community renewable energy and of the induced transition on community structures and processes (Sub-question 4). How do people assess renewable-energy technologies in their local place and community? How does the community-based energy transition affect social life positively and negatively? The chapter firstly provides a review of current approaches for assessing community renewables. Next, the results of the structured analysis of qualitative and quantitative data are presented, revealing multifaceted and linked benefits and challenges induced by community-based renewable energy.

Chapter 7 critically reflects on the methodological and theoretical approaches of Chapters 2-6. The chapter addresses the strengths, challenges and limitations of the research practice, the theoretical approaches and, finally, the methods and results. How can I reflect on myself as a researcher in the field? How did a place-based and agent-based approach contribute to this research? What are the strengths and challenges of a mixed-methods approach?

Chapter 8 concludes the research by summarising the key results of the previous chapters, before outlining the social relevance and political implications of the findings for communities, practitioners and policy-makers. Finally, an outlook on future research questions and aspects to be addressed in the future is provided.

2 Methodology: A mixed-methods approach

Essentially, all models are wrong, but some are useful.

George E. P. Box and Norman R. Draper

Models are applied widely across scientific disciplines including mental models, conceptual models, numerical models, statistical models and computer models. Generally defined, a *model* is 'a representation or abstraction of something such as an entity, a system or an idea' (Balci, 2003:150). This implies that the building of models follows a reductionist approach, and they can be considered 'ways of addressing and skilfully representing a certain aspect or perspective of the world' (Döring et al., 2015a:91). The phrase 'Essentially, all models are wrong, but some are useful' from George E. P. Box and Norman R. Draper (1987) takes up the nature of models and the implications of their use in research. Because every model is an abstraction of reality or a simplified representation of a system, 'all models are wrong'. Nevertheless, 'some are useful' because simplified representations can help to better disclose, understand, explain and predict system behaviour. Thus, a useful model should fulfil the requirements of being both sufficiently accurate and simple enough, instead of being complex. In the present research, this challenge has been confronted during the research process by designing useful models, and more generally, by choosing a methodology assumed to be of relevance for analysing the complex nature of climate change and energy transition in a place-based context.

To empirically investigate the phenomenon of climate change–driven energy transition, the study applies a mixed-methods approach in the present context. Such an approach allows the inclusion and analysis of different facets of climate change–driven energy transition and facilitates an in-depth understanding of the dynamics and complex functionalities underlying and triggering the nature of the social system (Alexander et al., 2008). A *system* could be consequently defined as a 'composition' (from Greek term *systema*) of different structural entities and their innate relationships. If these parts of the system are non-linear and dynamically weaved or twinned, the system is considered complex and can, again, be subdivided into structural and behavioural complexity. Structural complexity exists where the system 'consist[s] of many different elements and interactions', whilst '[b]ehavioral complexity [...] arises from the processes and relations between the system elements'

(Ratter, 2013:3-4). The phrase 'The whole is greater than the sum of its parts' applies to the latter behavioural complexity, as the system can be structurally simple or complicated. Behavioural complexity is in the main focus of the present research. In order to investigate community dynamics and the behavioural changes of a complex social system, structures and processes need to be examined by exploring local agents, which requires the conceptual study and analysis of their interactions and relationships with their local environment and place (Ratter, 2012, 2013). To execute this examination, the study applied an exploratory and mixed-methods research design consisting of qualitative and quantitative research, as well as simulation (Greene et al., 1989; Alexander et al., 2008).

Because the research area was new to me, and given the complex nature of the research object, it appeared suitable to conceptually combine and integrate different methods. Five methods were used: analysis of literature, policy documents and online news (Section 2.1); semi-structured interviews (Section 2.2); group discussions (Section 2.3); a standardised household survey (Section 2.4); and agent-based modelling (Section 2.5). Generally, '[m]ethods extend and magnify our view of studied life and, thus, broaden and deepen what we learn of it and know about it' (Charmaz, 2006:14). Hence, their application 'can add new pieces to the research puzzle or conjure entire new puzzles' (Charmaz, 2006:14). In this research, methods have been applied in different sequences (Punch, 2014) (Figure 2.1). This sequencing implies that the results from one method have been analysed to progress with the next method or to provide insights to be used on the following analytical level (Greene et al., 1989) – except in the case of the model implementation, where it was useful to enact the survey in between. The advantage of the sequential use of methods offered was to adopt diverse methods for focusing on specific, emerging and dynamic themes while they also build on each other. Thus, different methods enabled new or different perspectives on the system under consideration in order to disclose new questions and answers.
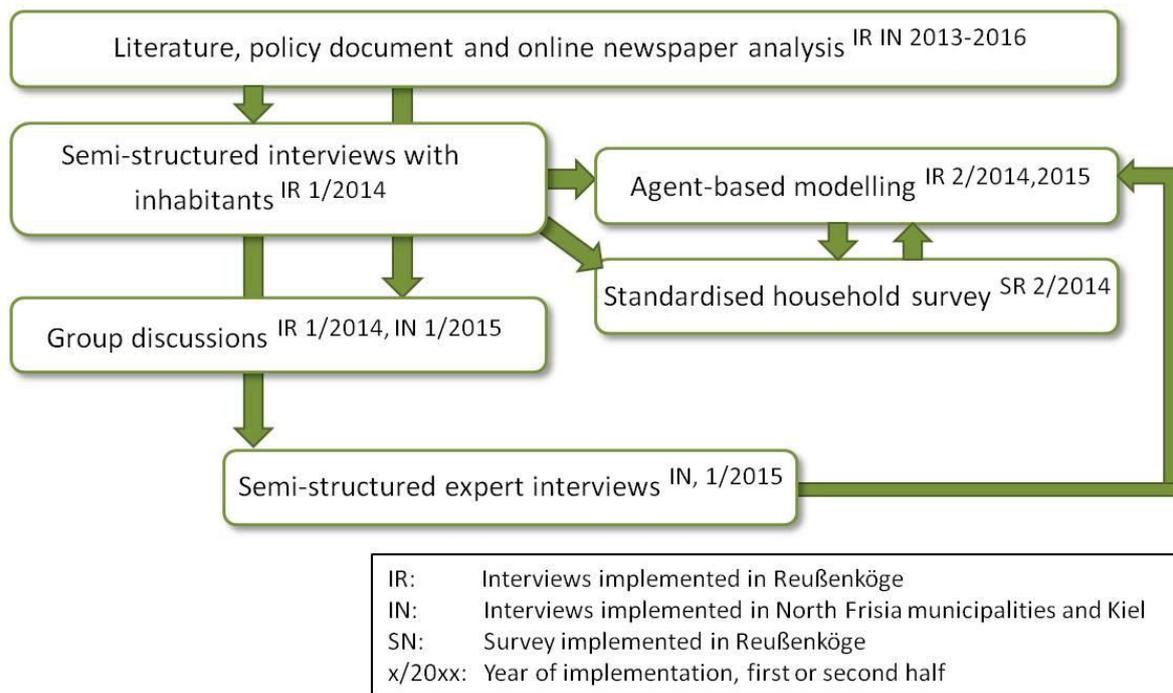
Figure 2.1: Methodological framework

First, the analysis of the local literature, policy documents, online news and the first round of interviews served as initiation or 'the discovery of paradox and fresh perspective' (Greene et al., 1989:260). The literature review was essential for the empirical research because the historical, socio-economic and cultural context of the case study area had to be identified for an interview guideline (Mitchell & Streeck, 2009). Furthermore, the interviews with this guideline enriched the written evidence of place-based themes and important contextual aspects and secured comparability. Therefore, the qualitative interview method was used to request information about people's perspectives on climate change generally, and measures of coastal protection and renewable-energy technologies specifically, as well as furnishing a reflexive assessment of why and how they performed certain kinds of behaviour. Furthermore, the research focus and the content for the first group discussion and the questionnaire-based household survey could be defined.

The standardised household survey was designed as an expansion of the qualitative interviews with two main intentions. First, the survey served as a qualitative and quantitative backdrop for the interviews by providing both a larger sample size and statistical data on what people had been thinking and doing. Secondly, the survey was designed to deepen knowledge of the adoption of renewables and to provide calibration data for the agent-based model (ABM). Therefore, the survey was conducted after the first interview phase and during the development of the model to inform the development of the latter. The computer model

represented an expansion aiming to provide more detailed insights into complex system behaviour in community-based renewable-energy transition. The initial interviews and the survey provided important insights into the processes underlying the development of renewables and the importance of specific decision-making factors, which informed the ABM (see Chapter 5 for a detailed explanation). This application of the initial stages of the research entailed that the empirical research influenced the operationalisation of the model by providing case study–based evidence on households' behaviours and interactions (Punch, 2014). Finally, the first phase of interviews indicated the local materialisation of renewables in the local places and communities and the relevance of renewables for the local people, which instigated a second phase of interviews and a second group discussion to compare, substantiate and extend the previous findings (Greene et al. 1989). The second interview phase finalised the empirical research.

Because I have assigned a specific purpose to each method, the findings from each method are partially integrated in the study chapters. The literature review and analysis of policy documents and online news served mainly as background information about the case study area(s) (Chapter 1). The interviews provided important empirical data that have been made use of in Chapters 3, 4 and 6, and served as the foundation for Chapter 5. The survey provided important statistical data and more detailed insights into the adoption of renewables integrated in Chapters 3 and 6. Chapter 5 was the most experimental chapter, centring on agent-based modelling. This chapter discusses why the methods have been applied and how the different methods complement each other.

2.1 Literature, policy document and online news analysis

The analysis of literature, policy documents and online news consisted of a review of regionally relevant books, online journals, websites and policy reports to tackle the historical context of the municipality of Reußenköge and the developments concerning the prevalent energy policy on the local, regional and supra-regional levels. These texts offered rich insight into the historical development of and socially relevant themes in North Frisia, in general, and the municipality of Reußenköge in particular. Research of the literature began with the search for a case study area in North Frisia and ended with the submission of the dissertation.

The North Frisian Institute (*Nordfriisk Instituut*) offered important sources and information about the history of North Frisia and Reußenköge. The library provided publications about the polders of North Frisia, including Reußenköge (Kunz & Panten, 1997; Pingel, 2005). Literature

about the history of North Frisia (Steensen, 2008; Pingel & Steensen, 2009) and yearbooks – *Nordfrisisches Jahrbuch* – (Pingel & Steensen, 2014, 2015) have been published by the North Frisian Institute (Nordfriisk Instituut). In addition to the literature analysis, different websites provided further and actual background information. The websites of the district of North Frisia and the department of Middle North Frisia identified Reußenköge as possible case study area because of its coastal locality, suitable size, and interesting historical development. Also the website of the municipality of Reußenköge contains extensive and important information on the local history and economy.

A review of relevant regional policy documents offered valuable insight into the discourses and debates surrounding the topics and political targets concerning climate change, coastal protection and energy transition in North Frisia. It should be highlighted that the Climate Protection Plan for North Frisia (*Klimaschutzkonzept für den Kreis Nordfriesland*) (Wuppertal Institute, 2011), a Draft for a Legislation for Energy Transition and Climate Protection in Schleswig-Holstein (*Entwurf eines Gesetzes zur Energiewende und zum Klimaschutz in Schleswig – Holstein*) (Schleswig-Holsteinischer Landtag, 2015) and the General Plan for Coastal Protection (*Generalplan Küstenschutz*) (MELUR, 2013) also offered important information.

Actual developments in Reußenköge and other municipalities were followed by online journals, newsletters and exhibitions. The *sh:z* (Schleswig-Holsteinischer Zeitungsverlag) provides online news published in different regional and local newspapers such as the *Husumer Nachrichten*. Updates on regional articles were provided by Google Alerts and via Twitter, while the newsletter 'En koon friisk', published by Nordfriisk Instituut, provided information about regional events and offered insights in the Frisian language and culture. Furthermore, the websites of local companies provided news regarding the development of renewables and related innovations supported by local people and the municipality of Reußenköge as a whole. Moreover, the attendance of local exhibitions, such as the *New Energy Husum* and *Husum Wind,* supplied consistent updates about current themes and the latest developments of renewables in Schleswig-Holstein and beyond. It provided the possibility of speaking with representatives of local companies and politicians involved in the topic.

The analysis of the literature, policy documents and newspapers ostensibly disclosed the general importance of issues emerging around coastal protection and renewable-energy technologies. Concerning renewables, online newspapers showed much interest in local

innovations. Yet, the analysis could not provide deep perspectives into the social system. Consequently, semi-structured interviews were conducted.

2.2   Semi-structured interviews

After the local and political developments in the literature, policy documents and online news were tackled, 23 semi-structured face-to-face interviews with the inhabitants of Reußenköge were conducted, which had a generally freeform quality, but at the same time, followed a structure and list of questions which secure comparability (Bernard, 2011). 'Semi-structured' implies that major questions were asked to all interviewees but the sequence of questions asked may differ and more information concerning a specific aspect is allowed by the option to ask follow-up questions (Fielding & Thomas, 2008). The advantage of this procedure consists in the fact that the interviewer can both react to the given answers by adapting questions and skipping already answered ones and still guarantee a comparable content structure for all interviews conducted (Fielding & Thomas, 2008). This type of interview structure was thus chosen because it maintains the balance between the flexibility of interviewing and comparability in the data gathered.

The interviews were one-on-one interviews, except one interview that was partially conducted as group discussion (see Section 2.4 for detailed information). Two interview phases existed (Figure 2.2):

> Phase 1 – February and March, 2014: 15 interviews with inhabitants of Reußenköge
>
> Phase 2 – February and March, 2015: eight interviews with experts in North Frisia (mainland) and Kiel.

In the first phase, interviews with coastal inhabitants were conducted in order to get a general understanding of people's perspectives on climate change in the case study area. The qualitative data analysis of interviews was 'an art as well as science', requiring creativity and analytical penetration (Corbin & Strauss, 2008:274). By applying grounded theory as outlined by (Corbin & Strauss, 2008, 2015), it was attempt to get a grounded understanding of the system processes and structures rather than testing pre-established hypotheses. However, before undertaking interviews, existing theories and relevant analytical concepts were reviewed to the study theme and local context. As a result of the data analysis, the relevance of existing theories and concepts was assessed and refined into new concepts.

This process of refinement dictated that the research performed should made use of existing theories by integrating and expanding them based on empirical findings. Becker (1998:109 in

Corbin & Strauss, 2008) underlined the pertinence of this grounded approach by saying that his '[...] favourite way of developing concepts is in a continuous dialogue with empirical data. Since concepts are ways of summarising data, it's important that they will be adapted to the data you are going to summarise'. From the interview data, key themes gradually emerged, which informed the second phase of interviews. However, this influence on the second phase did not consist in a kind of downscaling, meaning that the interview questions remained relatively broad and exploratory.

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│   Review of existing concepts and theories │
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                    ↓
┌─────────────────────────────────────────┐
│         First round of interviews         │
│   1/2014 – 15 interviews – Reußenköge      │
│        Initial / open data collection      │
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│        Data analysis and comparison        │
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│   Comparison with and merging of existing  │
│                 theories                   │
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│          Identification of themes          │
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│        Second round of interviews          │
│  1/2015 – eight interviews –North Frisian  │
│        municipalities and Kiel             │
│         Focused data collection            │
└─────────────────────────────────────────┘
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│        Data analysis and comparison        │
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│            Refining of concepts            │
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Figure 2.2: Adopted grounded-theory approach after Glaser & Strauss (1967)

First phase: Interviews with inhabitants of the municipality of Reußenköge

The first set of interviews was performed in the case study area of Reußenköge. For this to be done, two meetings with the mayor and the local council of Reußenköge took place in 2013. They provided contextualised field access to the municipality and allowed for consent and support for the research to be undertaken there. During the fieldwork in the winter of 2014, I was renting a small apartment in Reußenköge. Living in the municipality provided the possibility to perceive the landscape and keep track of how people were living in and interacting with nature. Moreover, I could experience on my own how it was to cycle in the landscape and to rely on groceries in the neighbouring village of Bredstedt. Although, participant observation was not conducted during the fieldwork (see Bernard, 2011, for an introduction), some qualitative data provided contextualised information apart from the interview data: Personal notes and photographs of the landscape and people's houses were taken to contextualise myself as analyst.

Within two weeks, 15 guideline-based qualitative interviews were conducted with inhabitants living in Reußenköge. Interviewees were found via personal recommendation and with representatives of the local council, farmers, dike masters, volunteers in local associations such as the fire brigade or the countrywomen and managers of the community wind parks. The social position of interview partners was in the focus of the interview rather than their varying expertise. The interviews were conducted in an environment well known to the interviewees – either in their homes or offices. One interview was conducted at a loud workplace, wherefore only hand notes were taken during the interview. All other interviews have been recorded in agreement with the interview partner. As a guideline for the interviews, a semi-structured questionnaire was developed (for interview guideline see Appendix A). It was first discussed with colleagues and afterwards checked for applicability during three test interviews. After a slight revision of the interview guideline, further 12 interviews were conducted.

The interviews started with a question on people's place attachment (Manzo & Devine-Wright, 2014) to the region (North Frisia) and the municipality (Reußenköge). This question was followed by queries addressing social life and interactions, along with the problems the municipality is currently facing. Furthermore, people were asked about their framing of climate change, personal experiences of it and expectations about its future. Finally, questions revolved around measures to prevent climate change in the municipality and further opinions about such measures then being taken.

If time permitted, interviewees were also asked to show me their houses or farms in order to get better insights about their living or working environment. In one case, the son of the interview partner showed me around, while in another case, a farmer invited me on a tractor trip to distribute fertilizer on his field. Even the 'walking' and 'driving' conversations revealed to be very valuable for the visualisation of impacts and measures of climate change in the environment and for fostering awareness of the experiences and emotions involved (Anderson, 2004). This benefit has been also highlighted by social science studies that conducted so-called walking interviews in the place of interest for studying interactions between humans and their environments (Anderson, 2004; Weig, 2016). Because the conversations in this study were not designed as interviews and explicitly not planned to be recorded, only notes and photos could capture certain aspects, and therefore some content got lost. After each interview, a short protocol was written to capture impressions of the interview partner, place and situation, and my personal satisfaction with the interview.

After the completion of the interview phase, interviews were transcribed verbatim, which helped to rethink emphases in the interviews, to guide the analysis and to reveal themes not previously considered (Fielding & Thomas, 2008). After transcription, the interviews were analysed using the qualitative interview analysis software MAXQDA (VERBI GmbH, 1989-2015) and were based on the conceptual requirements outlined in grounded theory (Charmaz, 2014; Corbin & Strauss, 2015). Grounded theory is a process of 'creative and solid data analysis requ[iring] astute questioning, a relentless search for answers, active observation, and accurate recall' (Morse & Field, 1996:125-126 in Corbin & Strauss, 2008). Following the coding process by Corbin & Strauss (2015), 'open' and 'axial' coding was applied. Through an initial or open coding, 'conceptual labels to different segments of data' could be assigned (Hodkinson, 2008:87; Corbin & Strauss, 2015). It implies that text segments were coded once main themes or topics emerged during the process of analysis. Under chronological analysis of the other interviews, concepts were further elaborated, refined and combined.

In the second phase of passing through the data, focussed coding implies a more directed, selective and conceptual coding in order 'to synthesize and explain larger segments of data' (Charmaz, 2006:57). Third, in the so-called axial coding, crosscutting or relationships between concepts could be defined, and core and sub-categories were created (Fielding & Thomas, 2008; Corbin & Strauss, 2015). This exploratory development of analytical categories and their integration led to the design of a coding tree, and finally to a theoretical saturation

(Corbin & Strauss, 2015). Even after finalising the first data analysis, this process was further developed under different research questions addressed in the study. This further refinement was done by collaborative discussion about the interpretation of the empirical data with a colleague, Martin Döring, who analysed the interviews independently.

Second phase: Interviews with experts in North Frisia and Kiel

In the winter of 2015 – one year after the first interview phase – a second round of interviews was conducted on the North Frisian mainland and in Kiel. The interviews attempted to collect expert opinions about regional challenges and opportunities surrounding climate change, as well as impressions from experts about the municipality of Reußenköge. While the status of the interviewee slightly went into the background, the balance was kept between the story of the person and their expertise. Two interview partners became aware of my research through a press release concerning my household survey in Reußenköge. After these two contacted me, I successfully requested an interview. Both were revealed to be important for my research endeavour. One was involved in regional management of climate change in North Frisia while the other was working for a natural protection non-governmental organisation. The other six interview partners were selected based on their expertise and position in regional policy and administration. First, two politicians from the Ministry of Energy, Agriculture, the Environment and Rural Areas (MELUR), the federal state government based in Kiel, were interviewed because of their longstanding expertise in water and coastal management and renewable-energy transition. The interviews offered valuable insight into the political relevance and agenda of climate change–related themes. Furthermore, it was important to conduct interviews with two local entrepreneurs in North Frisian municipalities offering consulting, project planning and development. The aim here consisted in getting to know the story of the local development of renewables from other regions in North Frisia by discussing obstacles, challenges and opportunities. Lastly, two mayors of municipalities located in North Frisia were interviewed because press releases were published about local opposition to wind energy in the municipalities. The interviews attempted to address how to deal with and solve local conflicts with wind energy opponents.

All interviews took place in the interviewees' offices or homes. The guideline developed for the interviews in Reußenköge was for these interviews revised, while questions about personal perspectives on their home and climate change remained the same (for interview guideline see Appendix A). A new focus, however, was dedicated to experiences and perspectives from the interviewee's career. With the agreement of all interviewees, the

interviews were recorded. In addition to the records, a short protocol was written after each interview in order to capture the impressions of the interview partner, the interview place and situation, and my personal satisfaction with the interview. During the week of conducting six interviews in North Frisian municipalities, it was not possible to stay at all the different locations. Therefore I decided to stay again in the municipality of Reußenköge.

Similarly to the interviews from Reußenköge, the interviews were transcribed verbatim in order to become familiarised with the data and to compare analytical themes between the interviews but also between the ones from the first interview period (Fielding & Thomas, 2008). The data analysis was performed by making use of the categories developed with the interviews in the first phase, but with an open eye on newly emerging categories. Under chronological analysis of the other interviews, all categories were further elaborated and extended. The emerging categories were discussed with other researchers and compared with the empirical findings of Martin Döring, who conducted empirical research on islands in North Frisia addressing comparable questions in the course of his interviews.

2.3 Group discussions

During the two interview phases, respectively, one group discussion was implemented. To capture the perspective of the young people, a meeting with the Country Youth (the *Landjugend*) was held in Reußenköge in March, 2014 (Figure 2.3). In the meeting, five youth participated in order to discuss three issues: (i) the social life in the municipality, (ii) meanings of climate change and (iii) different organisations and people driving developments in Reußenköge. As analytical tool, note cards were used. In case of questions about the social life (i) and important people in the municipality (iii), the young people were granted the possibility to think about their own ideas and opinions and to write them down. In the case of climate change, it was decided to follow studies which examined word associations or elicited spontaneous associations related to climate change (Bostrom et al., 1994; Smith & Joffe, 2013; Moloney et al., 2014). Young people were asked to write down what came to their mind when they heard the phrase climate change, allowing for a maximum of 10 statements. In this case, the note cards were marked with names and an ordering number.

After each of the three issues were raised, results were discussed in the group by looking for equal and contrasting answers and different relations. One advantage of group discussion was the 'dynamic effect of interaction or expressed opinion' (Fielding & Thomas, 2008:248). The group atmosphere helped to open the minds of the participants and to receive and

discuss different views. The note cards and personal notes taken during and after the discussion served as data basis for the analysis of the meanings of climate change.

Figure 2.3: Group discussion with the Country Youth (Landjugend):
Group of young people (left), results on note cards (right)

Besides the group discussion with the youth, a group discussion was held with two politicians responsible for the issues of energy, climate and resource protection at the Ministry of Energy, Agriculture, the Environment and Rural Areas (MELUR). The group discussion was conducted in February, 2015, preceding a one-to-one expert interview with one of the two interview partners. The group interview attempted to discuss incentives to lead to the local development of renewables, and different challenges and opportunities of a regional energy transition in Schleswig-Holstein. The value of the group discussion consisted of the fruitful interaction between the two interview partners and me. With the agreement of the two interview partners, the conversation has been recorded and could be therefore transcribed verbatim afterwards. Under application of the MAXQDA software (VERBI GmbH 1989-2015), the discussion was analysed following the approach for the analysis of qualitative interviews as outlined in Section 2.2.

2.4 Standardised household survey

Following the first phase of interviews and during development of the ABM, a standardised household survey was conducted in Reußenköge in August, 2014. The survey was distributed to receive information about people's attitudes, values, personal experiences and behaviour concerning climate change and especially renewable energy technologies. It is important to note that the survey data were indented to be used for identifying the parameters influencing

people's decision-making for the adoption of renewables and to calibrate the variables in the ABM. This purpose in mind provided an additional challenge in developing the survey. Simmons (2008) underlines that the development of questions is the most important element of doing a survey. The success of a survey largely depends on 'the questions asked, the way in which they are phrased, and the order in which they are placed' (Simmons, 2008:184). The framework for the questionnaire was developed carefully based on three factors: (i) inclusion and further investigation of the findings from the first round of interviews, especially by addressing decision-making factors; (ii) inclusion of diffusion of innovations theory by addressing innovation characteristics and communication (Rogers, 2003); (iii) investigation of determinants of the social-psychological theory of planned behaviour (Ajzen, 1991) (see Chapter 5). Through feedback from colleagues and family, who did and thus tested the design of the survey, the questionnaire-based survey was revised several times (for questionnaire example, see Appendix C). The written questionnaire included open and closed questions addressing questions of what why how and when. Thematically, they were related to regional climate change, measures to counteract climate change and the development of renewables in the municipality. While past studies have often addressed the future, planned behaviours or willingness to do something, this questionnaire focussed on *past* actions and motivational factors for the past adoption or rejection of wind and solar energy. Lastly, interviewees were given the possibility to add some additional point of interest not covered by the questionnaire.

The survey was designed as a self-completion postal survey to be personally distributed to 110 households. This type of survey implies that the interviewer is absent during its completion, and it is thus self-administrated (Bernard, 2011). Through the personal distribution, it was possible to reach some people at home so that it was possible to explain the task of the survey and to ask them to take part. Other questionnaires were distributed in people's post boxes. The person who had the soonest birthday in the household was asked to fill in the questionnaire in order to gain a random participation along gender and age. A time of two weeks was given to return the questionnaire. Three possibilities were provided for the questionnaire's return: (i) place the questionnaire under the doormat or to leave it in front of the door in a bag; (ii) put the questionnaire, closed in an envelope, in the post box of the mayor; or (iii) to send it by mail to my office address. On a fixed date, I personally collected the questionnaires at people's houses in case they had placed them in front. In doing so, I was able to talk to people and to receive some direct feedback about the questionnaire. These

feedbacks were useful in order to assess the response rate and to learn for the future administration of surveys. Simmons (2008) and Bernard (2011) argue that the disadvantage of postal questionnaires is the relatively low response rate. However, it has been also highlighted that the response rate is highly depending on different factors such as the subject and the ease of completion of the questionnaire.

For this survey, 51 completed questionnaires were returned, equalling a response rate of approximately 46%. With 31 males and 20 females, a higher number of men participated in the survey (Table 2—1). Furthermore, the sample revealed that the majority of participants were between 45 and 65, although also represented were a high number of people age 65 and over. For the majority of the interviewees, Reußenköge was their first residence. While almost all participants were owners of their houses, about half of them own also owned agricultural land. Considering possible changes to the buildings, the study found that 14% of the houses are under monumental protection.

Table 2-1: Demographic statistic of the household survey, N=51, Reußenköge, 2014

	Number	%
GENDER		
female	20	39
male	31	62
AGE		
under 25 (1990)	1	2
25-35 (1980-1989)	5	10
35-45 (1970-1979)	3	6
45-55 (1960-1969)	13	25
55-65 (1950-1959)	10	20
65+ (1949)	17	33
n/a	2	4
HOUSING ARRANGEMENT		
tenant	5	10
owner	45	88
n/a	1	2
owner agricultural land	25	49
owner further buildings	4	8
RESIDENT		
main	49	96
secondary	2	4
BUILDING FEATURE		
under monument protection	7	14

2.5   Agent-based modelling

An ABM is a computer program that is able to simulate individual agents, their actions, their interactions with other agents and their environment in order to study system dynamics (Gilbert, 2008; Crooks & Heppenstall, 2012). Within this research, I have developed the community renewable-energy transition (ComRET) model in computer code to simulate the process of households' adoption of solar panels and wind turbines. This agent-based approach has been applied in order to improve an exploratory and experimental endeavour with the understanding of how households' behaviours enhance the phenomena of community renewables. Because computer simulation and, more specifically, agent-based modelling is a relatively new method in social science research, it is worth to introducing main ingredients here, and presenting how the methodology has been applied within this research.

Models are purposeful representations or simplifications of a real system – 'smaller, less detailed, less complex, or all together' (Gilbert & Troitzsch, 2005:2; Railsback & Grimm, 2012). They are usually built and used to solve a problem or to answer a question about the system. Social simulation is one type of modelling which implies the use of computers for simulating social phenomena, a method increasingly popular in social research since the early 1990s (Epstein & Axtell, 1996; Axelrod, 1997; Gilbert & Troitzsch, 2005). Different computational social simulation methods can be distinguished among macro simulation (or system dynamics), micro-simulation, cellular automata, and agent-based modelling. Agent-based modelling is one of the most complex computational simulation techniques. In the literature, many similar terms are used for agent-based modelling: multi-agent simulation, multi-agent–based simulation, agent-based simulation modelling, or agent-based social simulation. However, this study deploys the term ABM throughout.

Agent-based modelling provides a way to formulate simplified representations of social phenomena in a dynamic computer program (Epstein, 2011b). In ABMs, a bounded system is modelled consisting of heterogeneous and autonomous decision-making entities interacting with each other and their environment. These entities are named 'agents' and typically represent individuals, firms, organisations or, as in the case of the ComRET model, households. Agents can be considered as miniature computer programs which constitute a larger program (Elsenbroich & Gilbert, 2014). ABMs allow, generally, for highly complex agents, while the number of agents is few (Gilbert & Troitzsch, 2005). Agents are heterogeneous, which implies that they are defined by specific attributes or parameters affecting their rules and behaviours. Differences in the parameter values therefore lead to

different behaviours. Furthermore, the autonomy of agents implies that they can make decisions about their behaviour, such as moving or consuming based on a set of rules. The complexity of these rules can vary widely, depending on the purpose of the model. Agents' behaviours and attributes might be informed by theory, empirical research, or a combination of both. For example in the ComRET model, households make decisions about the individual adoption of solar panels or the collective adoption of wind turbines in a bounded community system based on the perceived utility of adoption. Furthermore, agents' interactions are central to the idea of agent-based modelling and distinguish it from other modelling approaches. Agents are able to interact with each other, and they can perceive and react to the environment in which they are located. Typically, the social environment is represented by a network of social relations (Gilbert & Troitzsch, 2005) through which information is exchanged and agents' behaviours are influenced. The physical environment is typically represented by geography, a spatially explicit grid of cells, which may offer resources and define agents' behaviour in a specific space. For example, in the ComRET model, households are located in a spatial environment, their municipality, and they are able to communicate and act together with other households, as well as make decisions about the use of specific land (detailed explanation in Chapter 5).

The development of an ABM can help to provide new ways of thinking about social processes, especially about inherently complex and dynamic ones (Gilbert, 2004, 2008). This ability of ABMs evidences that agent-based modelling assists in the discovery and formalisation of ideas about the social world (Gilbert & Troitzsch, 2005). The modelling is cyclical (Railsback & Grimm, 2012) (Figure 2.4). During this cycle, the explicit thinking, the formulation of different assumptions and algorithms, and the documentation of each step are crucial for studying and documenting what they entail (Epstein, 2008; Railsback & Grimm, 2012). A major advantage is that it forces a researcher to be precise: one must 'think through one's basic assumptions very clearly in order to create a useful model' (Gilbert, 2004:1). The initial assumption is that there is a real-world or target phenomenon in which researcher is interested. The model is developed as a simple representation of that target in order to study the target phenomena itself (Gilbert & Troitzsch, 2005). For this study to be carried out, conceptual and computational models must be developed. In contrast to other methods, it is with ABMs possible to use computer coding as a way to formalise social theories about behaviour. Making this application possible is that models are informed by theories, empirics, or ideas about agents' behaviour and their interactions.
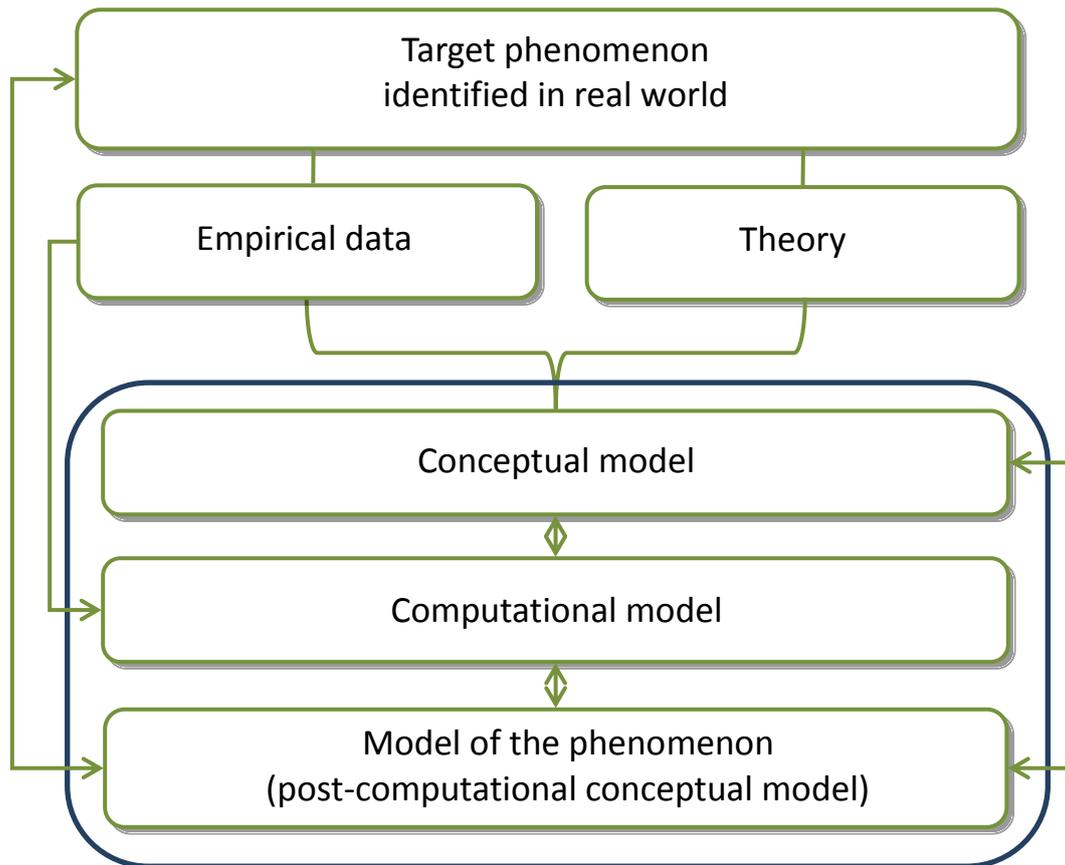
Figure 2.4: Epistemological framework, adapted from Anzola (2015)

Because of the possibility to incorporate and test theories and to use empirical data as input or for model validation, agent-based modelling has been recognised as contributing to the combination of both qualitative and quantitative data in social science (Yang & Gilbert, 2008; Chattoe-Brown, 2010). The ComRET model was based on qualitative interviews in the case study area and the theoretical foundations of diffusion and behavioural theory, which have been represented in written text, graphics and equations. The conceptual model of ComRET model needed then to be 'translated' systematically into computer code, a challenging task Chattoe-Brown, 2010). The computational model represented thereby only a simplified representation of the conceptual model. A computational 'raw' model of the ComRET was designed based on the theoretically and empirically based understandings of the processes underlying the development of renewables and factors influencing the households' decision-making about the adoption of solar panels and windmills (see Chapter 5 for detailed explanations). To feed the model with empirical evidence, a standardised household survey was conducted in Reußenköge in September, 2014. The survey identified important decision-making and communication parameters, and statistical data could be generated supporting the model calibration. Based on the survey, the model was further developed and applied to the case study of Reußenköge. With the computational model, simulation runs were

implemented, and the occurrence of emerging patterns could be observed. By implementing the simulations, in a step of making sense of the simulation results, a post-computational conceptual model needed to be formulated by 'a narrative linking both to the computational and the conceptual models' (Anzola, 2015:16). Such a post-computational *model of the phenomenon* has been invented by Anzola (2015), who emphasised its importance in order to compare and assess the behaviours and patterns represented in the model with the target phenomenon.

The exploratory character of the method provides an innovative feature to study complex systems. Agent-based modelling encourages the exploration of different phenomena of interest by observing and recording different behaviours and patterns (Di Paolo et al., 2000; Gilbert & Troitzsch, 2005). The computer code can be run in a computer program, and emerging macro-level behaviours can be observed over a period of time. An agent-based perspective provides the possibility to investigate new phenomena 'arising from decentralized bilateral agent-interactions' (Epstein & Axtell, 1996:49). As such, non-linear dynamic systems consist of individual micro-level actions, which can lead to the emergence of a macro-level that fosters new system behaviour (Bonabeau, 2002; Ratter, 2012). Complex behaviour patterns can even emerge from simple ABMs, and the dynamics of complex systems can be explored (Reynolds, 1987; Gilbert, 2008). This supervening complexity is fundamental to ABMs, which makes them distinctive among other modelling approaches. For example, in the ComRET model, the construction of a community wind park that was recognisable at the macro-level emerged from individual micro-level interactions in the community. Through the identification of patterns and the generalisation of model results, understandings of the system dynamics could be generated. This exploratory nature of ABM has, so far, not often been made explicit (Anzola, 2015), but provides an important methodological tool for exploring the social system under consideration (Figure 2.4)

An ABM can furthermore be considered a 'virtual laboratory' (Railsback & Grimm, 2012). The method encourages experimentation because different model runs or 'experiments' can be carried out under varying model characteristics (Bonabeau, 2002; Gilbert & Troitzsch, 2005; Di Paolo et al., 2000). Thus, simulation experiments can explore the effects of different parameters, and can thus achieve clarification about relationships and interdependencies and a deeper understanding of system dynamics (Gilbert & Troitzsch, 2005). This dynamic and experimental facet makes it quite distinctive from most other social science methods, such as structured interviews and standardised surveys.

A model can be built for different purposes, including explanation, prediction, data collection guidance, the discovery of new questions, training and policy dialogue (Gilbert & Troitzsch, 2005; Epstein, 2008). Johnson (2015) distinguishes three main purposes for ABMs, which define the model design, development and use: descriptive models, participatory models and exploratory models. Descriptive models attempt to describe real-world phenomena in much detail and to predict behaviours by reproducing the dynamics of some behaviour (Gilbert & Troitzsch, 2005; Johnson, 2015). The reliability of forecasts is, however, debatable, and their construction is both time-consuming and difficult. Participatory models are developed together with stakeholders, used for engaging stakeholders, as discussion tools and to understand and learn (Johnson, 2015). Lastly, in exploratory models, the agents' decision-making and agent interactions are formulated more intuitively, informed by theories about agent behaviour. In this sense, system behaviour can be explored and better understood (Gilbert & Troitzsch, 2005; Johnson, 2015). Given their different purposes, simulations generally satisfy both explanation and prediction. Nevertheless, the principal value of agent-based modelling in social research is explanation of the social processes, patterns and roles of real-world social phenomena rather than prediction (Gilbert & Troitzsch, 2005; Epstein, 2011). Explanation 'help[s] us to organize the complex world we encounter, making it cognitively manageable (which may be why they also give us a sense of understanding)' (Douglas, 2009:454). But it does not imply that explanation cannot hold some kind of prediction, even if it is at least a prediction of type one: 'an explanatory model will be always capable of making some predictions, even if they are not very precise' (Gilbert & Troitzsch, 2005:16). In case of the ComRET model, the research interest was to study the process of the development of renewables in the municipality of Reußenköge in order to better understand the role of social interactions for the emerging phenomenon of community renewables. Therefore the intent to use a model in this research is both exploratory and explanatory in nature.

2.6   Overview of the mixed-methods approach applied

In this research, a generally exploratory research design was applied, which incorporates a mixed-methods approach. Diverse methods were integrated in the attempt to analyse different facets of community renewables and its interaction with the social system under consideration to get an in-depth understanding of the multifaceted and complex nature of community-based energy transition.

In order to deal with the system complexity, the study explored the place, the local agents and their interactions by combining and integrating five different qualitative and quantitative research methods: an analysis of the literature, policy documents and online news, semi-structured interviews, group discussions, a standardised household survey, and agent-based modelling. Of central importance were the grounded analyses of interviews and the combination of a standardised household survey feeding into an ABM. Overall, this mixed-methods approach attempts to study a climate change–driven renewable-energy transition by focusing on specific, emerging and dynamic themes. In particular, the methods are perceived to be suitable for revealing and studying the different developmental layers contributing to community renewables

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3 Climate change – Does it matter? Understanding people's individual and collective engagement with climate change

But climate protection has no face. That's why the face of climate change is renewable energy.

Interviewee in North Frisia

The understanding of individual and collective forms of engagement with climate change is of growing relevance because the need for societal responses has been reinforced by scientific evidence (IPCC, 2014b). Meaningful public engagement with climate change is conceived to be of vital importance as it is supposed to encourage low-carbon behaviours and to develop and implement low-carbon technologies and climate resilient infrastructures (Lorenzoni et al., 2007; Whitmarsh et al., 2011). In the present study, the term *engagement* is defined as an individual or shared connection to the issue of climate change, comprising knowledge, awareness, concern and caring about climate change to induce motivation and willingness to act, and to encourage mitigation and adaptation (Lorenzoni et al., 2007; Whitmarsh et al., 2011). This definition assumes that engagement with climate change creates a change in 'the way we think, feel and act' (Hulme, 2009:xxviii), precipitating both individual and collective levels on which attitudes are created, and social change and actions are performed. However, engaging people with climate change is not an easy task. Although most studies worldwide show that people consider climate change to be a serious problem, the public's understanding of its causes and solutions is limited (review by Lorenzoni & Pidgeon, 2006). This finding is mirrored in the widely identified value-action or attitude-behaviour gap that addresses the discrepancy between awareness and concern of climate change, and moreover, between these two features and pro-environmental behavioural responses (Blake, 1999; Kollmuss & Agyeman, 2002). For example, a study by Ratter et al. (2012) shows a general variance in public concern about climate change and that increases in scientific evidence and media coverage about climate change lead to only short-term effects, which do not increase public concern in the long run (Ratter et al., 2012). But do people use the places they live in as an anchor for understanding global changes and future projects for mitigation and adaptation to climate change and if so, how? What memories and experiences are used to make sense of climate change? In what way does this deep-seated and place-dependent meaning structure bear an impact on individual and collective climate-change engagement?

Climate-change engagement is often considered challenging because climate change is an abstract entity: it is geographically too distant, occurring in the future, and outcomes are too uncertain or imprecise to be personally relevant. Current discussions about climate-change engagement refer to four dimensions of *psychological distance*, namely temporal, spatial, social and hypothetical distance (Milfont, 2010; Spence et al., 2012). These dimensions raise questions, such as '*when* [does climate change] occur, *where* [does it occur], to *whom* [does it occur], and *whether* it occurs [at all]'? (Trope & Liberman, 2010:4). Climate change is largely considered to be a 'contextualized and culturally situated phenomenon' (O'Neill et al., 2010:1001) manifesting different meanings to different people in different places, as well as different courses of action (Hulme, 2009). Thus, geographers (Hulme, 2008; O'Neill et al., 2010) demand a situated consideration of climate change in order to understand how people's framings of and engagements with climate change are grounded in local places. However, so far, there is little empirical evidence about how meanings of climate change are embedded in local places and communities (Spence et al., 2012; Devine-Wright, 2015a), and how they are structurally shaped and fabricated by underlying psychological proximities and distances. The present study takes this aspect as a starting point for investigating people's meanings of climate change, along with individual and collective engagement. The main research question addressed is: How are people's ways of making sense of climate change affected by and embedded in local places and communities?

For this question to be adequately addressed, this chapter outlines, combines and empirically explores the interdependence between the concepts of engagement, psychological distance and place attachment. So far, the potential to explore the interplay between engagement, psychological distance and place attachment in the context of climate change has rarely been addressed. In the present case, the collected empirical data constitutes 15 qualitative interviews with coastal inhabitants in the municipality of Reußenköge, a group discussion with the Country Youth (*Landjugend*) and eight further interviews conducted with experts from government, companies and associations spread over North Frisia and in Kiel. Moreover, a standardised household survey was conducted with 51 surveyed households in Reußenköge (for a detailed explanation, see Chapter 2). It's aimed to analyse the social construction of and relation to climate change by addressing questions about place attachment, local problems in North Frisia, climate-change meanings, and measures implemented individually and collectively. Based on grounded theory (Charmaz, 2014; Corbin & Strauss, 2015), firstly, analytical categories for the meanings of climate change were identified, compared and

further elaborated along the course of the interview analysis. Secondly, the study addressed the analytical concepts of psychological distances and place attachments which permeate these meanings of climate change. This methodical procedure secured analytical consistency and resulted in empirically structured and saturated data.

3.1 Conceptual linkage of psychological distances, place attachment and climate-change engagement

Engagement with climate change has been increasingly used to describe a personal (private) connection with the issue of climate change, or public involvement in driving consumption patterns and in political decision-making (Lorenzoni et al., 2007; Whitmarsh et al., 2011). In light of a place-based approach for climate change, this engagement goes beyond the 'private sphere' to the 'public sphere' of civic and community forms of engagement which 'offer an expanded role for individuals in respect of defining climate change responses and shaping social change' (Whitmarsh et al., 2011:271). Hence, people can engage on the individual and the community level. In contrast to Lorenzoni et al.'s (2007) conception, engagement is in the present context considered as process: it is encouraged by the slowly advancing process of climate change itself and the resultant place changes over time.

However, limited public engagement with climate change has increasingly been explained by psychological barriers called 'dragons of inaction' (Gifford, 2011). Psychologically speaking, if the 'object' of climate change or related entities and events are moved away from the here-and-now – the reference point – different distance dimensions occur that may hinder action (Trope & Liberman, 2010; Gifford, 2011). The concept of psychological distance can be used to understand the psychologically important proximal or distant dimensions of climate change by exploring how people make sense of climate change risks and climate-related actions (Milfont, 2010). The concept rests upon four dimensions: first, the temporal distance of anthropogenic emissions and climatic change spans the generation gap between human actions inducing climate change and perceived climate-change consequences. Moreover, the occurrence of climate change might be, second, geographically distant or, third, socially distant from a person, due to the distance between perpetrators and victims of climate change. Fourth, the complexity of climate change in terms of scientific, informational and moral uncertainties makes climate change's causes and consequences distant (Liberman & Trope, 2008; Hulme, 2009; Trope & Liberman, 2010). These distances are found to be interactive and cognitively related to each other, and they are of vital importance to the

meaning of climate change (Trope & Liberman, 2010; Milfont, 2010; Spence et al., 2012). It should furthermore be noted that psychological distance is theoretically related to construal level theory (Trope & Liberman, 2010), which provides a valuable approach for systematically analysing people's framings of climate change. This study, however, focuses on psychological distances and the construction of climate change between the *global wideness*, the 'out there', and the *local place*, the 'home', because it enables the investigation of a 'situated' climate change, a central concern of the study.

People make sense of climate change by using globally or locally based entities such as climate change as a whole, or icons and events such as climate-related phenomena. 'Psychologically close' entities will be equipped with many specifications, and they embody entities by providing detailed emotions, knowledge or action about it, and are thereby mainly contextualised in local places (Milfont, 2010; Trope & Liberman, 2010). In contrast, psychologically distant entities are more abstract and unspecified, often decontextualised (Milfont, 2010; Trope & Liberman, 2010). However, even if they are distant, they are often characterised by shared entities, such as the polar bear symbolising the threat caused by the melting Arctic. Thus, they could be conceived as core elements for the sense making of climate change. Entities are infused by 'individual cultural values, world view and sense of place' (O'Neill & Hulme, 2009:403; Trope & Liberman, 2010), and become perceived as an 'element of reality' (Moscovici, 2001). This implies that people use entities in their living environment to make sense of climate change. Hence, understanding the geographical, local and socio-cultural embeddedness of meanings might reduce perceived psychological distances to the issue of climate change and help to increase engagement (Liberman & Trope, 2008; Wibeck, 2014).

Place is a longstanding analytical concept in geography, while it 'differs from related concepts such as "space" or "environment" that describe physical aspects of a specific location as well as the variety of meanings and emotions associated with that location by individuals or groups' (in Devine-Wright, 2009:247; Tuan, 1977; Gieryn, 2000). In the present context, place provides the setting for exploring people's place attachments and how they make sense of climate change on a continuum ranging from the global to the local. The 'bonding of people to place' is commonly defined as *place attachment* (Altman & Low 1992:2) and is characterised by positive affective bonds between individuals, groups or communities and their daily environment (Brown & Perkins, 1992). It is considered static, which makes it necessary to mention that place attachment is here considered dynamic. Place-based

processes such as interactions and the development of identity can create, sustain or undermine place attachment, and thus may change structures and dynamics in the locality (Seamon, 2014). Considering the past, (Scannell & Gifford, 2010b:3) highlight that 'one can grow attached to the settings where memorable eras or important events occurred', events such as natural hazards or love affairs. In this sense, attachment is informed by experiences, memories, narratives and representations of the past and the present, as well as visions for the future. Attachment can be thus based on individual and collective or social meanings (Scannell & Gifford, 2010a). Furthermore, looking into the future, climate change may bring in new dynamics in place-based processes and place attachment (Brown & Perkins, 1992; Devine-Wright, 2014). If the 'social fabric' of places is 'at risk', place-related values and feelings are triggered (Short, 1984 in Stedman et al., 2014). Thus, the correlation between place attachment and climate change is bi-directional. Although empirical evidence is still mixed and sometimes lacks consistent comparability, various authors agree that individual and shared place attachment can shape climate-change perceptions and are ultimately decisive for individual and collective engagement (Manzo & Perkins, 2006; Carrus et al., 2014). Hence, considering place attachment seems to be essential for understanding place-protective behaviours and responses to climate change (Upham et al., 2009; Scannell & Gifford, 2010a).

Out of this consideration follows that place attachment can be envisaged as an important ingredient in engagement with place. Place attachment addresses separated and combined social and physical sub-dimensions. While social aspects refer to the social arena and social symbols, physical aspects encompass the natural and built environment (Scannell & Gifford, 2010b). These social and physical aspects can be related to social and spatial proximity or distance to climate change, whilst proximity leads to the localising and anchoring of climate change. In fact, people connect, compare and interpret the impacts of climate change to places by making use of familiar and localised knowledge, experiences and history (Moscovici, 2001; Wibeck, 2014; Döring & Ratter, under review). Previous studies have pointed out that the social framing of climate change is created, mediated and negotiated though social interaction and that it is permeated by social factors such as norms and values (Wibeck, 2014).

Both place attachment and engagement furthermore encompass a process dimension based on three interrelated elements: knowledge, emotions and actions. The co-dependent elements are cognitive aspects such as memory and meanings, affective aspects such as the

emotions of happiness and love, and behavioural aspects including actions (Lorenzoni et al., 2007; Scannell & Gifford, 2010b). Devine-Wright (2009) proposes a consideration of these three aspects in a place-based process of responses to place changes, and these could also be applied to people's ways of making sense of climate change. First, people become aware of climatic changes, situating them in specific, geographically near or distant locations. Interpretation and the evaluation of climate-induced place changes bring spatial and social relevance to a specific place that may bear an impact on concerns about and engagements with climatic change. Depending on the assessment of these changes, climate-change threats or opportunities are perceived, resulting in a negotiation of responses and, finally, action (Devine-Wright, 2009). Thoughts, feelings and actions are found to be permeated with psychological proximity or distance from climate change from here and now, and moreover they characterise and sway people's engagement with climate change. The degree of engagement is thereby informed by 'individual underlying knowledge, values, experiences and lifestyles', which are in turn affected by social, natural and institutional contexts (Lorenzoni et al., 2007:44).

As explained above, the concepts of engagement, psychological distance and place attachment are interrelated and infused with different forms of proximal relation to climate change, localising climate change in the 'out there' or 'the home' and bearing an impact on how people attribute meaning to climate change (see Figure 3.1). To following chapter empirically examines how people construe climate change through their engagement, psychological distance, and place attachment. How does the experienced locale serve as an anchor for understanding and assessing climate change and how does the global process of climate change influence the sense of the local?
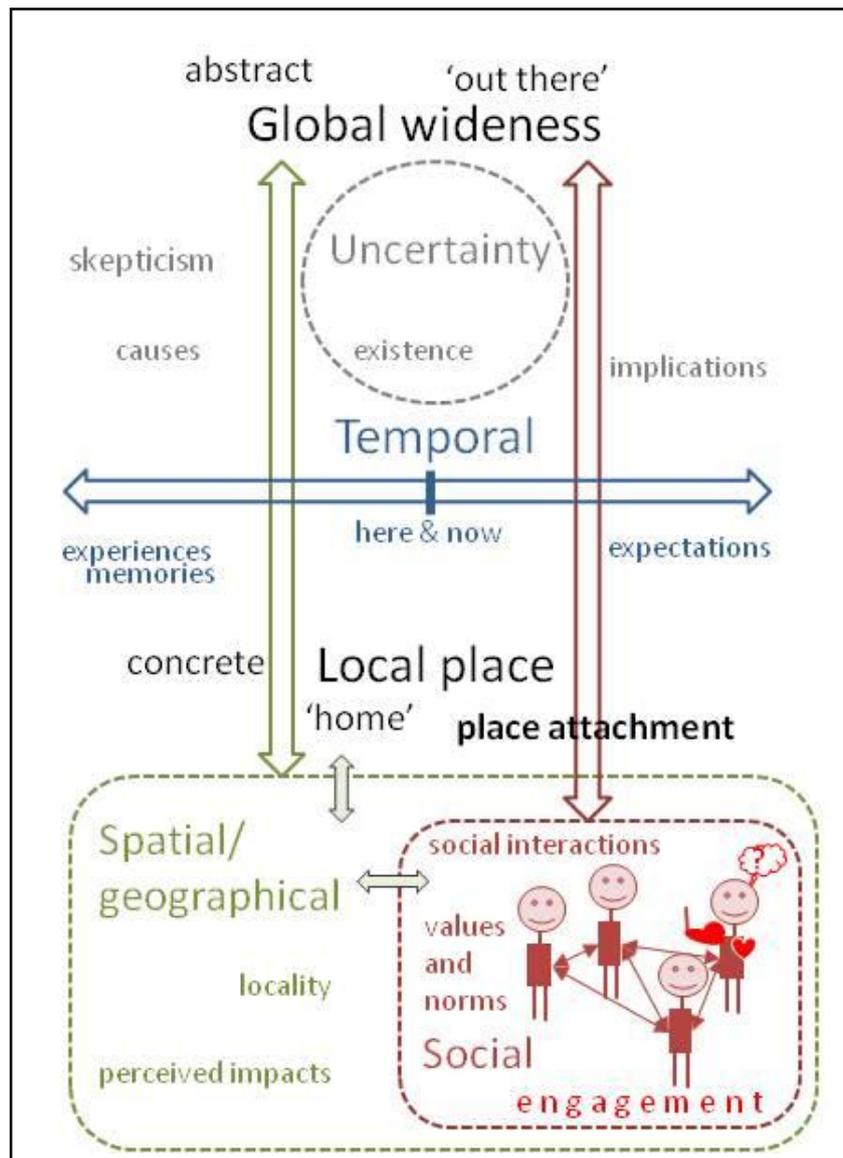
Figure 3.1: Conceptual linkage of climate-change engagement, psychological distances and place attachment

3.2   Empirical findings

This section is devoted to the analysis of the empirical findings of the in-depth interviews in Reußenköge (IR) and in North Frisia and Kiel (IN), the household survey (SR), and the group discussion with the aforementioned group of young people (LR). The section aims, first, to study people's place attachment and place-based social cohesion and problem setting (Section 3.2.1); second, to explore people's meanings ascribed to climate change and how these are informed by an underlying combination of different psychological nearness and distances (Section 3.2.2); and third, to investigate how people engage with individual and collective measures to counteract climate change (Section 3.2.3).

3.2.1 Place attachment and place-based social cohesion and problems

To understand people's socio-geographic embeddedness, analysis was undertaken of people's place-based attachments and social cohesion, and related problem setting. The analysis of the empirical results revealed that the majority of the people had a strong attachment to North Frisia in general and to their municipality specifically. About 84% of households of Reußenköge stated a 'very strong' or 'rather strong' attachment to the municipality of Reußenköge and, with 92%, an even stronger attachment to North Frisia (Figure 3.2). One interviewee explained the strong attachment to North Frisia:

> North Frisia symbolises for me the larger unit – the unit for the 'fight', human against sea and the other way around [...]. In Reußenköge there emerge also conflicts within and with the larger unit because of the small space. (SR_#49)

This quote reveals that the strong bond to North Frisia is based on experienced interactions (the 'fight') between humans and the nature, whilst the ties to Reußenköge are permeated with emerging conflicts. These conflicts may emerge due to the perceived 'small space,' while North Frisia represents the 'larger unit'.
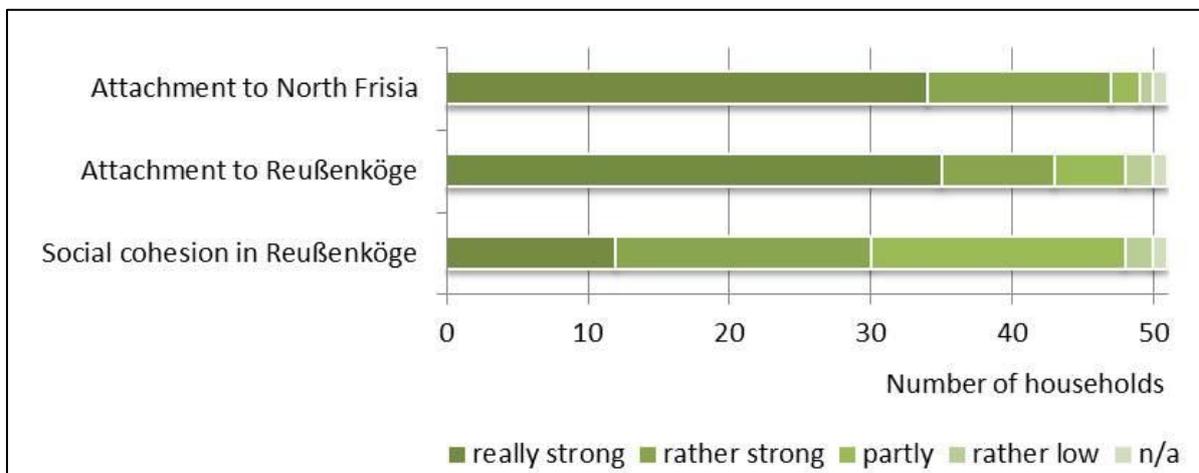
Figure 3.2: Place attachment and social cohesion. Household survey Reußenköge, 2014, N=51

By asking the open question of 'why' people feel attached to North Frisia and their municipality, thirteen of the twenty-three interviewed people answered that they feel attached to their municipality because it is their sense of home ('*Heimat*').

> First, place of home; second, family; third, the dike... the dike, the nature, um... growing up, going to school – home! I would say. (IN_#6:25-27)

This quote indicates that the 'home' has been characterised by people with emotional, spatial, and social components. One person added to this sense by saying, 'I feel good here. I

love the landscape and the social environment' (SR_#37). Interviewees often used expressions like 'I love' to depict their emotional bonds to specific elements of their place. These elements consist of physical or social environmental aspects. 'We do have only flat land here; we have distributed settlements, distributed farms, and no central place' (IR_#7:84-85), one interviewee responded, framing the spatial patterns of Reußenköge. Common spatial components and other phenomena included the 'good air' (LR_group), 'the rough climate' (SR_#36), 'the sea, the wind, the width' (SR_#17) and 'windmills and biogas' (LR_group) shaping the landscape. Regarding their social lives, people often referred to their childhood and to their livelihood to represent their local anchoring: 'My roots are here' (SR_#38). Furthermore, one interviewee expressed his attachment by generally describing it as the 'habitat for family, friends, acquaintances [and other residents, with a] high recreational value' (SR_#18). The strong reference to the social is mirrored in the bonding between the inhabitants. One inhabitant quoted a North Frisian saying:

Wide heart, clear horizon! *(Rüm hart, klaar kimming!)* (SR_#24).

This quotation symbolises the open natural landscape of North Frisia ('clear horizon') and is tightly interwoven with the foresight, emotionality and open mentality of the people ('wide heart'). It indicates the relational characteristics between people and landscape: openness and wideness of the landscape and of the people's hearts are inseparably linked, if not interwoven. The openness of people is grounded in the experienced interactions between humans and nature: 'That the people are open-minded here, because they have always lived with natural hazards. And always had to deal with storm floods, fires and storms, isn't it?' (IR_#12:54-56). This statement reveals a strong relation between the inhabitants and nature, evidently based on experienced natural hazards.

The findings furthermore indicate that people strongly identify with the historically shaped land, and that they are proud of their ancestors, who have reclaimed and diked the land which forms their current livelihood. Through this process, the marsh land was created, to which the people feel strongly attached:

I am attached to my place of home. Especially because of the history. (IN_#5:16-17)

I identify myself very strongly with it, the municipality, with the young marsh. (IR_#6:21-22)

The second above quotation expresses the relevance of the marsh, a fertile landform along the coast, for the agricultural land use that is practised by many people in North Frisia. In the

minds of the people, the social landscape is still highly connected to agriculture: 'We do live all on the same...field, I would have just said...in the same landscape' (IR_#7:83-84). One interviewee explained his attachment to agriculture also as a bond to the place that might not always be positively framed: 'Because I was guided towards agriculture by my parents when I was young, and as a sole economic activity, you are often committed to the farm' (IR_#6:11-13). This commitment to the farm exhibits that he followed his parent's footsteps. The relation between the people and their place has been nicely described by one inhabitant saying, 'Nice place, nice people – what else?' (SR_#6). The expression 'what else?' strengthened the perceived generalisation of people and the landscape.

Although most of the people exhibited a strong attachment to their place, a few people did not feel this bonding. People justified this more negative view by saying, for example, 'too many windmills too close ' (SR_#26), the '"isolated" living of the municipality' (SR_#1), and 'low contact with other inhabitants' (SR_#30). This kind of response implies that wideness of the place might be impaired by windmills, or it may cause a perceived loneliness. Despite the negative aspects, it underlines again the importance of the social structure related to place attachment.

The attachment to North Frisia and the municipalities is found to be related to social cohesion in both positive and negative ways. This finding is also mirrored in the survey responses about social cohesion within the municipality itself. Approximately 59% of the respondents assessed the cohesion with very strong or rather strong, while approximately 40% of the respondents 'partly agreed' or 'rather agreed' (Figure 3.2). Reußenköge is perceived as a 'committed municipality' (SR_#1) where people meet and exchange, and almost 'everyone knows everyone' (LR_group). People stated that 'everyone helps everyone' (SR_#29, SR_#34) 'in emergency situations such as high water, fire, wind or other breakdowns' (IR_#1:22-23). This social cohesion also in emergency situations might be grounded in the historical development of the municipality:

> But for example my grandfather has built the dike here and, of course, together with 20 other famers in North Frisia. And of course it has created social cohesion through that alone. (IR_#7:41-43)

> Therefore it has developed quite a strong community spirit, because none [settlers] had a lot of money in their pockets to that time. To some extent, you were depending on each other, and I think this was quite defining. (IN_#8:55-58)

People related strongly to land reclamation and settlement by genealogically referring to their relatives ('my grandfather'), the collaboration between people ('together with 20 other farmers in North Frisia, were depending on each other') and the developed community spirit ('developed quite a strong community spirit'). Because the polders were created and settled during different periods of time, this attachment is found to be somewhat higher between the people living in the same polder. One interviewee explained his social cohesion within the polder named Desmerciereskoog:

> This polder was diked in 1767. So, we belong to the oldest municipality polder, in contrast to the Cecilienkoog and Sönke-Niessen-Koog, which were shaped and diked at the beginning of the 20th century. So yes, there is an historical attachment... (IR_#5:61-64)

A common historical identity was found, which may also have influenced the prevalent commonality between young and old people who speak to a large extend the local language, Low German (*Plattdeutsch*). As one teenager was referring to the local language, he said, 'You speak differently with the people' (LR_group). Moreover, people highly valued communal activities such as games or sport events and festivals organised by the voluntary fire brigade or children's festival. One interviewee described the tradition that people sing the song 'No nicer land' (*Kein schöner Land*) together during the children's festival (IR_#4:30-31). This song nicely expresses the attachment of the inhabitants to their local place. Furthermore, important associations in North Frisia are the voluntary fire brigades, the Country Women Association (*Land-Frauen-Verein*), sport association, the Country Youth (*Landjugend*) and a group of hunters. For example, the Association of Country Women was revealed to be highly 'enriching [...] for the cultural and collective life' in municipalities, villages and regions (IR_#11:30-31). Overall, people perceived the social fabric of their places distinctly. However, in contrast to the positive, negative aspects were also present.

Besides the positive social bonding, the formation of groups, envy and lack of integration of immigrants seems to add negative facets. Social cohesion was found to be partially dependent on 'interests, acquis and origin' (SR_#4), which were found to cause a perceived division of the people in groups of natives versus newcomers, farmers versus non-farmers, or owners of renewables versus non–owners of renewables. Related to that, one interviewee stated the competition between the people as factor which minimises cohesion 'because sometimes there is the factor of envy that is added' (IR_#12:16-17). Furthermore, in some municipalities there may have existed the problem of the integration of people into the social

life. This problem was found to be even more the case for immigrants from other places in Germany: '[...] immigrants, how we say nicely. Um... they have cottages, and you don't see a lot of them, don't know them, don't know who they are' (IN_#6:34-36).

To analyse the perception of different place aspects and for changes in the local place, the interviewees were asked about problems in the municipality. The assessment of interviews shows a high relevance of environmental and social problems. The survey in Reußenköge identified storm surges as the largest perceived problem, from which 57% of people felt that the municipality was strongly or rather strongly affected (Figure 3.3):

> Storm surge – what's that to me? (*Wat geit mi dat an?*) (IN_#3:236-237)

This quotation mirrors the local threat of storm surges as presented on a brochure distributed by the federal government about seven years ago which used the phrase as its title. Storm surges as a problem revealed people's awareness for the natural pressure of the North Sea:

> Okay, I mean you have to say that we do live behind the first dike. We experienced two or three months ago that the Blanke Hans, the North Sea, came higher than expected. We do live behind a dike enhanced 20 years ago. [...] We do live here relatively safe, but the storm in autumn has shown that nature is stronger than humans. (IR_#1:34-38)

The dike secures the protection of the hinterland; however, nature is perceived to be equipped with an unexpected power ('came higher than expected'), which might be even stronger than human-made barriers ('nature is stronger than humans').

Regarding the social situation, demographic change was identified as the largest problem affecting the social life in the municipality:

> There will be fewer students; there will be fewer kids, yes. So and that's not so nice. This was nicer in the past, because also fewer people will [now] go to the fire brigade if only the old ones will be living here. (IR_#12:26-28)

This quotation exhibits the local relevance of negative impacts caused by an ageing population. One interviewee elaborated on this relevance by linking it to local employment opportunities: 'Over-ageing, isn't it? Um... the children are moving away, work is....good, we have some jobs, but not for those who want to earn much money. Yes. Also, I compare it with us, two-third of the children moved away' (IN_#6:81-84). Related to the social life, the interview findings showed that great distances, especially for pupils travelling to school, are perceived as a problem. This finding was grounded in the fact that the rural municipality had

no school. These social challenges have also been disclosed in the survey: people felt 'strongly affected' or 'rather affected' by demographic change (47%), bad infrastructure (39%), climate change (41%), and conflicts with natural protection (39%) (Figure 3.3). Natural protection is perceived as a critical aspect in the region because people have the feeling that their opinion is not appreciated enough by the federal-state government:

> I also see it critically, how the [regional government, responsible for] natural protection, is dealing with us and thinks 'Well, they don't belong here'. There was the discussion about a 'free zone' of three kilometres without trade, without agriculture. And this I perceive as threat for us. (IR_#3:31-33)

The quotation reveals the lack of appreciation shown for the people ('how the [regional government, responsible for] natural protection, is dealing'), and the gap of appreciation shown for their place ('the discussion about a "free zone"').
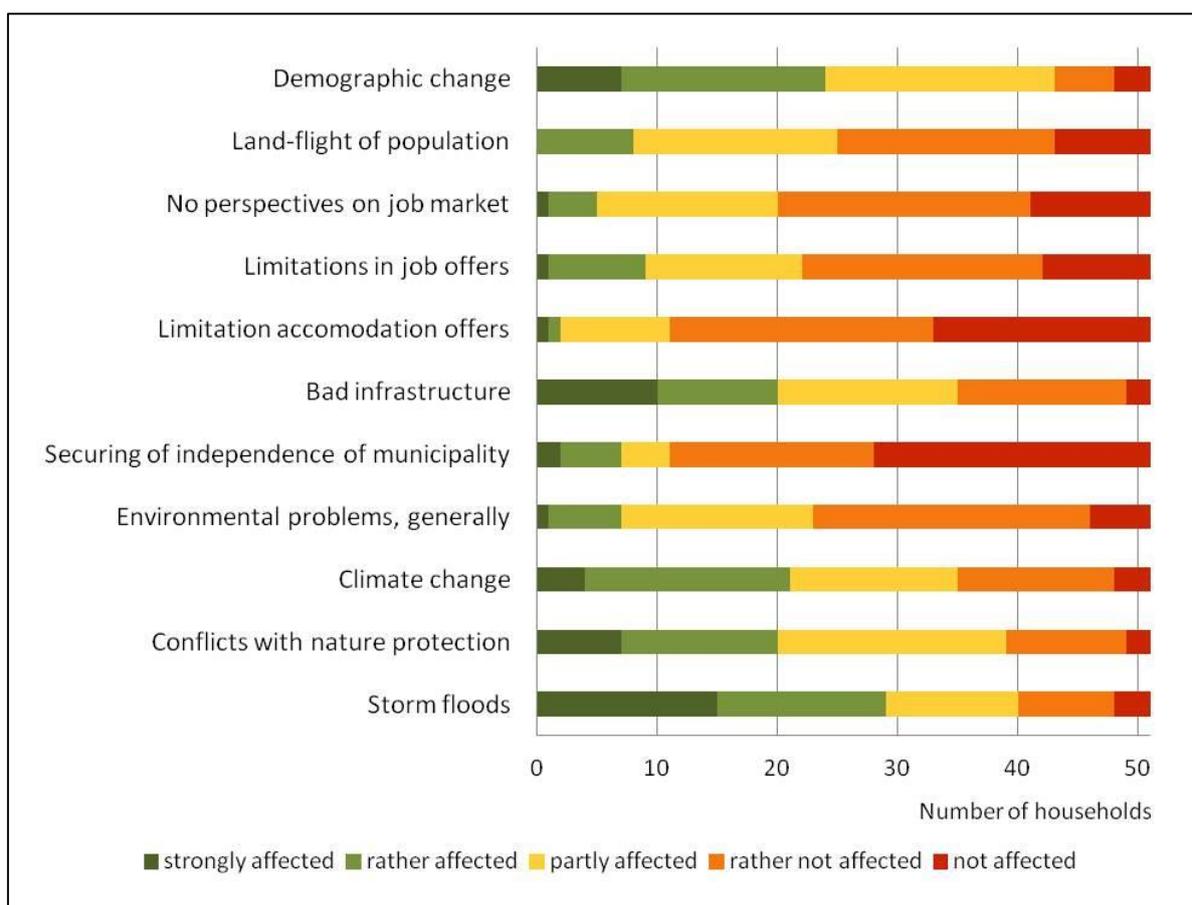
Figure 3.3: Perceived problems within the municipality. Household survey Reußenköge, 2014, N=51

The interviews furthermore revealed that the financial situations of the municipalities were perceived as a problem: '[The municipalities] have big deficits, communal financial

compensation and so on. I really think that's true for the whole area. The municipalities have no money […]' (IN_#5:105-107). This quotation exhibits the financial dependency of many North Frisian municipalities. The survey found problems related socio-ecological aspects, namely changes in the livelihood, acceptance of wind farms, noise and landscape image changes due to windmills, and furthermore, economic activities such as changes in the agriculture structure and emigration of economic power. In the interviews, people stated changes in the agriculture:

> But I see it with fright that the young people, especially here, do not have any passion for agriculture. Yes, it is….when I started here, we were 11 farmers in the polder and now, I think, we are only...two, four, six... six! (IR_#6:57-60).

The quotation suggests the decreasing interest of the youth in agriculture ('do not have any passion for agriculture'), and the perceived social threat caused by it ('I see it with fright'). Additionally, the interviews revealed envy and overarching economic activities as problematic. When it came to personal concern about problems, only 12 of the 51 respondents of the survey stated being personally affected by the problems, depending on their own or family-related situation. The personal concern reflects that although problems have been perceived to be locally relevant and thus proximate, they are often perceived to be personally distant. Problems perceived to bear impacts on the people are storm floods due to the low-lying land, conventional farming, the possible impacts of climate change and natural protection on farming, changes in the economic orientation of the companies, development in community windmills, and the departure of youth related to training vacancies and the bad country roads. This finding confirms not only anthropogenic impacts on the natural landscape, but also challenges for the social life and economics. However, generally, interviewees stated that the inhabitants are all good and have a relatively high income, there is a good social community, and thus 'love, peace and harmony' in the municipality (RI_#8:81-82).

3.2.2 People's meanings of climate change – psychologically proximate or distant?

After having investigated people's place attachment and social cohesion, this section explores what meanings local people ascribe to climate change. 'What does climate change mean to you?' was a general question given to the interviewees and participants of the survey. This question provided space for an individually driven thought process and enabled the interviewees to explore their meanings of climate change in relation to their experiences and

perceptions. All interviewees exhibited meanings of climate change which stood in stark contrast to the household survey, in which two people answered that climate change means nothing to them and five gave no answer. The analysis of the interviews revealed 11 structuring and interlinked analytical categories of climate change: global phenomenon, local phenomenon, phenomenon of concern, uncertain phenomenon, anthropogenically driven phenomenon, social change, issue of the future, materialisation of climate change, issue of education, political issue and terminology of climate change.

To start with, climate change was found to be conceived as **global phenomenon** that has generally been referred to as global warming: 'That the global warming is coming now […]' (IR_#12:37:38); 'Earth gets hotter' (LR_#5). However, this global warming was conceived as hardly perceivable:

> I believe you can't feel climate change. It is half a degree more or a quarter degree. It is hard to perceive but it is statistically there. (IR_#13:56-58)

> At the moment I cannot claim that I can feel anything of climate change. (IN_#6:140-141)

These quotes exhibit the social distance of climate change due to its gradual nature. Interviewees stated that global warming induces long-term changes such as the melting of the polar ice caps, increase in sea level rise, change of seasons and shrinking of glaciers: 'glaciers for 50 and 100 years, which have covered the mountains, and to where they retreated [now], if they are still there' (IN_#8:126-128). Climate change was mainly perceived to affect other regions or at least to affect them more significantly, while impacts have been even localised in the 'here-and-now'. One interviewee, however, explicitly referred to locally rising water levels:

> So, one spectre is always the water here. And this means that ice sheets are melting at the poles but also in Greenland, and the sea level is increasing. If you see that and the impacts would really happen like assumed then it could be that we are losing our home. (IR_#7:113-116)

This statement exhibits that climate change is found to be a globally relevant but also geographically distant phenomenon. Phrases such as 'ice sheets melting at the poles but also in Greenland' reveal that climate change is an abstract phenomenon, mainly perceived to affect distant regions, establishing geographical distance from inhabitants' own position in North Frisia. However, the geographical distance is reduced when put into relation with one's

own situatedness, as in, 'If you see that and the impacts would really happen like assumed then it could be that we are losing our home'. The geographical distance becomes more concrete and implicated in geographical and social proximity as expressed in the possessive pronoun 'our', but, temporally, it is kept as distant and hypothetical ('would' and 'could'). Such reflections might be informed by and grounded in information taken from the media coverage of climate-change impacts in other regions of the world:

> [...] if you see what impact climate damages can have on the Philippines or especially in third world countries... If you have been there… I personally was also not there. But if you see the images, I think this is enough incentive to do something about it. (IR_#15:139-142)

'The Philippines' inserts geographical distance, however, a social proximity arises from the quotation in its reference to motivation for action: 'I think this is enough incentive to do something about it'. The survey results indicated that approximately 62% of the people totally agreed that climate change is happening and assessed it as relevant (67% 'strongly disagree' that it is not socially relevant) (Figure 3.4). The geographical and social distances of climate change have been emphasised as a problem for perceiving the personal relevance of climate change: 'Because the problem is, climate change is there, but not with us. Yes, and it is easy to get to this thought. This I have to admit' (IR_#15:146-148).
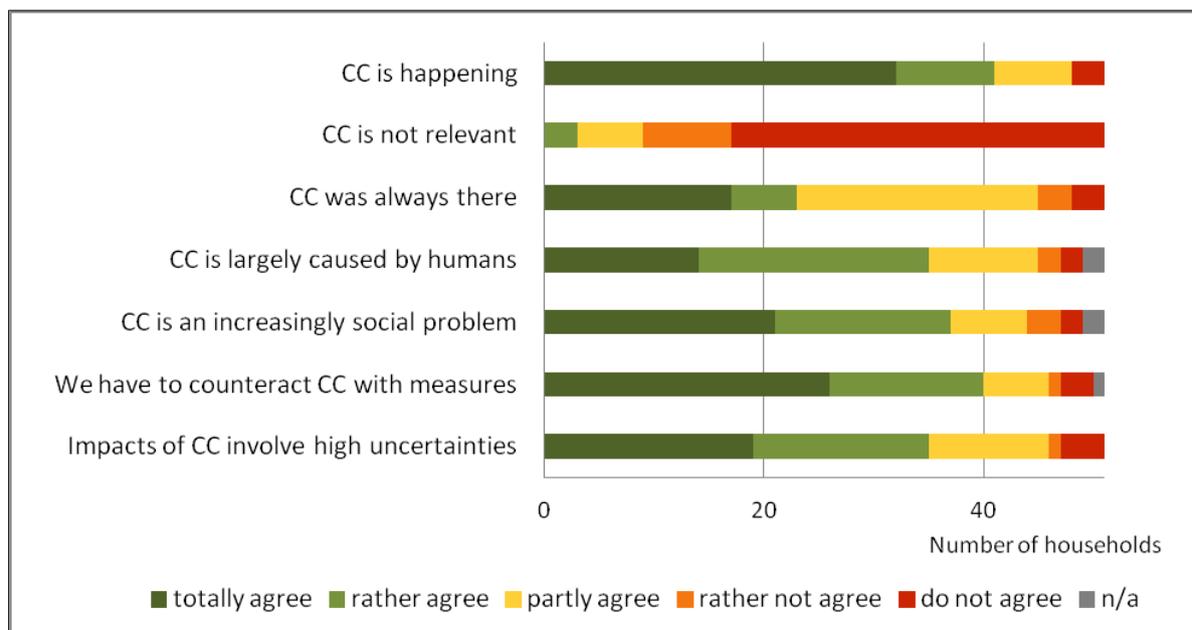
Figure 3.4: Perceptions of climate change [CC = climate change]. Household survey Reußenköge, 2014, N=51

As previously seen, the interviews are also permeated by the effort to localise climate change.

It is thus represented as a **local phenomenon** in form of short-term weather events, long-term changes in season, flora and fauna, and sea-related aspects engendered with personal experiences and memories. The most frequently mentioned long-term change, however, is sea-related aspects such as water levels, which are officially documented by measurements carried-out by local authorities: 'You can read the water levels from floods that flooded the land 500 years ago. But they are increasing over the recent years' (IR_#1:64-66). During the interviews, people often made use of their memory of storm floods and extreme weather events, which appear to be temporally distant but are in most cases used as backdrops for assessing the situation in the here-and-now:

> Yes and um... the experiencing and the story telling play an essential and formative role. I have to admit, I am also shaped by the storm flood of '62. (IN_#3:310-311)

> And the storm flood 1999 – Anatol – when the water was increasing rapidly. These are the things I've experienced. And the last storm [Christian] was the strongest [I've seen]. [...] Such a strong one I had never experienced before. (IR_#12:63-65)

These quotations exhibit social nearness and the formative nature of the experiences ('I am also shaped by the storm flood of '62'), but also the unexpectedness and extraordinaryness underlying latest phenomena ('I had never experienced before'). Another indicator for long-term climatic change is perceived seasonal changes:

> Because changes in the seasons we have to live with. We often say that winter and summer blend without a break, that the spring is not there anymore. That's at least what you perceive. (IR_#7:208-210)

Here, the change in seasonal sequences and even a loss of spring and autumn were articulated ('winter and summer blend without a break'). An interesting aspect of this statement is the use of 'we' in the first two sentences, which creates social proximity in terms of shared experiences and perceptions. Although climate change is literally not mentioned, a shared social vision of its impact in terms of disrupting temporal continuity in terms of successive seasons becomes apparent. Related to that, interviewees often related climate change to changing weather: 'If it would be a little warmer or so...But it's often more added to that, isn't it? The weather is changing a bit' (IR_#10:56-58). This statement mirrors local relevance by transforming distant climate change into increased extreme weathers including precipitation duration, dry periods, storms and increases in danger due to storm floods: 'But that we got ten weeks of dryness or eight weeks of rain. These are the trails which we have to

recognise' (IR_#10:41-42). The impact of extreme weather was mainly perceived in agriculture:

> I can remember the last dry summers. When the potatoes start to wilt in the marsh, this is extremely dry; when the ground here in the marsh doesn't deliver enough moisture to the potatoes... (IR_#6:122-124)

'I can remember', here, underlines the social proximity and the memories and experiences the person is referring to. Furthermore, the increase in temperatures seemed to have contributed to the immigration of flora and fauna species which 'had never had a habitat here [in North Frisia], formerly' (IR_#7:135). For example, one interviewee stated a change in the 'bird population for two years now' (IR_#14:21). In agriculture, changing climate was seen to have led to changes in crop cultivation: 'Yes, that we have grown corn in the marsh or rape in the geest, we didn't have that' (IR_#7:136-137). Hence, corn was called 'a child of climate change' (IR_#14:28), and it can be therefore conceived as an icon to frame the materialisation of climate change on the local level. Thus, it reveals a tension between social distance and material proximity. One interviewee added that

> the crop cultivation first came because the temperatures were increasing, not only because the crop became interesting for the people and the agriculture. Of course from the crop perspective, it contributed to the development, but in sum, I think, climate change has evolved and thus the crop has been established from the south to the north. Perhaps you can cultivate the crop in Sweden soon. (IR_#2:83-87)

While the quote exhibits the situatedness of climate change, it also transfers impacts to a distant but northerly 'neighbouring' country, Sweden. Thus, it reveals a geographical and social nearness, but also geographical and temporal distance ('perhaps', 'soon'). All the previously encountered phenomena in the interviews embed climate change locally by merging geographical and social proximities with phenomena of local environmental change.

Although a relatively strong perception of local climate-induced changes in the natural environment could be found in the interviews, this grounded awareness does not result in **concern**. The survey shows that the perceived concern by climate change follows a normal or Gaussian distribution curve with a highest peak for partial concern (Figure 3.5).
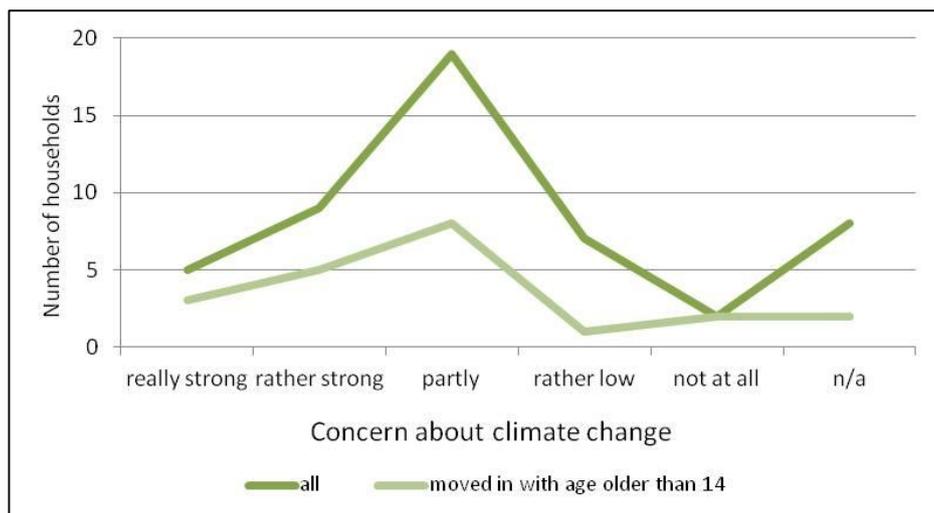
Figure 3.5: To what extent do you feel concerned about climate change? Household survey Reußenköge, 2014, N=51

Nineteen surveyed households or about 38% expressed feeling partially affected by climate change: 'I don't have a big fear, yet' (LR_#1) (Figure 3.4). People feel rather little, or virtually no, concern about climate change:

> That I do now feel a threat by climate change due to sea level rise or something like that, I cannot say. Perhaps it is because you are born here and you know everything with the dike...and so. Well, I never felt threatened that the water is coming over and that the water's coming up to my neck. Although, we have perceived storm floods as children […]. Yet, I've heard from others who moved here 'This is really bad'. I've never perceived it like that. (IR_#10:62-71)

The response brings two aspects to the fore: First, the perceived threat might be lower among people who grew up in the municipality, because they experienced and dealt with natural hazards in the past. Thus, temporally distant experiences (perceived storm floods as children) are synchronised with the 'here-and-now' to create security, while new people, who migrated to the place, lack this past experience and are more fearful: temporally distant and personal experience seems to correlate with lesser concern and fear. But less concern could also be a way of self-protection, as indicated in 'But, well, it isn't like a perception of climate change that we all must run away. That wouldn't be good for our municipality' (IR_#5:167-168). The quotation exhibits a relatively high degree of climate-change awareness but also a practical perspective on it. The social and geographical proximity expressed through 'we' and 'our municipality' arguably underpin the need to deal with temporally distant climate change instead of running away. This requirement was underlined by one interviewee even under uncertain future living conditions:

But for me it is nevertheless not the case that I pack the whole kit and caboodle and swan off, but that I contribute to the normal life and have at the back of my mind that I rarely can imagine that my grandchildren will be able to live here. (IR_#15:112-114)

Farmers, especially, felt affected by seasonal changes in terms of dry and wet periods of weather but were also willing to find adaptive solutions. Hence, one could say that the category of concern was permeated by social and geographical distance related to the impacts of climate change, while the temporal dimension of future climate change was informed by past experiences, producing a relatively low degree of concern. However, the awareness for the necessity to deal with climate change implies a social and geographical nearness and relevance today.

Not only under future conditions but also related to its existence, causes and implications, climate change is perceived as an **uncertain phenomenon**. One interviewee expressed his uncertainty about the existence of climate change: 'Uncertainty [about] climate change, [weather] Yes or No [it's happening]' (SR_#23). Some interviewees perceive natural variability as an integral part of the climate system: 'that [it] has always been in existence on Earth' (IR_#12:36), caused naturally, and that this variability leads to '"natural" changes of the weather' (SR_#27). In the survey, approximately 45% of the households 'strongly' or 'rather' agreed that climate change was always there and, further, 43% 'partially' agreed (Figure 3.4). Besides the general scepticism related to the nature of climate change, the majority of the people, almost 70%, 'strongly' or 'rather' agreed that impacts of climate change involve high uncertainty. While sea level rise seems to be clearly related to climate change, people are sceptical about the causes of extreme weather events. One main uncertain 'threat' is represented by the sea. One interviewee quotes his wife saying, 'Well, hopefully, we will always be lucky that the North Sea (*Nutze*) won't look beyond the dike' (IR_#7:73-74). Reference is made to the North Sea, with past and concrete phenomena such as past storms and their impacts on the interviewee's mind. The geographical and social proximity ('North Sea, won't look beyond the dike') is characterised as temporally distant, resulting in climate change being estimated to be an uncertain phenomenon ('hopefully, we will be always lucky'). Future impacts, especially, involve high degrees of uncertainty: 'There, I don't know what we have to expect. There, I don't know what our children and children's children will expect' (IR_#1:39-40). The quotation exhibits the temporal shift of climate change to the future ('children and children's children will expect') and underlines its uncertainty by constructing social proximity ('what we have to expect'). One interviewee added this aspect

of uncertainty by relating to projections of climate change by science: 'And my problem is that they – the scientists – cannot tell me where it goes, but um... can only represent scenarios. Or how you say, so nicely, if-then-relations' (NF_#3:69-71). The noted problem presents two considerations: the distance of science ('they'), and the distance of applicability of the results in concrete climate actions: 'scientists can only represent scenarios, cannot tell me where it goes.' The findings suggest that the uncertain nature of climate change leads to an intermingling of meanings between social and geographical proximity and future-oriented temporal distances. Although interviewees were sceptical about climate change and perceive it as an uncertain phenomenon, a strong requirement to counteract climate change was also found: 'Predominantly, it is naturally caused. Nevertheless, you have to do everything so that people do not influence it more than necessary' (SR_#33).

Besides the scepticism about climate change, the majority of inhabitants envisaged climate change as an **anthropogenically driven phenomenon**. The survey found that almost 70% of the people 'totally' or 'rather' agreed that climate change is largely caused by humans (Figure 3.4). The results of the group meeting with the youth revealed that four of the five teenagers connected climate change to 'CO_2', 'CO_2 emission' or 'stopping CO_2 emissions'. More specifically, most of them believed that climate change is largely caused by humans: 'an inevitable consequence of the burning of fossil fuels' (SR_#49). The fact that humans still cause climate change was perceived as 'greed, to account for humans' [relationship with] the environment' (SR_#31). This statement interestingly exhibited critique to a lock-in situation, which might be only financially and institutionally convenient. Social and physical places are locally affected by the consequences of high-emission practices and strategies, which challenge local dike and sluice management. Nevertheless or because of that, the interviews display an awareness of people's general responsibility for local emissions and their willingness to reduce them by 'doing everything in one's power to decelerate it' (SR_51). This 'doing everything' is largely represented by the reduction of emissions through locally managed renewables. The background of such transformations implies that people draw on different scales to bridge the gap between geographical distance and geographical proximity. The local reflection of emissions encompasses a social and geographical nearness. Emissions in land use and animal farming are perceived as a critical and challenging issue:

> What I am wondering, how it started...sometimes I am missing the extent a bit...how it started that cows produce too much methane. Well, our industries or comfort or our lifestyles produce so many environmental gases, and where do you start to look for it?

By the animals in the wild. […] I think there are other construction zones where you can save more. (IR_#5:131-134)

The response reflects on local emissions ('that cows produce too much methane'), but also questions the responsibilities of different sectors ('there are other construction zones where you can save more').

Besides being an anthropogenic phenomenon, climate change is mainly perceived as an **issue of the future**, which is often discursively related to possible impacts on and implications for future generations: 'I won't experience that (climate change), but our children...perhaps not as well, but our grandchildren' (IR_#7:116-117). The problem of climate change is again shifted to children and grandchildren, which constructs social proximity and a future-related temporal distance. This shifting might explain why people care much about the possibility of children continuing to live in the area:

I think about climate change long-term because it is a demographic problem, from my point of view. I think about my children and how they will be able to live with it. Perhaps they won't be able to live here. (IR_#15:91-93)

Here, climate change is conceived as a threat to future generations ('how they will be able to live with it'). People care whether their children will be able to live in the area, forming a social proximity with regard to the moral responsibility felt. One interviewee underscored that care by expressing decreased care about climate change because his children will not live in the area:

[...] it is a bit joking (laughing). Because I say to myself, if my boys won't become farmers, then climate change doesn't matter to me, if everything is under water. But I should sell [my land] on time (laughing). Isn't it? That's something taking out the pressure for me. For what should I care in the end. (IR_#6:76-79)

Generally, climate change can be interpreted as a socially near and relevant issue especially for parents. Nevertheless, a temporal distance is created because future generations are perceived as the ones who will be more affected and who might also be the ones who have to decide to what extent protection from it is suitable. Regarding coastal protection, one interviewee said:

People value the solidarity of the population that coastal protection has a specific status, because at bottom it protects everything. If the climate change or the sea level rise will further increase, you have to question, from the population side, to what

extent you can enhance coastal protection. (IR_#2:126-130)

Thus, climate change as an issue of the future exhibits its temporal distance ('will further increase'), hypothetical nature ('if the climate change') but also social ('question from the population side') and sometimes geographical nearness ('to what extent you can enhance the coastal protection'). One interviewee expanded on this complex of distance saying, 'And some serious scientists say the sea level will increase by 1.4 meters in the next 100 years. And then you have to know that every 50 centimetres of dike means 500.000 Euro per kilometre, which we have to add. You have to clearly think about it, what to do?' (IN_#3:1154-1158). The reflection nicely highlights the temporal distance of climate change impacts ('sea level will increase'), and the requirement and decisions to be made about measures ('have to clearly think about it, what to do').

Adding to input on the matter of dealing with climate change, some interviewees described climate change as social problem that requires **social change**. Climate change is perceived as an increasing social problem, about which approximately 73% of the surveyed participants 'strongly' or 'rather' agreed (Figure 3.4). As answer to climatic change, a behavioural change was thought to be required:

> I can even see that you have to change probably. So, some things will change. But I think that you can cope with that, because principally, it is a creeping process, which is relatively slow and you must change only [slowly]. (IR_#10:120-123)

A transformation was perceived to be needed in society – 'you have to change your attitude toward life' (LR_#3) – but also in the economy: 'Everything in the economy must become more sparing and ecological' (LR_#4). Adaptability was furthermore related to local extreme weather events: '[…] what you can perceive is that weather extremes are increasing and that you have to find adaptation strategies. In that respect, the willingness is there' (IR_#5:111-113). This adaptation involves a behavioural change, 'a change in practices' (SR_#18), 'to give up egoism' (SR_#18) and the willingness to adapt. 'Accept the new, let the old go' (SR_#18), stated one surveyed inhabitant to highlight the requested social openness. The analysis of the lines of argumentation reveals again a strong interaction between humans and nature: 'Restrict, rethink, live in conformity with nature, live natural. Perceive how the nature is fighting the exploration' (SR_#34). People seemed to be aware of their impacts on the climate and their need to adjust their lifestyles according to nature. It was furthermore found that climate change can motivate actions directly or indirectly: 'It is a serious threat that pushes me to fight against it!' (SR_#9). Overall, climate change induced social change that might be

embedded even in the broader social question of how to live with climate change in the future.

Climate change not only implied social change, it had already materialised in the living environment of almost all interviewees. This **materialisation of climate change** had already indirectly taken place in the form of dike enforcement, drainage systems, renewable energy technologies and other sorts of small activities of mitigating climate change:

> 100 years ago, there was the North Sea here [in the polder]; there was nothing here. From this perspective, we take something, we are allowed to keep it for a while and we have to give it back; not our generation, but the next. That is my perspective on climate change. (IR_#3:57-59)

This quotation nicely exhibits peoples' place attachment in terms of land reclamation and diking. In times of an anticipated climate change, people strongly identified themselves with the historically shaped land of the ancestors who created their current livelihood. Dikes are perceived as the essential protection measure: 'With the coastal protection we are all well, I think' (IR_#9:148). Nevertheless, the dealing with the foreshore was found to be a critical aspect of coastal protection. Although interviewees saw the foreshore as their 'protection before the dike' (IR_#6:209-210), people critically experienced the declining of the coastal zone instead of increasing over the last years: 'And I see a long-term threat in the end. Because we know that the tideways are changing and that also adnate surfaces can be degraded and lacerated' (IR_#6:218-219). Furthermore dike enforcement and renovation were underlined to adapt to climate change today and to secure the place in the future:

> And those are the consequences that we can perceive. For example, now in the area of Dagebüll, we have to increase the dikes. That's a consequence of climate change. (IN_#7:219-221)

> To deal with climate change, we have to build the dike higher; or the land. (IR_#8:227-228)

The dike is thereby perceived as the essential protection measure. '[…] The dike stands or the polder fills up like a bath' (IR_#1:106). This quote exhibits the symbolic power of the dike as a wall for protecting the land, and the manifestation of climate change in coastal protection. However, the awareness of the limits of adaptation were expressed by the phrase 'we have to give it back' (IR_#3:57-59). Under expected climate change, people anticipated that the degree of dike protection might change, but also that it is important 'to build with

anticipation' (IN_#3:201). The number of people who 'totally' agreed that the coastal protection is sufficient declined from 47% for current protection to 18 % for the coming centuries (Figure 3.6). As a result, approximately 63% of the survey participants 'strongly' or 'rather' agreed on the necessity for additional coastal protection measures. It becomes apparent that the aspect of climate-change materialisation is strongly connected to questions of the future ('not our generation, but the next') and that the objects of protection themselves blend temporal distance and proximity in the here-and-now of geographically experienced proximity. Although coastal protection seemed to be generally informed by a high degree of geographical and social proximity materialising amidst interviewee's lived experiences in terms of dikes, the need for additional adaptation measures was shifted to the future.
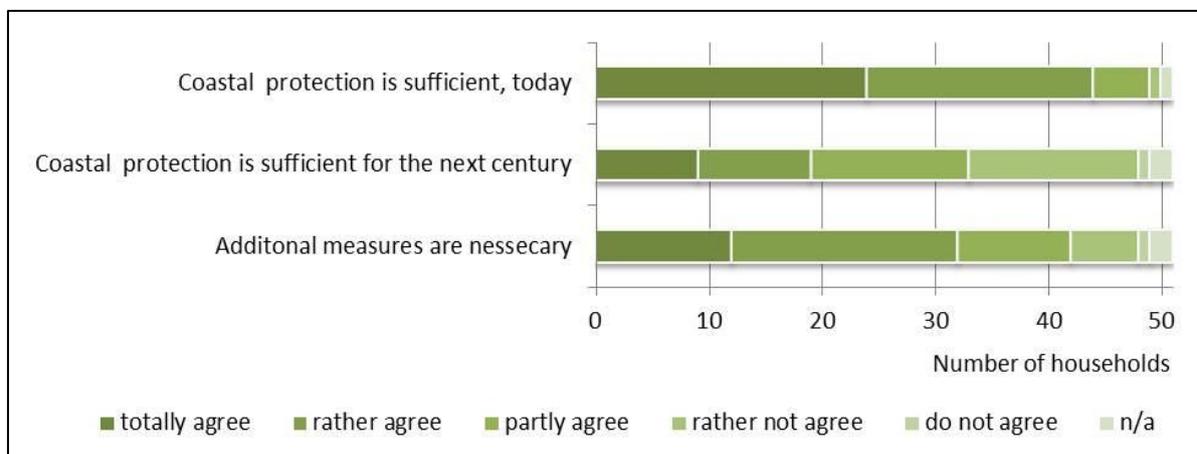
Figure 3.6: Perception of coastal protection. Household survey Reußenköge, 2014, N=51

Dealing with water coming from the sea, precipitation and its drainage from the hinterland into the North Sea were also of high priority: 'But it is more the technological handling with drainage. Here in the marsh, drainage is often the first issue' (IR_#6:131-132). Challenges for drainage were related to extreme precipitation that might even accelerate in the context of climate change:

> And I think you have to keep an eye on heavy rain because the entire surface water coming from the geest needs to be sluiced through the marsh. And this has to be guaranteed. (IR_#13:52-54)

Here, we find again a reaction to climate change materialising aspect in the landscape: sluices and, though implicitly, drainage ditches. Such landscape features are geographically near and could also, as objects of common interest and management, be conceived as generating social proximity through shared concerns about security ('And this has to be guaranteed').

Additionally, it was found that especially low lying areas were expected to be affected by drainage problems:

> We can also see that the question of drainage of heavy rain events will not only more strongly affect the water bodies but also the low lying areas. In Schleswig-Holstein, two thirds of the areas are drained towards the west and only one third, through relatively small and short, drains towards east. That's not unimportant to know. (IN_#3:920-926)

Climate change, moreover, indirectly materialises in the landscape in the form of renewable-energy technologies. One interviewee connected climate change and renewables by saying, 'But climate protection has no face. That's why the face of climate change is renewable energy' (IN_#5: 269-270). This quotation nicely expresses the hardly perceivable nature of climate change, on the one hand, and its local manifestation in renewables, on the other hand. Renewables were situated in the local place and perceived as a clean and non-polluting form of energy generation. People in North Frisian municipalities constructed a geographical proximity that closely connects energy generation and consumption through wind turbines, solar panels and biogas plants; their polder landscape; and climate change, as in the following interview excerpt:

> And from that perspective, in the polder we do have much energy which is generated from renewable energy. That is climate neutral. That is the simplest and nicest [form of energy generation] in the world. (IR_#13:89-91)

The merging of these different entities suggests a strong identification with the development of renewables and implies that mitigating climate change with renewables has strong geographical and social anchoring, mainly triggered by the underlying concept of geographical proximity. Approximately 78% of the surveyed households 'strongly' agreed that renewables contribute to climate protection, and about 73% 'strongly' agreed that therefore carbon dioxide emissions (CO_2) were reduced (Figure 3.7). Even more households, about 88%, 'strongly' agreed that renewables are important for an energy transition. This agreement was reflected in the high number of households who invested in different types of renewable such as wind turbines, solar installations and biogas plants: 'Yes climate change, you can see renewables are wanted and we are pioneers, so to say' (IR_#3:172-173). A strong identification with the development of renewables could be found in most of the people. This identification implies that mitigating climate change with them has a strong spatial and social anchoring in local municipalities.
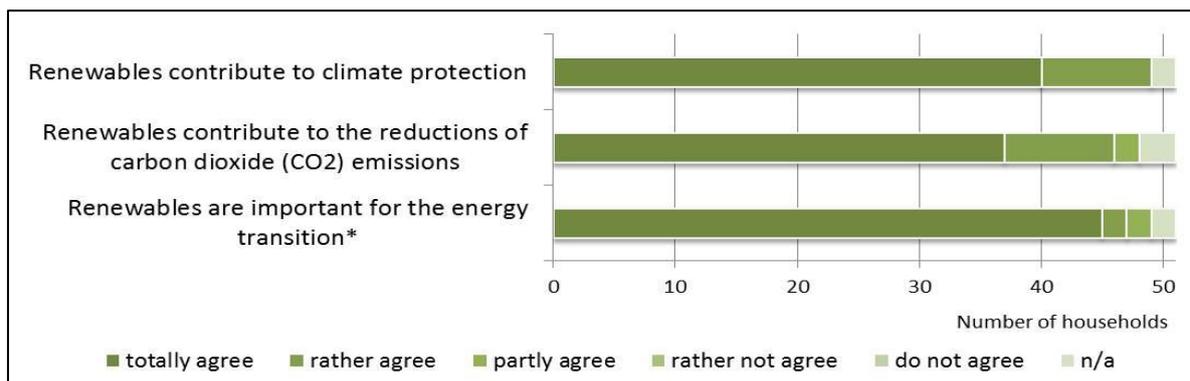
Figure 3.7: Perception of climate mitigation impacts of renewables. Household survey Reußenköge, 2014, N=51
*Transition towards a sustainable energy supply based on renewable energy

Furthermore, climate change was found to be also an **issue of information**, diffused through different communicative channels and provided by different sources. Information politics and education, which address citizens, were seen as essential for creating awareness, for contributing to personal relevance and for enhancing behavioural change. 'Climate change has for me a lot to do with education, because education is an essential aspect to stop climate change, from my point of view' (IR_#15:125-126). One interviewee elaborated by saying,

> And in the end, the information politics must address the citizens, which have to adopt their behaviour according to that. And if international agreements are signed, the education level of the usual citizen might be too low [...], in order to see the relevance: 'But I have my own problems; I cannot take care of the saving of the world.' (IR_#5:208-214).

The provision of information and education were perceived as important for personal climate change action ('information politics must address the citizens, which have to adopt their behaviour'). Whilst information via media and politics seems to be perceived as unspecific and less trustful ('I feel influenced'), local information sources might be more effective for creating awareness and to inform people ('you know from each other'):

> Felt [concern], because I feel influenced by politics and media. (SR_#33)

> There it is important that you know from each other and that you can use also the multipliers in the association. (IR_#11:184-185)

One interviewee added the aspect of information by referring to the role of science: 'For this, science has a really important position, which can say you, you have all right, but we do have the observations of the last 60 years. And then you can see from 2014 to 2015, there was one

day more with storms, but if I look on the last two generation, then we talk about a quadrupling of such climatic changes. And this I think is really exciting [...]' (IN_#8:165-170). Climate change, as an issue of information, exhibits its social and temporal proximity, which equips people's sense-making about climate change with trustful and less-trustful information and knowledge.

Interaction with the interviewees reveals that climate change has much to do with politics. The **political issue** of climate change involves global aspects such as international climate agreements, the national scale, in terms of financial incentives for investments in renewables, and the regional level, in terms of local management and place-based planning. Generally, people underlined the importance of globally binding climate agreements:

> Well, I would wish that they (politicians) would speak plainly and consider the matter. Miss Merkel is in London, I guess, and that she agrees on something and not only small talk, shaking hands and taking photos, but rather that they talk straight. I would say, the climate shows us what is going on and the temperature curves, that the temperatures have increased. Obviously, nobody cares about that. And that's so dangerous. (IR_#8:256-260)

A strong focus was put on global emissions and the common responsibility to decrease emissions to mitigate climate change. While these decisions are made in geographically distant political hubs, their results were perceived to affect people locally. Although mainly geographically distant countries such as China, India and America are envisaged as the main emitters, the required support by those countries provided the effectiveness to the geographically near.

> Well, world politically, that the countries such as China, India and America will pull themselves together and reduce emissions a bit more, with less fuel consumption in cars and less emissions in industry. And I think it is impressive, how egoistic these countries are. The smog threat in China – where people have to walk on the streets with masks. That's so sad, I think. (IR_#12:109-112)

This response displays the relation between causes of emission and their impacts on society. The problem, however, becomes apparent as global treaties and contracts work on different geographical scales and have to be broken down to the regional or local dimension. The distances and proximities implicated in these processes represent one of the main problems for coordinated action that considers the emplaced and grounded aspects of climate

adaptation and mitigation. Challenges of proximity have even been found within Germany. The interviews revealed the importance of regional and local management plans and strategies:

> But we do have the issue of coal and especially in Germany. I think it is unbelievable, that the portion of coal electricity is increased even further [...]. You don't need to pay for CO_2 and if it is polluted in the air, it hurts me in my soul. And we make a lot of effort for CO_2-free electricity production [...] (IR_#15:118-122).

The quote exhibits the dependency of the effectiveness of local measures ('we make a lot of effort') on national targets ('portion of coal electricity is increased even further'). Thus, local actions are perceived to require governmental support and incentives in order to enable an energy transition. The district of North Frisia aims to become the most climate-friendly district that has been positively assessed, even as 'the highlight, which we do have here' (IN_#5:258-259).

Finally, the **terminology of climate change** itself was criticised by interviewees. This aspect was justified by the use of the phrase 'climate change' by media to explain everything and the non-representation of climate change's actual meaning. 'For me, it is a media catch phrase which is a summary for all weather phenomena' (SR_#49). This conviction represented the interviewee's perceived use of the term in media to explain weather events. By explaining his understanding of 'change', one interviewee said:

> Because climate change, yes, everything is in change. The climate has been always changed. Yes, and it is also not changed, but it is a...in my view, we are destroying our livelihood – for us, for our children for our grandchildren, our future generation. And this is, in my view, extremely irresponsible. (IR_#15:134-137)

This statement expressed that climate change is mainly a term that does not explain causes and actual impacts on human and environmental systems. Therefore, it evinces social proximity.

The 11 different empirical categories analysed were saturated with and based on a vast array of interacting psychological distances and proximities (Table 3—1). Combinations of different social, geographical and temporal distances exhibit how people on the local level in North Frisia constructed, interlinked with and – more importantly – related to the abstract entity of climate change. The network clearly indicated that climate change was an entity of importance, even though the interaction between the conceptual proximities and distances

found in the empirical categories did not enable clear or dichotomous distinctions. What appears to be of vital importance is the fact that social and geographical proximity, in connection with temporally distant developments (past or future), seem to provide entry points for the willingness to engage with climate-change mitigation and adaption. The physical and social place provided an important context, engaging people in three ways: to memorise experienced events and adaptation strategies, to relate to currently perceived changes and measures (re)shaping local places, and to think about possibilities to actively adapt to future expected climate change. In short, present-pasts and future-presents (Koselleck, 2004) need an anchoring in the here-and-now to generate psychological relevance and emotional concern for an engagement with climate change.

Table 3-1: Overview of the meanings of climate change and related psychological distances and proximities identified

Meanings of climate change	Psychological distance or proximity	Qualitative and quantitative examples of the survey
Global phenomenon *Global happening; globalising causes, consequences and actions*	Geographical distance, social distance and proximity	'Change of the worldwide climate' (SR_#4). 'Global warming' (SR_#25) 'Change of the nature with all that belongs to it' (SR_#18) ~80% 'totally' or 'rather' agree that climate change is happening ~87% 'totally' or 'rather' disagreed that climate change is *not* socially relevant
Local phenomenon *Local relevance of causes, consequences and solutions*	Geographical proximity and distance, social proximity	'Stronger storms, longer dry periods, stronger precipitation' (SR_#50) 'I don't see climate change in our region so strongly' (SR_#39). 'increasing water levels' (LR_#2) 'Not at all. Both of the last storms, 'Xavar' and 'Christian', were extreme but not unusual for this region' (SR_#24).
Partially concerning issue *Between distant threats and local threats*	Social distance and proximity, geographical distance and proximity, temporal distance	'Worldwide threat' (SR_#21) 'Threat for humans!' (SR_#1) 'Risk for the environment' (SR_#45) '[...] does not affect me yet' (SR_#7) ~38% feel partially affected by climate change
Uncertain phenomenon *Uncertainty and scepticism about existence, causes and implications*	Temporal distance, social distance	'Uncertainty [about] climate change, [weather] Yes or No [it's happening]' (SR_#23) 'It is too hastily considered' (SR_#41) ~70% 'totally' or 'rather' agree that climate change involves high uncertainties ~45% 'totally' or 'rather' agree that climate change was always there
Anthropogenically driven phenomenon *Human-induced causes of climate change*	Social distance and proximity, geographical distance and proximity	'CO$_2$' (LR_#2) 'Change in climate is preliminarily caused by human impacts.' (SR_#43) 'Human-caused changes of long-term and mid-term weather phenomena' (SR_#37) 'Cutting of rainforests' (LR_#3) ~70% 'totally' or 'rather' agree that climate change is largely caused by humans

Meanings of climate change	Psychological distance or proximity	Qualitative and quantitative examples of the survey
Social change *Behavioural change to mitigate of and adapt to climate change; economic transformation*	Social proximity	'A serious topic in the society' (SR_#22) 'Environmentally aware life' (LR_#8) 'Adaptability' (SR_#18) 'Everything in the economy must become more sparing and ecological' (LR_#4) ~73% 'totally' or 'rather' agree that climate change is an increasing social problem
Issue of the future *Generational shift of impacts*	Temporal distance, social and geographical proximity	'Future forecasts of sea level rise' (SR_#21)
Materialisation of climate change *Technological mitigation and adaptation measures to deal with climate change*	Geographical proximity, social proximity, temporal distance	'Generate energy from other sources to "relieve" nature' (SR_#29) 'Fight through measurements like renewable energy' (LR_#3) 'Dike construction' (SR_#36) 'Enforcement of dikes' (LR_#3) ~96% totally or rather agree that renewables contribute o climate protection
Issue of information *Education* *science* *information sources, networks*	Social distance and proximity	'Felt [concern], because I feel influenced by politics and media' (SR_#33).
Political issue *Requirement for political will and incentives*	Social distance and proximity, temporal distance	'Worldwide efforts to stop it' (LR_#4)
Terminology of climate change *Implications related to the term*	Social distance	'For me, it is a media catchphrase which is a summary for all weather phenomena.' (SR_#49)

3.2.3 Counteracting climate change

The analysis of the ways people make sense of climate change revealed a high materialisation of climate change in measures and that people perceive such measures to be highly relevant. Thus, this section investigates the behavioural dimension of engagement. Generally, the interviews showed that people were mostly not aware of or did not distinguish between mitigation and adaptation measures. Due to their distinctive nature, various measures are, nevertheless, analysed here by considering their type, based on the IPCC definitions. While adaptation in human systems 'seeks to moderate harm or exploit beneficial opportunities' (IPCC, 2015), mitigation involves the 'human intervention to reduce the sources or enhance the sinks of greenhouse gases' (IPCC, 2015). The interview results furthermore identified three responsibility types: governmental measures, collective measures and individual measures. In the scope of the research, the focus lies on collective versus individual actions. Different measures could be identified, according to measure type (adaptation and mitigation) and responsibility type (individual and collective).

The findings revealed three main groups of **mitigation measures**: energy efficiency measures, electric- (e-)mobility and renewable-energy technologies. To start with, energy-efficiency measures mentioned by the interviewees include the adoption of energy-efficient appliances such as washing machines or of energy-efficient lighting such as energy-saving lamps and LED lights. The survey in Reußenköge reveals that about 45% and 39% of surveyed households answered that they had 'totally' adopted energy-efficient appliances and energy-efficient lighting, while another large number 'partially' adopted them (Table 3-2). Furthermore, people stated the insulation of buildings as an important measure to reduce their heating demands. Related to that, people adopted more efficient heating systems such as with pellets or the use of thermal discharge from biogas:

> You could say now, we talk about the insulation of buildings, for example. That you have to isolate your houses and that you have thermal conduction, uh… central thermal conduction. On the yard we have, for example, all houses profit from the biogas plant. We also have vacation apartments. That we use the discharge heat of the biogas motors as heating source, for example, isn't it? (IR_#1:134-138)

The remark highlights the possibilities for energy-efficient heating and insulation of buildings. The survey found that only 33.3% of the households stated having a well-insulated house, while 47% have 'partially' insulated their house (Table 3-2). The high costs involved in insulation could be identified as barrier to implementation. Regarding heating, almost 63% of households stated having adopted an energy-efficient heating system, including wood pellets or gas heating systems. Beyond these technological changes, the survey results indicate also a high willingness for behavioural changes. Approximately 43% of the households reported not using the sleep mode, a low power mode, for their electric devices and about 67% turn off the lights while leaving the room.

Table 3-2: Energy-efficient measures adopted by households, Household survey Reußenköge, 2014, N=51

	Energy-efficient appliances		No sleep mode* for electric devices		Energy-efficient lighting		Turning off light then leaving room		Insulation		Energy-efficient heating system	
	#	%	#	%	#	%	#	%	#	%	#	%
Yes	23	45.1	22	43.1	20	39.2	34	66.7	17	33.3	32	62.7
Part.	26	51.0	18	35.3	24	47.1	13	25.5	24	47.1	/	/
No	1	2.0	10	19.6	5	9.8	4	7.8	10	19.6	19	37.3
n/a	1	2.0	1	2.0	2	3.9	0	0	0	0	0	0

The second, and most surprising, group, is sustainable and electric or e-mobility. 'Electric mobility is another key in the direction of climate change' (IN_#5:186-187), said one interviewee, highlighting the importance of transportation in the climate debate. Generally, people perceive a high potential for e-mobility and highly value the use of the freely available wind electricity: 'Um… there are nice calculations. If the whole region doesn't use fuels for mobility anymore but muscles and electricity, then you need 60 windmills. 60, we do have. We do have over 700' (IN_#2:348-351). Although, interviewees expressed their strong interest in electric driving systems, possibilities for the adoption of e-cars are mainly perceived as limited:

> Electric cars don't work enough, you cannot drive far enough. If I drive to Husum, then I will be stuck in between and I cannot come home. Otherwise I would also switch to them. Electronic cars would be really a topic for me. (IR_#3:101-104)

About 53% of the households in the household survey reported having an energy-efficient car, while three people answered that they owned an electric car (Table 3-3). Local entrepreneurs, especially, seemed to have already adopted e-cars in their companies. On the community level, opportunities have been realised concerning e-bike renting stations and electric charging stations:

> And we support also things like e-mobility, also the charging stations for e-mobiles such as cars and bicycles. And this is also fed by wind energy. Behind my house there is a charging station. And I think that we [in our municipality] try to do something, as well as we in the municipality. In the municipality, in general, we try to adopt energy saving–friendly measures where ever it makes sense. (IR_#9:69-73)

This quotation nicely underlines the perceived support for energy-efficient measures on the community level, and the strong individual identification with it, as expressed by the phrase 'we try'.

Table 3-3: Energy-efficient measures adopted by households, Household survey Reußenköge, 2014, N=51

	Energy efficient car		Use of public transport		Walk or cycle short distance (up to 5km)	
	#	%	#	%	#	%
Yes	27	52.9	6	11.8	16	31.4
Part.	1	2.0	13	25.5	26	51
No	22	43.1	31	60.8	9	17.6
n/a	1	2.0	1	2.0	0	0

Furthermore, in the household survey, the people were asked whether they cycle or walk short distances and whether they use public transport. Approximately 31% of the people cycle or walk short distances, while a further 51% 'partially' do so (Table 3-3). Interviewees justified the high dependency on their car with time-saving and relatively rough weather conditions in the region. With about 61% of the people, the majority stated never using public transport. This relatively low number might be owing in the limited availability of public transport, in general. The school bus was mentioned as most important regional public transport, for bringing the children to school.

The third and largest group is energy generation with renewable-energy technologies.

> [W]e have the energy in North Frisia for 300%, for example […]. We could supply for ourselves three times […] three times and in such a federal state, which is simultaneously affected by climate change, which will drown us if we don't become active in the next centuries. (IN_#5:188-192)

The 'we' expresses the strong common bonding of energy generation in North Frisia, which is perceived as an important measure to counteract climate change. On individual level, people adopted renewable-energy technologies, such as solar installations, to generate electricity, or for heating they adopted small-scale wind turbines or biogas plants. The results of the household survey show that 48% of the households adopted solar panels and about 34% adopted a wind turbine, individually, over the early years, or they invested in small-scale wind turbines. Furthermore, some farmers could provide their land for the construction of a community wind farm. Collective investments in community wind farms were revealed to be the most important and highly accepted measures: 'Yes, with the wind farms, that these are all community wind farms, that is a good thing' (IR_#13:164-165). This reliance on wind farms is also reflected by the survey, since about 88% of the households in Reußenköge were stated to have invested in a community wind farm (Table 3-4). Other collective concepts were applied to solar and biogas. In the municipality, a solar farm was built with people from the municipality and outside the municipality. Furthermore, some inhabitants of the municipality participated in a collective biogas project in a neighbouring municipality, which has been, however, unsuccessful. Another interesting aspect related to RETs was that less than half of the households had a green electricity provider and thus give their money to a company investing only in and pushing the development of renewables (Table 3-4). One interviewee justified his decision by voicing his doubts: 'You could switch to green electricity, but green electricity also comes all out of the same grid. From that perspective, I'm always a bit critical'

(IR_#3:97-98). This respondent outlined a critical view based on the 'unseen' nature of the kind of electricity consumed. Furthermore, it was surprisingly found that many people adopted mitigation measures, although they still evaluated their abilities to have an impact on climate protection as low: 'That's all the theme of energy. How can I save fossil fuels? As private person, you are a really small light. What can you do personally about climate change? Indeed, you can inform yourself, but as a private person you have almost no approach' (IR_#1:155-157). 'A really small light' highlights the limited perceived impacts of individuals but also the importance of the collective underlying the energy question.

Table 3-4: Renewable-energy technologies and green electricity adopted by households, Household survey Reußenköge, 2014, N=51

	Solar individually adopted		Wind individually adopted		Wind community-adopted		Green electricity	
	#	%	#	%	#	%	#	%
Yes	24	47.1	14	27.5	44	88.2	20	39.2
No	26	51.0	29	56.9	6	9.8	29	56.9
n/a	1	2.0	8	15.6	1	2.0	2	4

Besides the mitigation measures, four main groups of **adaptation measures** could be identified: coastal protection, drainage, adaptation of buildings and adaptation in agriculture. Coastal protection was perceived as the most important measure in order to deal with future sea level rise: 'More self-protection you cannot build up. The dike is the dike must…' (IR_#12:56-57), said one interviewee, underlining the importance of the dike line. The main responsibility for coastal protection has been devoted to the regional government and federal state, respectively: 'We've had dike enforcement in the 80s, 90s, but…well, it is through federal governmental measures' (IR_#5:148-149). Nevertheless, people perceived the relevance of the municipality and local organisations in taking care of the dike management:

> Yes, the municipality can only do a little because it is a matter of the federal state. But there are attention and criticism also if there is not enough done. And they look to the hands of the federal state only because of the sluice associations which are on site. Looking at the dike, yes, everything is under observation, and with hawk's eyes, that everything is kept in tip-top order here. (IR_#12:81-84)

This response underlines the importance of local involvement, which has been mainly devoted to the dike and sluice associations. One interviewee expanded by emphasising the importance of dike and sluice associations or water and soil associations:

> Um… the dike and sluice associations or water and soil association, as they are called in

some areas, the organisation of the landowners, which takes care of the water-economic questions. And I believe, because the landowners come together, it's the right form of organisation to deal with such things. (IN_#3:742-747)

Here, it became apparent that the local organisations are especially valued for tackling issues related to water and soil. However, it was also expressed that technical support is needed to enable such local management. The voluntary fire brigade was furthermore found to be important for disaster management in case of storms and floods. Relatedly, the relevance of local engagement in the form of the dike reeve and firemen was justified by one interviewee:

Now, you can become active in an association, which takes also care of and supports [protection measures], such as the fire brigade which stands the disaster management in North Frisia. It is important, I think, that you give support financially or get involved as a volunteer. (IR_#4:162-165)

In the household survey, 38% of the respondents were found to be engaged in a dike and sluice association and 30% in the voluntary fire brigade (Table 3-5). Furthermore, interview results revealed a high willingness to help in case of an emergency such as floods or storms. About 86% of the survey respondents stated that they know neighbours who would help in such an emergency case. Besides the communal cohesion in case of emergency, it could be found that other adaptation practices slowly get lost. One interviewee explained the situation in case of the reactions to a power-failure in case of the storm 'Christian' in 2015:

Um… and in the past there were battery-driven telephones. Um... nothing, no light. We have searched – where are our candles [...] How do I get information? [...] Ah transistor radio, mhm. What do I do if the electricity is gone, how do I get… Hm…, torches. Um, and what happens with groceries if [storm] takes longer? There are so simple things which get lost. (IN_#3:258-266)

This respondent nicely expressed how the non-experience of certain events may affect preparedness ('so simple things which get lost'). Although people experienced storm surges and may expect a higher number of storm events, retreat was not perceived as an option, but moreover seen as a threat to people's livelihood: 'Well, there are people who would prefer to sacrifice low-lying areas such as ours. Yeah, there are such people. [...] That you want to flood [our area], there, I ask myself…such people you should give a ban on talking' (IR_#1:342-356).

Table 3-5: Engagement of local households, Household survey Reußenköge, 2014, N=51

	Engagement in dike and sluice association		Engagement in voluntary fire brigade		Knowing neighbours who would help	
	#	%	#	%	#	%
Yes	19	37.3	15	29.4	44	86.3
No	30	58.8	34	66.7	6	11.8
n/a	2	3.9	2	3.9	1	2

Not only the water coming from the sea but also the inland water through heavy rain puts pressure on the land. Therefore, people perceive drainage as highly important in order to transport the water into the North Sea. 'Sluices have to function' and 'drainings's need to keep clean' in order to guarantee efficient drainage (IR_#14:48 and IR_#14:46). One interviewee underlined the importance of the dike and sluice associations for drainage:

> [How drainage works you] know only roughly… There, you are not alone. There are many people [thinking] "Why? The water flows down the hill and somehow it flows into the North Sea." Just, anybody is doing it, and it is being done. And this the sluice associations do, in principal. And here I would wish that it is more recognised that they are doing it. (IR_#10:522-525)

This quotation highlights the importance of managed drainage and its recognition ('that it is more recognised that they are doing it').

Third, the precautionary maintenance of buildings was considered an important measure to increase resilience in case of storms: 'The only measures are that you keep your building in a good condition so that the storm cannot affect it' (IR_#3_113-114). Besides maintenance, it was apparent that in case of new construction and reconstruction, people do care about the structural engineering of the building and attend to the orientation of the building. 'Well, I took care that the ridge of my new building is in east-west-orientation' (IR_#6:181-182), said one interviewee, because buildings with north-south-orientation are more susceptible to storm damage and become more easily unroofed. In the survey, people were also asked about insurance for their properties and precautionary protection measures. It was that, at 88%, a majority of households had an insurance for storm damage and flooding (Table 3-6). In contrast, barriers for doors and windows and flood security for electric and heating systems seem to be less prominent. Approximately 92% of the respondents stated having no barriers installed, and about 53% have no security measures yet implemented for electricity and heating.

Table 3-6: Precautionary adaptation measures adopted by households, Household survey Reußenköge, 2014, N=51

	Insurance for storm damages or flooding		Barriers installed for doors or windows		Flood secure electric or heating system		Attending information events about climate change and adaptation	
	#	%	#	%	#	%	#	%
Yes	45	88.2	0	0	5	9.8	5	9.8
Part.	/	/	2	4	15	29.4	15	29.4
No	4	7.8	47	92	27	52.9	28	54.9
n/a	2	3.9	2		4	7.8	3	5.9

Low adoption numbers might be grounded in the perception of requirements or lack of information. The interview results revealed a relatively low interest in information events about climate change and adaptation. According to the survey, only one third of households had attended information events. Information brochures were found to be more effective if distributed though interpersonal communication and local social networks:

> Yes, there are also information brochures distributed [by the federal state]. And there results also the effective networks, which I've mentioned. There it is important that you know from each other and that you can use also the multipliers in the association. (IR_#11:183-185)

Lastly, changes in the nature have already led to changes in agriculture. Some people perceived the need for a change in agriculture management or crop cultivation because the 'farmers work with the nature' (IR_#2:112) and also for economic reasons. The change in crop cultivation has been perceived with the cultivation of corn but is also expected to evolve even further in the future: 'And if you see the whole thing from the agricultural perspective then I think that other varieties will be cultivated here' (IR_#13:54-55).

In sum, a range of mitigation and adaptation measures were discussed, along with the relevance of the individual and collective actions through which they are implemented. It also became apparent, however, that some groups are related or even overlap and thus may have a twofold potential to mitigate and adapt to climate change (Figure 3.8).
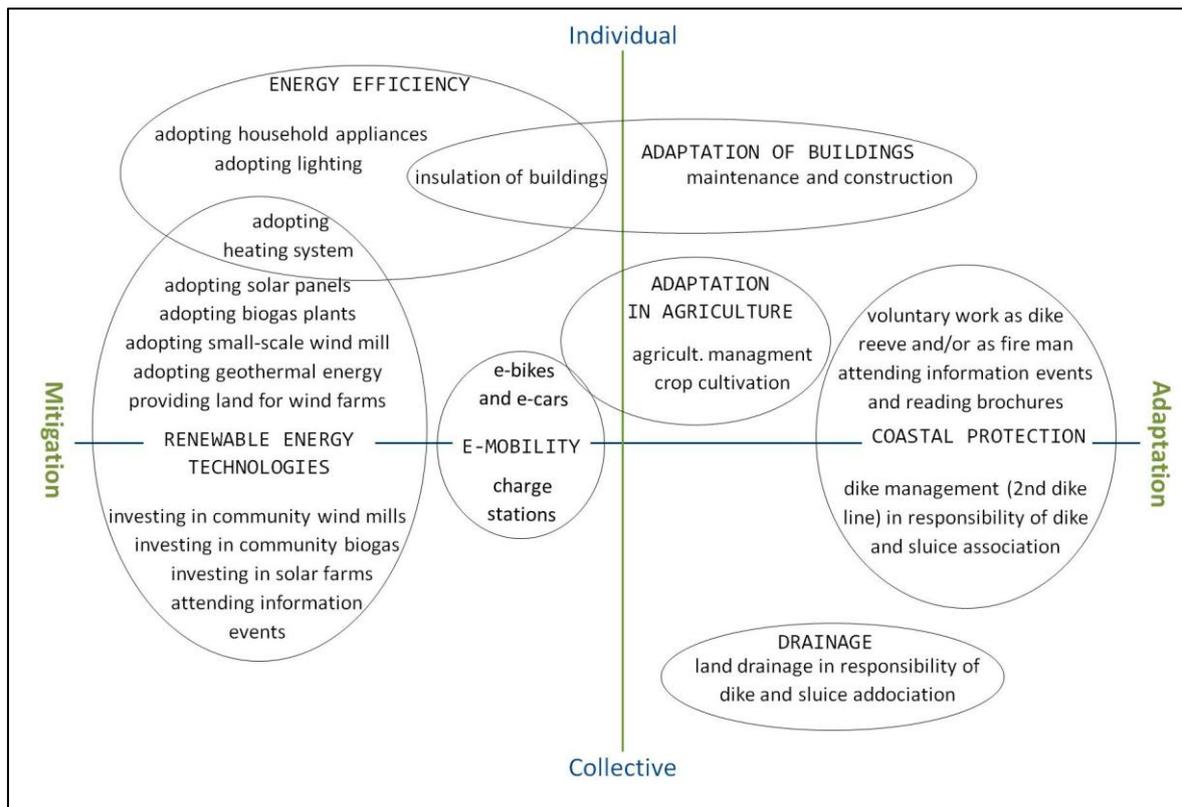
Figure 3.8: Overview of mitigation and adaptation measures adopted on individual and collective level, based on the interview results

3.3 Discussion

The empirical findings presented suggest two main elements: i) the pivotal role of place attachment and ii) the dynamic nature of psychological distances in making sense of climate change. To start with, recent research (Scannell & Gifford, 2010a; Devine-Wright et al., 2015b) highlights place attachment as an important predictor of climate change engagement. People with distinct place attachment may care more about their place (Gifford, 2011), and they are therefore supposed to engage more (Scannell & Gifford, 2010a). In the present study, a generally strong place attachment to Reußenköge and North Frisia was found that would indicate high willingness to engage with climate change and adaptation as well as mitigation measures. The findings revealed the importance of socio-cultural bonds between people and place through accounts of past memories and experiences. People referred to memories of place-based climate-related events, and experiences at the individual and collective levels to deal with environmental changes. This focus became especially apparent in relation to land reclamation, dike building and dike enhancement, which were informed by strongly emotional and historical place-attachment between people and nature. Concerning coastal protection, a strong motivation to protect the municipality could be found and a

rather robust engagement of people in related local organisations. Changes in the sense of place were furthermore revealed because renewables are an integral part of the identity of the community. Although renewables precipitate impacts on the landscape image and might even harm the place, many people are locally engaged in community wind farms and the adopted solar panels or biogas plants. The relatively high level of acceptance was found to be also rooted in the need to protect the place for future generations. These findings complement previous findings, which indicate that a strong place attachment does not necessarily lead to place-protective behaviour, but may even encourage openness to change (Manzo & Perkins, 2006). Place attachment could be an important ingredient of people's perceptions and the acceptance of place changes. This facet of place attachment also confirms that place attachment is dynamic and that its relation with climate change is far from being unidirectional.

Secondly, the present research discloses a much more complex picture of psychological distances of climate change as the interviewees' conceptualisation oscillated between different and even opposite mixes of psychological distances engendered by climate change. Adding to research by McDonald et al. (2015) and Spence et al. (2012), the findings indicate that concepts of distance and proximity might often co-exist and that different distances and proximities are connected or tied together. This relationship became apparent in the 11 categories of climate-change meanings: (1) climate change is a global phenomenon that is happening and implies global causes, implications and actions; (2) climate change has a local relevance concerning causes, perceived impacts and offered solutions; (3) climate change is of concern, while local threats are perceived as less than distant hazards; (4) climate change involves much uncertainty and scepticism regarding its existence, causes and implications; (5) climate change is mainly anthropogenically driven; (6) climate change requires behavioural and social change in order to minimise causes and to adapt to unavoidable impacts; (7) climate change is perceived to affect future generations much more than people today; (8) climate change materialises in locally implemented mitigation and adaptation measures; (9) climate change is also an issue of information and of creating awareness; (10) climate politics must involve a global agreement fostering local efforts; and (11) the term 'climate change' does not itself represent its true nature.

Considering the categories, firstly, understandings of climate change were found on a continuum between global wideness (geographical distance) and local anchoring (geographical proximity). The global aspects of climate change were generally represented by

distant icons and events, while proximal ones were mainly emplaced. People mentioned the local effects of climate change and the global ones sometimes even in one sentence, highlighting their mutual relationship. This finding contrasts most studies, which found that climate change (Leiserowitz, 2007), is perceived as geographically distant (Lorenzoni & Pidgeon, 2006; Leiserowitz, 2007). One study (Leiserowitz, 2005) found that people tend to use mainly global and future images of climate change. Here, interviewees were continuously reasoning about climate change meanings based on memories of the past, current observations and future scenarios. Climate change is not just happening now, but it is also strictly related to the past. History and experiences of storm surges and dike-building appeared to influence people's awareness of climate change–induced sea level rise, and, furthermore, people's emotional engagement and their preparedness to get involved in organisations. This finding is in line with Spence et al. (2011), who showed that the experience of flooding influences the way that people think about climate change. However, McDonald et al. (2015) point out that experiences have only a topic-specific influence on engagement. Furthermore, the topic of climate change instigates questions of how it will be in the coming years and decades. People still estimate that the next generation, in particular, will feel the main impacts of climate change, but that they might be the generation who has to change the climate trend.

Individuals tended to highlight the individual dimension of climate change (What can *I* do? How is climate change affecting *my* life?) and often extended it to the community level (*we* do, *we* try). While this kind of social proximity was recurrent, people assessed threats to other regions as much higher. A limited concern is present, and it could be not proven that a perceived distant threat leads to a level of awareness that is not enough for engagement (Chess & Johnson, 2007; Leiserowitz, 2005, 2007). The study reveals rather high levels of engagement, even under uncertainty about climate change, although a high level of uncertainty and scepticism related to climate change was found, as other studies did (Spence et al., 2012), and uncertainty has been not used to justify inaction (Lorenzoni et al., 2007). In line with Spence et al. (2012), it must be furthermore noted that it is important to consider the different kinds of uncertainty and scepticism related to climate-change's existence, causes and implications. Moreover, other agents were also cited as relevant ones, in particular politicians and scientists. In line with Lorenzoni et al., (2007), politicians were often estimated to be socially distant actors who lack action. Thus, people underlined the need for increasing global political efforts and local support. Scientists were also often represented as

socially distant and persons whose assumptions and knowledge are based on non-local events, and therefore met with scepticism. Thus, to engage people with non-context specific climatic change and expected changes, the distribution of information via trustful mediators was stated to be important. Emplacement of scientists, politicians and practitioners seems to be therefore inevitable in order to perform a situated science that engages with local people, institutions and concerns.

Furthermore, climate change seems to compete with other issues and problems (Lorenzoni & Pidgeon, 2006; Lorenzoni et al., 2007) which might be more important to emplaced locals or more often contemplated than climate change (Gifford, 2008). The findings exhibit social and environmental problems that are of high or higher priority or simply not, per se, relate to climate change, such as storm surges or demographic change. While concern about climate change may fail to address its personal relevance, measures that help to cope with climate change have the ability to provide solutions for personally relevant problems. For example, the development of renewables may create local jobs and help to stop land flight. Additionally, other studies (Kates & Wilbanks, 2003; Leiserowitz; 2007) suggested that the message of climate change would be more effective if it were to capture climate change's local materialisation. This research supports this assumption because the significance of climate change was commonly represented in its local challenges and opportunities.

To reflect on the materialisation of climate change, two main levels of action could be identified: the individual level and the collective level. In the book *Engaging the public with climate change*, Whitmarsh et al. (2011) highlight the importance of increased consideration of individual and collective levels. Related to individual engagement, awareness for 'lifestyle choices and specific behaviours' features prominently (Scannell & Gifford 2010a:61). A general reluctance to lifestyle changes was not found, as indicated by another study (Lorenzoni et al., 2007), however, willingness seems to be limited. Wibeck (2014), furthermore, has argued that climate-change engagement is largely formed by the interplay between people and the 'interaction with socio-cultural traditions' specifically. This research stresses the importance of the 'tradition' of coastal management for the current dealings with coastal adaptation. Adaptation can be found to be historically grounded, and its importance appears to be common sense. Renewables, in contrast, are found to be innovative and driven by a collective effort. Four different dimensions of measures can be, thus, highlighted here: measures to adapt to climate change or mitigate climate change performed on the individual or collective level.

3.4 Interim conclusion and policy recommendations

Overall, the empirical study reckons that place attachment and psychological distances and proximities are important ingredients of meanings of climate change and, moreover, of the engagement of people's hearts, minds and hands. Through the analytical methodological and empirical integration of engagement, psychological distances and place attachment, their interdependencies can be analysed. How people make sense of and engage with climate change is demonstrated to be more than a static condition, but rather a process informed by the interaction between psychological distance and place attachment. As a consequence of these findings, it becomes apparent that both psychological distance and proximity are present in individuals´ processes of framing climate change. While global images seem to strengthen the broader picture and the relevance of different places, local images make it near and perceivable. Proximity is highly reflected in the materialisation of climate change in adaptation and mitigation measures (Figure 3.9). Adaptation is largely informed by community knowledge and experiences, unfolds its main impact at the regional level and, therefore, results in a direct feeling of protection. In contrast, local mitigation is highly informed by creativity and innovation and is expected to provide an essential contribution to the climate on global scale. Underlying community-based experiences, memories and knowledge should all be recognised as place-based resources for an effective and sustainable adaptation to and mitigation of climate change in regional areas. Nevertheless, community action has limitations, and it should be highlighted that support by regional and national governments is unalterable for long-term prevention and mitigation of natural and climate change-driven phenomena.

In conclusion, the findings presented here conceptually and empirically reveal the importance of people's socio-geographic embeddedness for how people relate to and engage with climate change. It can be thus concluded that a place-based approach is promising because it considers climate change in people's localities, accounts for place-based resources, and represents the local opportunities of climate change related to social problems. Looking to climate change as catalyst and to places as sources for innovation and creativity, the next chapter will explore the interplay between place, local entrepreneurship and community-based renewables in detail. How do place and place-based entrepreneurship influence local energy transition?

Figure 3.9: View from the Sophien-Magdalenen-Koog sea wards (windmills and dike in the back), Reußenköge, January 2014

4 Harvesting energy: Place and local entrepreneurship in a community-based renewable-energy transition

A transition from agriculturalist to energy-culturalist

– From harvesting fields to harvesting energy.

North Frisian saying

Renewable-energy transition creates new energy landscapes characterised by a physical (re)shaping of places and a social transformation of communities into renewable-energy communities. Chapter 3 revealed that the local grounding of climate change is highly reflected in a strong materialisation of climate change in renewable-energy technologies. Inhabitants attributed much importance to their transition from mere energy consumers to energy producers who contribute to a local energy transition by referring not only to renewable-energy technologies themselves but also to social aspects underlying energy transition. Thus, this chapter explores the importance of place and local entrepreneurship in a community-based energy transition based on locally managed wind turbines (often named windmills), solar installations, biogas or geothermal plants.

Community renewable energy or *community renewables* have developed into a hypernym comprising small-scale and local renewable-energy generation by communities of place or interest (Walker & Cass, 2007; Walker & Devine-Wright, 2008; Feldman, 2014). Successful examples of community energy initiatives include energy communes, energy cooperatives or cooperative schemes, participatory local governance and transition towns, proceeding as best cases and highlighting the empowerment of cities, communities and neighbourhoods in energy transition (DECC, 2014a; BMUB, 2014). In this light, community renewable energy can also be conceived as a grassroots innovation concept for enabling sustainable energy generation (Hargreaves et al., 2013; Seyfang et al., 2014). Diverse kinds of localised and more participatory renewable-energy projects have been recently acknowledged for increasing awareness and acceptance of such renewable-energy technologies, and furthermore, the peoples' engagement with sustainable energy issues and behaviour more generally (Walker & Cass, 2007; Rogers et al., 2008; IZES, 2015). However, local energy transition has not remained unquestioned in the population and is often contested in a variety of cases. Problems on the regional and local scales have emerged, and some studies have applied the

concept of NIMBY ('not in my back yard') to characterise a movement, NIMBYism, and analytically address the discrepancy between people's openness towards new technologies of energy generation, as well as their opposition to the implementation or expansion of such technologies in their living environments (review see Burningham et al., 2006). Generally, the NIMBY 'syndrome' is defined by 'the motivation of residents who want to protect their turf. More formally, NIMBY refers to the protectionist attitudes of and oppositional tactics adopted by community groups facing an unwelcome development in their neighbourhood' (Dear, 1992:288). Yet, this concept has been criticised as analytic tool for its rather *ex-negativo* perspective, which conceptually overlooks the role of 'otherness' in siting processes (Wolsink, 2006; Burningham, 2000) and how the roles of support and objection are embedded in local places and communities (Devine-Wright, 2009). Because so far, theoretical and methodological attention has rarely been devoted to local places as spatial and analytical units (Devine-Wright, 2015a), this research places local places and communities in the central focus of analysis. Understandings of socio-geographic places of energy transition are insufficiently studied and often remain underestimated. This chapter takes this gap as a starting point to empirically explore the interaction and mutual interdependence of socio-geographic place meanings, place attachments and local entrepreneurship in the context of a climate-oriented energy transition. The main research question is: How do place and local entrepreneurship affect the emergence of grassroots innovations in the context of renewable energy?

The development of renewables was explored in the municipality of Reußenköge in North Frisia. The first wind turbine was built there in 1983 — a Vestas V-15 with 55 kilowatt —, and other single wind turbines followed in the beginning of the '90s. Post millennial, the community experienced a strong development of community-owned wind farms, solar installations, and biogas plants driven by strong technological progress and the financial incentives (Figure 4.1). In 2015, six single community wind farms were united to the community wind farm, the 'Bürgerwindpark Reußenköge GmbH & Co. KG' (Dirkshof, 2015). The wind farm consists of about 75 turbines in which 101 inhabitants of Reußenköge are involved. Besides wind energy, there are, nowadays, about 105 solar installations including one solar farm (three construction phases) and six biogas plants (DGS, 2015c) (Figure 4.1).
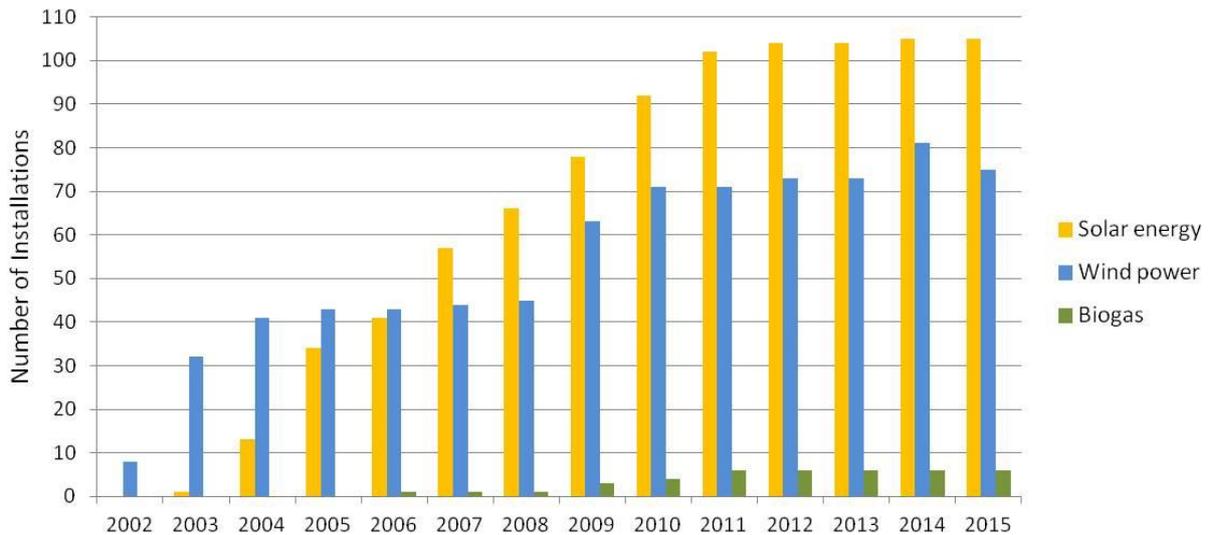
Figure 4.1: Development of community-based renewable. Data source: DGS, 2015c (data status: 24.08.2015)

As case study, Reußenköge was investigated, by conducting 15 semi-structured interviews and by analysing regionally relevant documents and policy reports (for a detailed explanation see Chapter 2). In order to qualitatively assess the different perspectives of a development from harvesting fields to harvesting energy, people's framings of community-based energy transition in Reußenköge are examined. The in-depth interview started with the question of people's place attachment (Manzo & Devine-Wright, 2014) to the region (North Frisia) and the municipality (Reußenköge). This question was followed by queries addressing social life and interactions, and the problems the municipality is currently facing. Furthermore, people were asked about their framings of climate change, personal experiences of it and expectations about future climate change. Finally, questions were asked revolving around measures to prevent climate change in the community and an assessment of these measures currently being taken. These interview questions were thematised in order to answer the following questions: How do places impact on local people and how do the actions of people reshape different characters of place? The chapter thus aims at investigating what socio-geographic aspects permeate the framing of local renewable energy and in what way the processes underlying these framings could contribute to an improved acceptance and adoption of community-based renewable energy. This chapter's four sections, firstly, present the conceptual framework and, secondly, the empirical results, and then, thirdly, discuss the empirical findings and, fourthly, draw conclusions.

4.1 Conceptual linkage of place, local entrepreneurship and community renewables

Over the last decade, *community* has been associated with renewable-energy projects, energy initiatives and energy policies in the area of research on energy policy. The noun 'community' is itself derived from the Latin words *com* (with or together) and *unus* (the number one or singularity) (Delanty, 2010), and the term as such has been used to analyse different forms of communities: small or large communities, locally or globally organised, with inherent 'thin' or 'thick' attachments, based on ethnicity, religion, politics or interest (Delanty, 2010; Feldman, 2014). In this context, the terms 'community renewable energy' and 'community renewables' refer to renewable-energy–generating social groups and structures that possess high degrees of project ownership and yield collective benefits on a local level (Walker & Devine-Wright, 2008). The concept of community renewables can, furthermore, be divided into two innovation perspectives: the technological innovation of the renewable energy technology itself and the social innovation initiated by its implementation through community action. New technologies can, hence, be conceived as actors that set social dynamics in motion which 'occur within a [specific] place and define a community [or social structure] of common interest around' it (Lowe & Feldman, 2008: 265). Such conceptual insights have paved the way towards an understanding of 'community renewables' as grassroots-led innovation that generate socially acceptable and contextualised bottom-up solutions for sustainable energy generation (Seyfang & Smith, 2007; Hargreaves et al., 2013). Such locally grounded innovation processes and concurrent social structures are often the outcome of private initiatives and can result in institutionalised organisations such as community energy initiatives, energy communes, energy cooperatives or more loosely connected entities such as cooperative schemes, participatory local governance and transition towns. Thus, such grassroots innovations are motivated by 'push factors' coming from specific people (Tanimoto, 2012), represented by the *unus,* or even a whole community, represented by the *com*. Intertwined aspects that trigger different kinds of engagement are ecological, economic or social aspects motivated by social needs, normative frameworks and certain ideologies (Rennings, 2000; Seyfang & Smith, 2007). This account is, however, only one side of the coin, as grassroots innovation requires 'pull factors' coming from the government. In this context, recent research has underlined that more attention must be given to (i) *where* grassroots innovations are created in order to situate renewable-energy

technologies and (ii) to better understand social and institutional changes induced by so-called 'soft' innovation (Rennings, 2000; Devine-Wright, 2011; Howells & Bessant, 2012).

These aspects have gathered attention in the field of *innovation research* that took profit from geographical research as it enhanced its conceptual scope by adding 'proximity and location to innovative activity' (Feldman & Kogler, 2010:381). Recent research has indicated that the geographical environment, in combination with social context, bears a significant impact on the innovative performance of companies and communities (Howells & Bessant, 2012). The concept of the socio-geographic setting includes analytical units such as social relationships, communication and interaction, routines, habits, and norms considered to be important for shaping the typical innovation potential of a region (Storper, 1997). Particular features that mark innovative and successful places are described with a 'spirit of authenticity, engagement and common purpose' (Feldman, 2014:10). Such elements portray, according to Feldman (2014), the 'character of place'. Although Feldman's characteristics appear to be of little analytical value, they refer to an understanding of place, place history and place attachment as outlined in research on place (Tuan, 1977) and sense of place (Buttimer & Seamon, 1980). Such approaches provide important theoretical and methodological elements to spatially and qualitatively refine and improve the place-related study of innovation processes, the emergence of technologies and the development of organisations and institutions (van de Ven, 1993; Feldman & Kogler, 2010).

The concept of *place* represents a longstanding analytical concept in geography that helps in the study of place-related social and emotional engagements with locality (Feldman, 2014; van de Ven, 1993). In the context of the study, place could be envisaged as the practical starting point and resource for innovative and entrepreneurial activities because people engage with their places via 'minds and hearts': they are suffused with meanings, endowed with values, knowledge, labour and governance structures and replenished with 'histories' which contribute to developing dynamic, consistently positive attachments to socio-physical locations (Brown & Perkins, 1992; van de Ven, 1993). An often-synthesised definition of place attachment from Brown & Perkins (1992) highlights its stabilising and dynamic nature, including both its individual and its collective aspects:

> Place attachment involves positively experienced bonds, sometimes occurring without awareness, that are developed over time from the behavioral, affective, and cognitive ties between individuals and/or groups and their sociophysical environment. These bonds provide a framework for both individual and communal aspects of identity and

have both stabilizing and dynamic features. (Brown & Perkins, 1992:284)

In the context of place changes as induced by renewable-energy technologies, the social and emotional dimension engendering place attachment was found to be of vital importance when it comes to developing social acceptance and trust (Devine-Wright & Howes, 2010). People 'are motivated to seek, stay in, protect and improve places that are meaningful to them' (Manzo & Perkins, 2006:347), although one has to bear in mind that place-protective behaviour does not imply that people are critical of change, per se. On the contrary, people perceive the opportunities of community-based renewables and can become actively involved in or even initiate community projects (Rogers et al., 2008; Devine-Wright, 2009). Recent research has too often emphasised the relevance of individual feelings and experiences, and to a lesser extent analysed collective place meanings and place attachments in a socio-geographic context (Mihaylov & Perkins, 2014). However, in the context of community renewables, the enlargement of the scope in terms of collectively shared place meanings and place attachments is imperative because they are grounded in situated socio-geographic places and local communities (Manzo & Perkins, 2006). The community perspective differs from the individual perspective in terms of (1) the extension to the local area, (2) the widening towards the level of some agreement among community members, (3) the more holistic focus relating to neighbourhood, city or municipality as a whole place and, most importantly, (4) collective responses (Mihaylov & Perkins, 2014). Psychologically speaking, three dimensions inform community place-attachment: mutual emotional bonds to home and community; shared place meanings, experiences and knowledge; and collective behaviours towards community planning, protection and improvement (Scannell & Gifford, 2010b; Mihaylov & Perkins, 2014). Manzo & Perkins (2006) however, emphasise that spatial and social dimensions of community place attachment primarily consist of emotional bonds with physical and social place. Understanding shared place meanings and attachments in the context of community renewables is hence important because intangibles such as place-related values and feelings are found to bear an impact on instigating engagement and participation (Manzo & Perkins, 2006; Gee, 2010).

In drawing on engagement with renewables, people are actors who identify, evaluate and make use of opportunities for innovation and entrepreneurship from a place-based perspective (Shane & Venkataraman, 2000). Innovators and change agents can be interpreted as local entrepreneurs who have the ability to detect occasions, develop prospects, raise social awareness for opportunities, gather support and transform innovation into a business

(Feldman, 2014; Tanimoto, 2012). Hence, their activities are a driving force underlying the innovation of community-based renewable energy. Entrepreneurship emerging in local places includes the study of locally anchored sources of opportunities, underlying social processes and practically involved individuals (Shane & Venkataraman, 2000). According to Schumpeter (1942), entrepreneurship is the engine for economic development. He defines the entrepreneur metaphorically, as the personified engine that embodies the previously mentioned characteristics (Schumpeter, 1942) and makes use of locally grounded ingredients in a creative and adaptive way (Feldman & Kogler, 2010). However, Tanimoto (2012) and van de Ven (1993) assert that grassroots innovations and entrepreneurship are driven not only by a single person but rather a 'collective achievement'. Knowledge exchange and interaction about innovation over space and time appear to play an important role for enabling local entrepreneurship (Howells & Bessant, 2012). Consequently, it must be considered how those place-related processes and aspects shape entrepreneurial individual and collective action. A local or 'emplaced' entrepreneurship, as discussed by Feldman (2014) and Audretsch et al. (2012), can contribute here to an improved understanding of the processes underlying renewable-energy transition.

Community-based renewable-energy projects, community place attachment and entrepreneurship are all three informed by an underlying process dimension (Shane & Venkataraman, 2000; Giuliani, 2003; Walker & Devine-Wright, 2008) that is 'concerned with who a project is developed and run by, who is involved and has influence' (Walker & Devine-Wright, 2008:498). This process involves social and emotional aspects: By whom is the project initiated and executed? How does it affect my place (bonding)? How is consensus about renewable energy negotiated by diverse social actors through social interaction in a specific locality (Mihaylov & Perkins, 2014; Smith et al., 2005)? The process of negotiation may result in a community of interest (Manzo & Perkins, 2006; Feldman, 2014) that creates shared understandings and appreciation of the technology to be implemented (Lowe & Feldman, 2008) and a feeling of belonging (sense of community) (Delanty, 2010). Empirically, local involvement has been found to be important in project development (Walker & Devine-Wright, 2008) and 'the greater the number of individuals who are able to participate in creative endeavour, the higher the probability that a place [such as a community] is able to [assess and] capture the resulting benefits' (Feldman & Kogler, 2010:387). This insight underlines the importance of the outcome dimension of community renewable energy, as it matters how the project is spatially and socially distributed and what social and economic

values are locally created (Walker & Devine-Wright, 2008).

As demonstrated on theoretical grounds in this section, communities and people define and shape places and are themselves defined by places (Giuliani, 2003; Feldman, 2014). Merging place, local entrepreneurship and community renewable energy, as distributed in the different strands of research outlined above, enables one to conceptually explore, empirically analyse and holistically integrate the importance of socio-geographic settings for innovation, as it appears essential to understand which emplaced social requirements permeate, inform and enable community-based renewable-energy transition.

4.2 Empirical findings

This section presents the findings of the analysis of the interviews in Reußenköge (IR). First, people's place meanings and place attachments with regard to the implementation of renewable-energy technologies in the local community of Reußenköge are analysed before depicting, second, the characteristics of innovation and local entrepreneurship related to renewable-energy technologies.

4.2.1 People's place meanings and attachments

The social framing of place addresses important questions of how people construct and develop place-based bonds. The grounded analysis of the interviews conducted revealed individual and community place-meanings and -attachments found in the interviews, and can be divided into five interlinked categories: physical and social place attachment, genealogical (historical) place attachment, contested place, climate in place and innovative place (Figure 4.2).
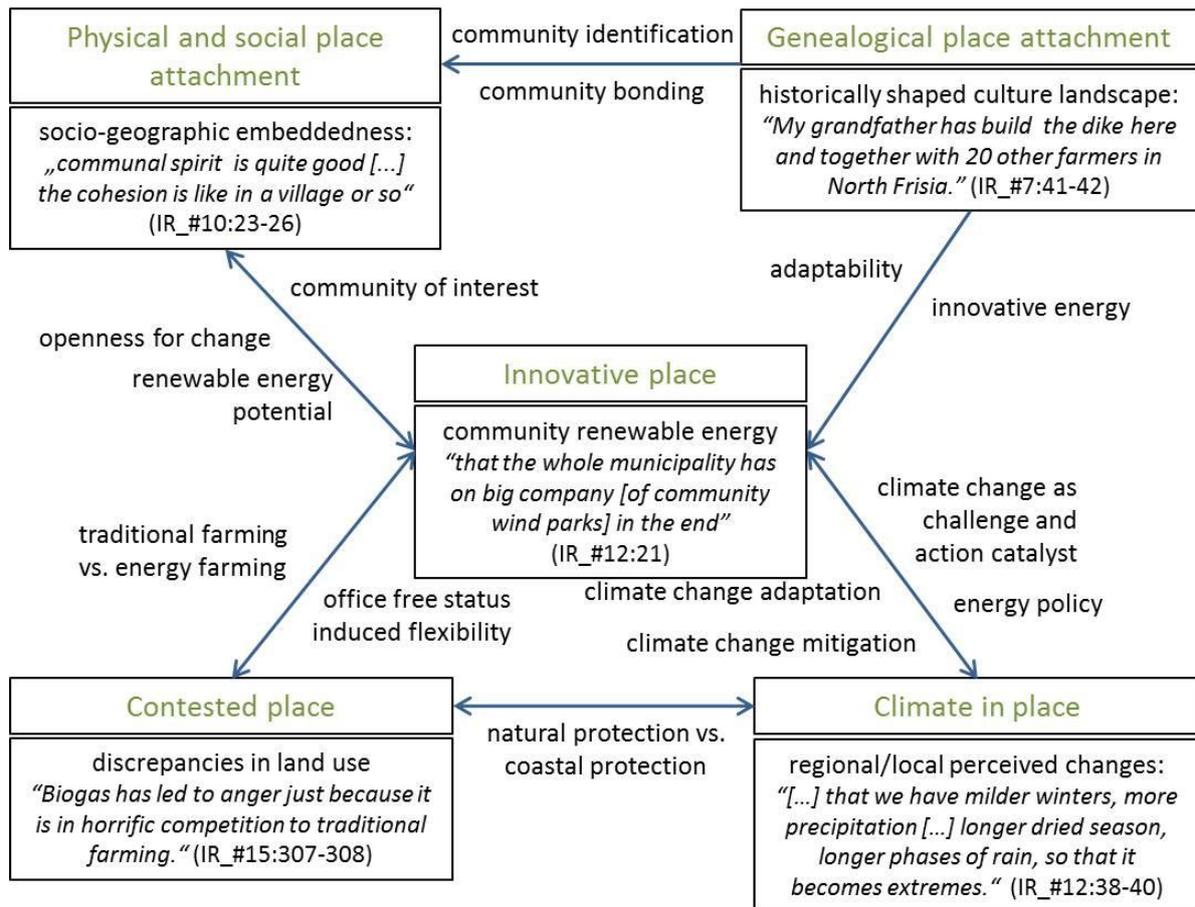
Figure 4.2: People's place meanings and place attachments with regard to the development of renewable-energy technologies, based on the interviews in Reußenköge

First, a very strong physical and social place attachment of all interviewees in the region of North Frisia and the municipality of Reußenköge were found, independently of whether the person was born and grew up in the region or not. Inhabitants who moved there described the process of social integration into existing structures as a mutual 'entrenchment' into the municipality. Besides the physical aspects of the landscape social aspects of place seem to play a particularly important role, as many answers were related to people's attachments to their family and friends. Interviewees gave a high value to the natural landscape but, moreover, highlighted social bonds to the people with whom they live. A recurrent phrase was, 'You get as much neighbourhood as you want' (IR_#11:18-20). This phrase expresses people's choice to live an insulated 'farm spirit', focussing on their own farm with spatial social contacts, or a 'village spirit', which is based on the active development and maintenance of social contacts, as described by another interviewee (IR_#5:44-48).

The findings exhibit that an active involvement in the municipality creates a social cohesion and coexistence where people organise social activities such as the children's festivals, and where 'nobody will be let alone, if anything comes up' (IR_#11:20-22). Findings reveal that

neighbour assistance, engagement in local associations such as the voluntary fire brigade and the farmer's women or collaborative wind energy create strong community cohesion. Between the people, such community cohesion resulted in strong personal interaction, as for example between farmers who meet every morning at the grain elevator to 'exchange, what is on in agriculture or wind farms' (IR_#8:137-138). Social structures and the small spatial and social size of the municipality were perceived to bear a positive impact on dealing with community renewable energy. Generally, it was found that Reußenköge, understood as local place, is seen as good location for renewables, where one can 'generate a lot of energy in order to provide it to somebody' (IR_#15:330-331). Through the analysis of the interviews, physical and social place attachments were identified as important ingredients that shaped people's place attachment, such as to the 'North Sea in front of [the inhabitant's] door, and the things [they] love: open view, free thoughts, clean air, iodine-containing salt air, healthy climate' (IR_#8:151-153).

Besides the physical and social dimensions of place attachment, the interview results showed that people possessed a genealogical and historical attachment to the place of Reußenköge. Interviewees identified themselves as bound up with the region, the municipality or the place close by where they were born and grew up. The results also demonstrated a strong identification with the historically shaped landscape through the practices of land reclamation and dike building that created the polders of Reußenköge and its fertile marshland. One interviewee described the landscape as 'constructed by [the] ancestors with much handwork' (IR_#15:213-215) that 'led to an historical attachment' (IR_#5:63-64). This description exhibits a strong historical community attachment and identity based on protecting the coastal hinterland and generating a living from agriculture. Interviewees often defined the landscape as 'cultural landscape' or 'manmade', underlining the meaning of place as historically constructed and materially shaped by human beings. Through cross-generational interaction with the sea and the experience of living with changes in the polders of Reußenköge, people construct an identity that facilitates the process of learning from past, current and future-related land uses.

In respect to land uses, the interview findings indicated that people also understand their place as contested. The study revealed a difference between natural protection perceived as privileged and governed from outside and coastal protection perceived as local and highly inevitable for the protection of the hinterland. Inhabitants disapproved of priority being given to natural protection and justified this disapproval by outlining the negative impacts on

coastal protection largely by the ban on using the foreshore for sheep-run. The idea of a nature in and of itself was countered by one interviewee, indicating possible consequences: 'If somebody is telling me we must have a natural heritage Wadden Sea, then I can put a sign here soon "to let"' (IR_#15:220-221). Moreover, competition has also been claimed between traditional farming and new 'energy farming', especially in relation to biogas. Inhabitants are aware of the space demand by renewables in the landscape, and there are also critical views about their implementation as expressed by the 'land-grabbing' involved in building expansive solar farms on fertile marsh land. Nevertheless, people perceive their municipality and place as deserving protection due to its beautiful landscape and the local people living there.

Asked about perceived changes in climate, the inhabitants of Reußenköge mentioned local climatic changes and extreme weather events although they did not necessarily link them to coming climate change. Interviewees used regional weather features and climate-related phenomena such as sea level rise, change of seasons, drier summers and wetter winters to depict perceived changes. One interviewee used higher water levels in the North Sea as a reference point when he claimed, 'Climate change is on our doorsteps' (IR_#7:118). At the moment, however, all inhabitants interviewed did not feel highly threatened by climate change but expressed concerns revolving around possible future developments. They temporally shifted the perceived impacts of climate change to the future and 'don't believe that [they] will experience it' (IR_#8:136). However, a general respect for nature was found that is strongly connected to the historically recounted and personally experienced storm surges and dike building. Related to this framing is the concept of climate change as an innovation or action catalyst. This conceptual link is justified by people's practices of adapting to an anticipated climate change by building higher dikes and implementing energy-efficient appliances, green mobility and renewable-energy technologies:

> And personally, if we look outside the window then you can see the windmills that generate clean electricity. […] This is a good contribution to climate-change protection, I would say. (IR_#11:118-119/204)

This claim exhibits the materialisation of climate change in people's local places and communities in the form of adaptation and mitigation measures and at the same time reveals an intangible positive atmosphere of the landscape by depicting one aspect of it as a 'good contribution' – a landscape that mitigates climate change.

This aspect was also reflected upon in people's framings of the settlement of polders and local energy as an innovative place. Interviewees developed a historical bond between the innovative energy of past generations who reclaimed and settled land with themselves, who implement renewable-energy technologies today:

> We have been always pioneers/innovators for something new. If you build a dike, you are a pioneer. (IR_#12:75-76)

This is additionally underpinned by people's perceived innovativeness and adaptability, which are linked to past dealings with natural hazards. Already in the late 80s, the interest in renewable energy emerged and developed a locally inspired energy transition:

> I think we are a municipality that is really progressive in the field of renewable and regenerative energy. We have many windmills; we have six wind farms; many agricultural enterprises have solar installations on their agricultural buildings and stables. There are a few biogas plants in the municipality. (IR_#2:138-140)

This emplaced material and social development led to increasing engagement of the locals with renewables. Furthermore, the inhabitants of Reußenköge conceived it extremely important that the implementation and ownership of renewables remained in the hands of local people and the municipality, and they actively 'took care that no "strangers" could come in' (IR_#13:169-170). 'Strangers' refers here to investors outside the municipality who have also been showing interest in planning wind farms on the farmers' fields. In contrast to allowing this outside influence, 'these are community wind farms for all fellow citizens in the municipality of Reußenköge' as one interviewee said (IR_#4:142-143). This communal attitude indicates that a community of interest was developed around the collective planning of implementing wind energy. The findings exhibit that the common interest in community-owned wind farms formed a shared meaning of place strongly connected to the idea of it as a source for renewable-energy generation, collective action, social proximity and renewable energy technology-connected identity:

> But we have many common interests and this is bonding, too. For example the interest in operating collectively renewable energy in form of wind farms for more than 20 years. (IR_#7:35-36)

Interviewees also highlighted a shared and dispersed 'entrepreneurial spirit' that connects local people and provides social cohesion. This mentality is characterised by a collectively shared mind-set that people in Reußenköge 'still have visions' (IR_#13:176) and thus

contribute to the innovative character of the place. The administrative status as a department-free municipality seems to play an important role for decision making, because the ability to hold this status is expressed in flexibility and innovativeness inside the municipality, and seen as 'a good, big chance to cause change' (IR_#15:342-342).

4.2.2 Grassroots innovation and local entrepreneurship

After having outlined physical and social place attachment, genealogical (historical) place attachment, contested place, climate in place and innovative place categories, the social requirements for the emergence of grassroots innovation and local entrepreneurship in Reußenköge are investigated here. Interviews are analysed regarding statements about the role and characteristics of local entrepreneurs in prompting community-based energy transition. Local entrepreneurs are used as analytical units who conceptually personify and reflect the characteristics of local entrepreneurship in community renewables.

The findings exhibit that local entrepreneurs, who are referred to as pioneers and innovators by the interviewees, actively contributed in Reußenköge to the transition towards community renewable energy. All interviewees directly or indirectly exhibited the important characteristics of entrepreneurs, which are not mutually exclusive but may emerge in a combined fashion in one person and shape local entrepreneurship. Based on the interview results, these characteristics can be considered over eight analytical categories: Grounded entrepreneur, collaborative entrepreneur, innovative entrepreneur, change-making entrepreneur, economic entrepreneur, communicating entrepreneur, networking entrepreneur and political entrepreneur (Figure 4.3).
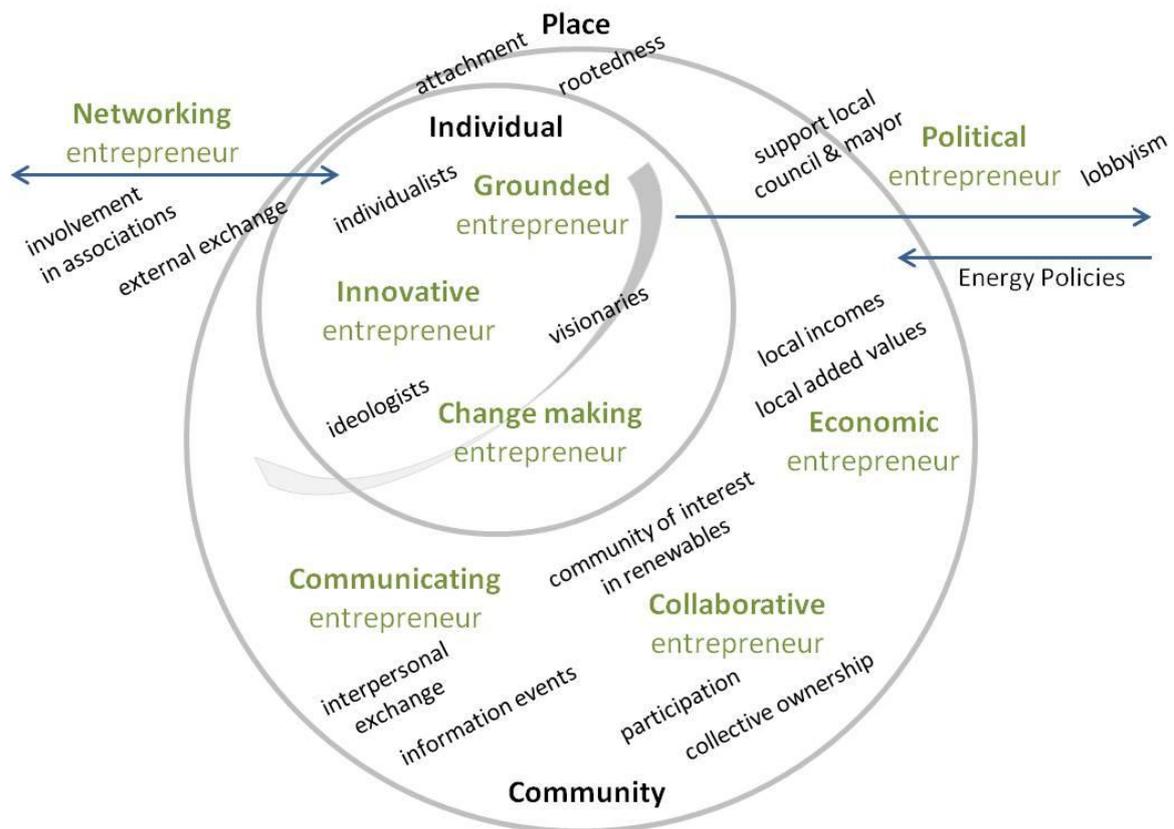
Figure 4.3: Characteristics of local entrepreneurs of the energy transition, based on the interviews in Reußenköge

First, interview results indicate the considerable importance of entrepreneurs being locally grounded. These grounded entrepreneurs developed a bonding to their place by living there since birth or for a considerable amount of time. Interviewees perceived the rootedness of entrepreneurs in agriculture and in the local place as essential ingredients for implementing community renewables because they share the same socio-historical context and experience:

> And I do have the advantage that I am a farmer, do have a farm here and do still work in agriculture. And I am grounded, so to speak. I don't reside somewhere in the city. (IR_#8:94-96)

The common rootedness of all people involved was found to play a vital role in generating credibility and trust in relation to the implementation of community-based renewables. Moreover, entrepreneurs socially and spatially 'live their businesses', merging their private and business lives. An interviewee underlined this connection with a statement related to his renewable-energy business:

> [...] I can entirely live with my business. I have entirely integrated my business life and it is fun. And you can make a change happen [with this renewable-energy business]. (IR_#15:523-525).

This quotation clearly depicts the attachment to and rootedness in community and place of business and private life. Based on this point, the research indicates that the common rootedness of people results in local entrepreneurs exhibiting collaborative thinking and a positive view of community. Results show that community renewable energy, as an innovative concept for local energy transition, emerged as a collective effort. One interviewee emphasised the importance of the collaborative – the 'we' – by indicating, 'We are proud here in the North, that we are the pioneers. We have built the first community wind farms here' (IR_#8:303-305). The fist community-owned wind farm went on stream in 1993 based on 28 turbines. For every of the six wind farms in Reußenköge the community opened up the possibility to participate. One interviewee described the equality behind this integrative procedure as facilitating collaborative ownership by saying

> [...] that we all have equal right, equal rents, no courtesy favour, otherwise it would be over-planned. In consequence, this [equality] creates trust. And the interests of the shareholder are always equal. Nobody has more than their neighbour. Every household has always one share. And in so far, it is good fellowship here. (IR_#8:63-66).

This participatory conception of community renewables was a social and not a legal 'consensus' informally accepted in the municipality (IR_#10:263-264). As already seen, engagement and participation have an essential influence on the acceptance of renewable-energy technologies as people develop individual and collective bonds to the technology and share the common purpose of renewable-energy generation. Furthermore, the integrative thinking of entrepreneurs characterised by long-term and municipality perspective emerges when it comes to revenues of renewable-energy technologies. Interviewees highly value concepts of how locally generated profits could be re-invested in the infrastructure of the municipality. The creation of local value and the investment of money are estimated to be important in providing a sustainable livelihood for inhabitants and the whole municipality. What became apparent was that community collaboration appears to be important, but it requires locally emplaced innovators who discover and socially exploit these potentials.

Local energy transition in Reußenköge appeared to be characterised by innovative entrepreneurs who started with renewable-energy technologies from an innovative and visionary view point, change agents who distribute products and concepts as well as economic entrepreneurs who transform their existing business or even start a new business. Innovators were the first who identified and explored the new opportunities inherent in renewable-energy technologies, partially motivated by the economically critical situation in

agriculture. They were publicly framed as individualists who started with the vision to become energy independent taking a high financial risk. The empirical research revealed that the innovativeness of entrepreneurs is reflected in their willingness to take risks and the demand challenges and change. A strong character and devotion to their project seems to be important in order to deal with refusal, problems and, sometimes, to fight for their visions to become real. The entrepreneurs interviewed described that others embodied them as 'oddballs' for their ideas about renewables because people had critical opinions and negative intuitions about renewable-energy technologies. This was found to be the case for the innovators in wind energy in the late 80ies as well as solar energy in the early 20th century. However, our results indicate that an innovative entrepreneur is characterised by foresight of local challenges and anticipation of technical needs. Interviewees stated an ongoing search or hunt for new innovations by local entrepreneurs and expressed that 'many initiatives and things went into the land' (IR_#8:306) of the municipality. Two examples can be given: electricity storage and a passive radar system for wind turbines to secure air traffic.

For both, technological solutions were invented or accompanied by companies in the municipality. Moreover, entrepreneurs actively contributed to the diffusion of renewable-energy technologies. They possessed a confidence that they could make a change happen and thus develop ideas and push projects actively forward. This drive was clearly expressed in the following remark: 'We have high aims, let's put it that way. And I don't lose the belief that you can do it' (IR_#15:239-240). In this context, to counteracting climate change represents an important but not the most important aspect. One interviewee underpinned moral and ideological aspects that could also be applied to more than one entrepreneur by recounting, 'then several followed, who did that seriously for ideological reasons. Because you could not earn money at that time' (IR_#15:270-271). Besides the individualistic perspective and innovativeness of entrepreneurs, a general openness for change in the municipality was imperative for enabling technological and social change. This was reflected in the quote of one interviewee, who said that individuals, but also the municipality Reußenköge as a whole, is 'able to think outside the box' (IR_#3, 20). This implies that the scope of the local community is beyond their local place in terms of exchange with and support of and for other municipalities. Subsequently, community-owned renewables developed to an innovative and applicable concept that also emerged in local renewable-energy companies. Renewable energy consulting and planning companies were founded by local entrepreneurs, who 'deal with, believe in and promote renewable energies' (IR_#4:136-137). Moreover, local people

made individual and collective use of incentives for investments in wind, photovoltaic and biogas plants that provided an important income to private households and farms. One interviewee expressed this feature by saying:

> And wind energy has a large significance, economically, for many companies. There are many companies who can exist only because of the wind energy. (IR_#3:207-209)

The entrepreneurial thinking in the municipality was found to be characterised by local people's willingness to invest in local companies and to reinvest in them and the municipality. The following interview excerpt shows that the municipality was aware that 'renewables are the future. But it also recognises that it is an economic future' (IR_#7:157-158), creating social and economic values. Local economic value was added, such as through the creation of jobs and communal infrastructure, while fairness and respect have proved to be important when it comes to social dealings. This impact created an atmosphere of trust that enabled economic management without fear of financial inequality and social envy.

One interviewee summarised the local benefits by saying that beyond civic participation, the 'main advantages of renewables are a decentralised energy supply, through decentralised structures [...] where also added values stay decentralised' (IR_#15:380-381). Thus, 'decentralisation' embodies physical as well as socioeconomic structures. The benefits of such concepts applied by the companies in Reußenköge raised awareness also in other regions. Hence, local companies also 'export' the concept of community renewables as service to other areas in the world and actively help with financing projects and socially implementing them. It thus becomes apparent that the concept of a change-making and economic entrepreneur is an export success that even other continents and countries ought to be interested in.

In order to enable and maintain community renewables, communication both inside the municipality and outside of the municipality was found to be important. In the interviews a strong interpersonal exchange about different topics such as agriculture and renewable energy could be found. Nevertheless, information provision and education were conceived as important requirements for people's understandings of the necessity of renewable-energy technologies and consequently for creating acceptance. The communicating entrepreneur perceived the need and experienced the responsibility to inform others about the importance of renewable-energy technologies for mitigating climate change and to be clear about the local potentials of different renewables. For example one interviewee reported that people did not know about the high potential of photovoltaic plants in the north of Germany due to

supposedly bad weather conditions. Moreover, one interviewee underlined the importance of transparency and the communication of project plans for the creation of trust and acceptance:

> Yes, that it is transparent and understandable, what we want, and no mistrust arises. And this works quite well. And sometimes there are countering voices or other opinions, but you have to talk about it. (IR_#8:148-150)

The Interview results also exhibit that local entrepreneurs offer community information events in their enterprises for providing information about the newest developments of renewable-energy technologies and to receive opinions about possible plans. For example, during the interview phase, interviewees informed us about the idea to merge the six community wind farms into one big wind farm. This idea was taken into consideration to increase the cohesion between the wind farms and to remove differences in the revenues of the wind farms, which may have resulted in social envy (IR_#4). In the end, many rounds of discussion and information events resulted in a positive voting about the merging of wind farms (Dirkshof, 2015). The fusion of the wind farms served as foundation for repowering with better use of space (Dirkshof, 2015). In addition to the internal communication, networking can be seen as important for exchange and the creation of new ideas. For example, one interviewee outlined that interns bring outside experience, from which the existing business structures could be positively challenged and society be transformed. Through the social networks in other regions, entrepreneurs were able to observe the community from outside, to get 'another view on the municipality than before' (IR_#15:56-57) and to develop new ideas. Moreover, the networking entrepreneur was characterised by his involvement in associations in order 'to place this comprehensive theme [of renewables] and to provide solutions' (IR_#15:298-299) to local challenges in community and business contexts. This engagement was of direct relevance for the political involvement of entrepreneurs, as they could contribute considerably to the development of administrative and policy structures. Hence, entrepreneurs could also be identified as political actors who make local politics and advise policy on the regional and national level. First, findings in the interviews show the importance of local politics for the development of community-based renewable energy. Looking back to the start of community-owned wind farms, the local council and the mayor were found to be essential for planning the first wind farm. They dealt with procedures of approval, changes of land development plans, establishment of development plans and initially adopted a collective approach. One interviewee revealed that

the municipality, represented by the local council, always strongly supported and pushed renewable energies forward:

> And then we, as municipality, said, 'we want the construction of windmills. […] Do we want to promote it? We want to promote it for the people locally!' (IR_#7:154-156).

Entrepreneurs were found to play an important role in advising the local council, if not even being part of it and managing the wind farms. Beyond the local level, grassroots innovations required reliable energy governance based on 'pulling' incentives. In order to be noticed, local farmers transformed to political actors, as one interviewee described:

> By now, the farmer has become a political representative, so to speak. Nobody who is interfering in politics, but a consultant, who is going to the federal association of wind energy (BWE) and also consults politicians, yes. (IR_#3:207-209)

The findings, furthermore, exhibit that political entrepreneurs represent the community externally and pursue lobbyism in order to create awareness for local benefits and to demand support of community renewable energy projects. The results indicate the importance of supportive governance for renewable-energy technologies and for a reliable foundation of investments. Emerging discussions about a revision of the German Renewable Energy Sources Act from July, 2014 (BGBL, 2014) have already yielded impacts on the fear of people about changing regulation and possible impacts on future financing of larger renewable-energy projects.

4.3   Discussion

The empirical findings presented in the previous two sections provided in-depth information on the relevance of socio-geographic settings enabling grassroots innovation and bearing an impact on local entrepreneurship within the context of local energy transition. The analysis revealed the multifaceted, if not integrated, interplay between place, local entrepreneurship and community renewables: (i) place represents, besides its physicality, a social reservoir that substantially affects and informs innovative and entrepreneurial activities; and (ii) local entrepreneurs and communities socially define and materially shape local places and communities through the implementation of renewable-energy technologies. Previous literature Feldman, 2014); Giuliani, 2003) has highlighted the importance of local entrepreneurs and communities for transforming local communities, which this research exhibits in the context of energy transition. While, to date, research undertaken explored the physical aspects of place and innovation, such as physical potential and the location of wind

power plants (Devine-Wright, 2009; Feldman & Kogler, 2010), the findings of this study elicit the influence of socially constructed meanings, attachments and dynamics underlying attitudes towards renewable-energy technologies. The analysis suggests that people's place meanings and attachments are in the following ways important ingredients that provoke or slow down the emergence of grassroots innovations; fuel or suppress local entrepreneurship; and affect the adoption or rejection of renewables: (1) the emplaced manners of social life affect cohesion and collaboration; (2) place-related and shared historical experiences and spatial developments influence openness for change and adaptability; (3) local and regional climate-change perceptions can function as motivators or obstacles to taking action; (4) possible overlapping land uses represent a problem and require negotiation; and (5) the level of (shared) innovative energy and entrepreneurial spirit has significant impact on local developments. Furthermore, people's place meanings and attachments are closely connected to the socio-cultural context: the meanings ascribed to, values nested in and 'histories' associated with places help to better understand people's place-based bonds and their attitudes towards changes of their place. In contrast to previous studies (review in Devine-Wright, 2011), this study did not find negative impacts of a high place attachment on accepting renewable-energy technologies in Reußenköge. Although the inhabitants of Reußenköge were critical about place changes induced by renewables, these were locally driven and replenished with new local opportunities and improvements which went beyond simple cost-benefit concepts of energy transition (see Chapter 6). Adding to the research of Manzo and Perkins (2006) the findings presented here point to the fact that individual and shared place meanings and attachments can create collective interests in developments and lead to collective actions.

The empirical findings, in addition, sustain the idea that community renewable energy is a collective achievement (Tanimoto, 2012; van de Ven, 1993) based on the support of local entrepreneurs and the local political authorities. While this study found (as did e.g., Devine-Wright, 2011) a strong scepticism towards new technologies at the beginning of the implementation process, the characteristics of local entrepreneurship appeared to be relevant for the creation of trust and support for community renewable energy: (1) the level of local entrepreneur's social embeddedness in the community; (2) the degree of open involvement and inclusive participation in project development and ownership; (3) the fair allocation of the benefits of renewables and the degree of effort to acknowledge and respect local needs; (4) the existence of entrepreneurs and leaders who develop new ideas, push

projects forward and take (project) responsibility; (5) the foundation of companies, which are locally anchored and provide employment opportunities on the spot; (6) the provision of internal information about (further) developments and participation within the community; (7) the information provision to and social interaction with other regions who are about to start community renewables; and (8) local, regional and national governance support for community renewables. This study shows that a high level of participation in community renewable-energy profits from an approach that is locally grounded, collectively shared, participatory and politically supported. People's concerted involvement and purposes for using and benefiting from renewable-energy technologies creates 'communities of interest' (Feldman, 2014) that can finally develop into an 'energy citizenship' (Devine-Wright, 2007). Furthermore, the previous studies by Rogers et al. (2008) and Hayward et al. (2004) highlight the relevance of interactions and information provision in diverse settings and on different social levels about who is participating and for whom participation is carried out in order to reach people's hearts and minds (Döring & Ratter, 2015). In contrast to studies by Hayward et al. (2004) and Rogers et al. (2008), the findings presented here reveal the importance of grounded and locally attached project leaders and direct management by community members. While sustainable energy studies highlight the challenge of responsibility and leadership in project development (Smith et al., 1999; Rogers et al., 2008), in this study a few people took action and promoted the implementation of renewable-energy technologies. The findings of this research indicate that these local innovators might be able and willing to support community renewables in other regions where local leaders and knowledge are absent. It would, however, require project support in order to facilitate local resources and empower communities (Rogers et al., 2008). In line with a previous study (Walker et al., 2010), trust to local leaders and entrepreneurs is based on the local embeddedness of people who bring projects forward.

Finally, the analysis emphasises that place meanings and attachment bear a considerable impact on people's attitudes towards the implementation of renewable-energy technologies, and that the analysis and understanding of this dimension could help to better understand and overcome barriers to implementing renewable-energy technologies. Thus, the findings reveal how the physical, social and historical context of places contributes to developing collective and individual identities and how people shape place through the decentralised implementation of renewable-energy technologies.

4.4   Interim conclusion

Overall, the data analysed designate community renewable energy as an innovative concept that emerges *in* and should be applied *to* local communities, invented *by* locally-based entrepreneurs but collectively realised and implemented *for* people, local communities and places. The analytical merging of place, local entrepreneurship and community renewable energy enabled the conceptual exploration and empirical analysis of their multifaceted interplay and relevance for the local implementation of renewable-energy technologies. Theoretically, the conceptual lens of place adds important aspects of the geographic environment and social embeddedness to innovation research and sharpens the view of attachments to a specific place. Furthermore, the concept of local entrepreneurship provides the analytical framework for assessing the importance of local entrepreneurs and social interactions for exploring opportunities and generating local values for places and communities. The qualitative methodology enabled an in-depth understanding of the importance of socio-geographic settings in order to identify characteristics stimulating grassroots innovation and entrepreneurship in local energy transition. Although the findings are based on only one case study, it was possible to identify general characteristics or tendencies whose solidity should be assessed in other study areas.

Furthermore, the findings presented provide important information to politicians and practitioners because energy innovation and the empowerment of communities are high on the political agenda (HM Government, 2010; BMUB, 2014), but understandings about places of energy transitions remain to date insufficient and consequently underestimated (Rennings, 2000; Devine-Wright, 2011; Howells & Bessant, 2012). On the basis of the present analysis, some policy recommendations could be drawn for enabling a decentralised energy supply: Place matters in both individual and collective senses and is characterised by regional difference as could be seen in climate-change perceptions and attitudes towards the alternative generation of energy (Andor et al., 2015). Thus, place's specific physicality, as well as the intangible social and historical circumstances, must be assessed before developing and negotiating implementation strategies. This analysis suggests an energy governance that acknowledges and takes seriously those local circumstances and provides flexible, supportive funding schemes that empower community-based concepts and emplaced strategies. Increased attention to potentials of community renewables would support and provide showcase examples for community-based energy projects that could learn from the process of current projects. The power of grassroots innovation and local entrepreneurship for

creating intangible and economic values for places and communities deserves considerably increased attention in political decision making.

In conclusion, the findings presented in this chapter conceptually and empirically illustrate the importance of a locally grounded transition towards 'harvesting renewable-energy', implemented *by, in and for* local places and communities (Figure 4.4). The results lead to two important contentions: First, a 'grounded' understanding of place – *where* community renewables are created and implemented – can provide a better understanding for the acceptance of place change for renewable-energy technologies, while in-depth understandings of the characteristics of local entrepreneurs – by *whom* community renewables are created and implemented – can improve structural understandings about the emergence and success of community renewable energy. To support further diffusion of community-based energy transition, energy policies and funding schemes should recognise local socio-geographic circumstances as highly relevant as participative and place-based strategies and concepts offer the possibility for a sustained implementation of renewable-energy technologies.

But how do people make their choices about the adoption of renewables? And how do social interactions influence the diffusion of community-based renewables? The next chapter will build on the importance of a local energy transition while bringing into focus household decision-making about the individual adoption of solar panels and collective investment in wind turbines.

Figure 4.4: From harvesting fields to harvesting energy, Reußenköge, September 2014

5 Energy made in communities: Simulating household adoption of renewable-energy technologies

Common good, common spirit and community are the godparents of every historical development.

Friedrich Ludwig Jahn

Individual households and communities have been recognised to be and to become the 'doers' of a sustainable and successful energy transition through citizens, as private owners or types of collective ownership (Walker & Devine-Wright, 2008; HM Government, 2010; Ethikkommission, 2011). Chapter 4 conceptually and empirically examined the importance of a locally grounded energy transition implemented by, in and for local places and communities. This transition requires individual initiative and collective effort that are both ingredients of *community renewable energy* – small-scale and local renewable-energy generation (Walker & Cass, 2007; Walker & Devine-Wright, 2008). But how do people make decisions about the individual adoption of solar panels and collective adoption of wind turbines? How do social interactions influence individual and collective behaviour? What are the roles of innovators and change-agents in the diffusion process? In order to answer these questions, a deeper and improved understanding of social adoption and diffusion processes is imperative.

Chapter 5 applies an agent-based modelling approach for investigating the adoption of renewable-energy technologies and the societal diffusion. *Diffusion* is a social '*process* in which an innovation is communicated through certain channels over time among members of a social system' (Rogers, 2003:5). This implies that diffusion is understood as a dynamic process influenced by the social, rather than a theory of equilibrium. The concept of diffusion is closely related to that of adoption. Whilst diffusion occurs on the societal and macro level, respectively, adoption of an innovation refers to a process at the individual level. An innovation can be an idea, practice or object that is perceived as new by a person within the society (Rogers, 2003). In the study context, wind and solar technologies are conceived as new technological innovations to the people. Moreover, the concept of community wind farms is a new idea for a shared investing, owning and benefiting from a technology. To explore the adoption of solar panels and wind turbines and their societal diffusion in a dynamic way, this investigation applies the method of agent-based modelling.

Within the present research, an agent-based model (ABM) has been developed that simulates the process of households' individual adoption of solar panels and the collective adoption of wind turbines, and their diffusion in the community over time. The so-called community renewable energy transition (ComRET) model is intended to explore how social interactions influence household adoption of solar installations and windmills. The crucial part of the model is its integration of the empirical findings of the qualitative interviews and the household survey in Reußenköge in order to equip existing agent behaviour theory with empirically collected evidence specific to the research context. Furthermore, novel representations of household interaction have been developed based on the findings of the semi-structured interviews and the survey. This chapter addresses the main research question: Can an ABM based on an existing framework of agent behaviour and representing household interaction contribute to the understanding of households' adoption of individually-owned solar installations and collectively-owned wind turbines in the case study of Reußenköge?

5.1   Modelling adoption and diffusion of renewable-energy technologies

Diffusion research is an emerging field of research to study diffusion trends of products and processes (technological innovations), and ideas and information (non-technological innovations) (Meade & Islam, 2006; Karakaya et al., 2014). Applications can be found in diverse disciplines such as geography, anthropology, economics, marketing, and sociology (Kiesling et al., 2012). Environmentally sound technologies, such as renewable energy technologies, differ in their nature from other technologies, because they incorporate sustainability goals, they may require financial incentives by the government, and their implementation is context-specific, however, with a global market potential (Karakaya et al., 2014; Rao & Kishore, 2010).

Generally, models of innovation diffusion can be distinguished between the more 'traditional' mathematical models and ABMs. Traditional mathematical diffusion models focus on an empirical generalisation of the new product's spread and mainly describe the diffusion of innovation at the macro- or market-level, based on a differential equation formulation (Kiesling et al., 2012). The mathematical Bass diffusion model (Bass, 1969) should be highlighted here, which defines the diffusion process as contagious through mass media and interpersonal communication. This aggregate model has been widely applied. The disadvantage of such mathematical diffusion models lies in their limit to explicitly model

individuals' heterogeneity and system dynamics. Because they are not designed for what-if questions, their explanatory power is limited.

Studies on the diffusion of ecological innovations such as renewable-energy technologies are of increasing scientific and political interest (Karakaya et al. 2014). These studies often focus on macro- or market-level diffusion, and therefore individual adoption and system dynamics are often not explicitly considered. Hence, there is still a lack in understanding how individuals make decisions about adopting renewable-energy technologies. To meet this challenge, a transition from a purely individualistic to an interpersonal approach is required. The present research attempts to contribute to that by applying an agent-based approach to the social phenomena of a local energy transition.

Agent-based modelling of innovation diffusion has been increasingly adopted (review by Kiesling et al., 2012) although it is still relatively new in the field of environmental innovations (review by Karakaya et al. 2014, on eco-innovations; and Johnson, 2015, on land-use practices). Agent-based modelling is a computational simulation technique able to model processes in order to contribute to their understanding. The method enables the creation, analysis and experimentation, and thus provides a new way of thinking about such processes (Gilbert 2008). In ABMs applied to human systems, a system is modelled consisting of autonomous, non-linear decision-making individuals named agents, which interact within a physical or social environment. In contrast to most other modelling approaches, ABMs operate on the individual level. This implies that agent behaviour and social interactions can be modelled explicitly. Situations can be modelled that are far from equilibrium. Hence, ABMs are much better able to capture emergent phenomena such as the societal diffusion of renewable-energy technologies, which result from the agent interactions (Gilbert, 2008).

In agent-based modelling, two major streams can be distinguished: theoretically and empirically based ABMs. The initial ABMs were mainly theoretical and abstract, and hence, the modelled diffusion processes were highly abstract and based on simple rules of interaction (Janssen & Ostrom, 2006; Kiesling et al., 2012). In the recent years, empirically based ABMs, which use empirical data as input or for the model validation, have experienced a significant growth. These empirically based models have the ability to function as decision support that provides managerial insights and for applied policy analysis. The ComRET model integrates both theory and empirics.

Using the theory of diffusion of innovations

The theory of diffusion of innovations by Rogers' (2003) provides a well-known diffusion framework that attempts to contribute to a better understanding of how innovations are diffused. The theory provides a social perspective focussing on the process and the conditions at which an *innovation*, such as an object, ideas or practice, is *communicated* over *time* and adopted by individuals within a *social system*. Thus, the four analytical categories are (i) the innovation and its characteristics, (ii) the communication channels through which information is disseminated, (iii) the time along which the innovation decisions are made, and (iv) the social system along which the innovation is diffused (Rogers, 2003). Rogers sees these categories as analytical elements, which can be identified and studied in every diffusion research study. According to Karakaya et al. (2014), the theory shows a large application potential in the emerging literature on eco-innovations such as renewable-energy technologies; however, its relevance to explain the diffusion of eco-innovations is not known yet. In an AMB, it is inevitable to have a clear framework upon which to base agent behaviour. The theory of diffusion of innovations (Rogers, 2003) has been recognised in this research for providing a suitably structured framework to be imported into an ABM for investigating the dynamic and social process of community renewables.

The theory of diffusion of innovations has been adopted for four reasons. First, it allows for the exploration of the social process of diffusion along different adoption stages. The decision-process is conceptualised from knowing about the innovation and the reasons for adoption or rejection until the confirmation of the innovation. For the incorporation of sophisticated decision rules, it was possible to merge and equip the diffusion of innovations theory with the analytical decision-making factors of the theory of planned behaviour (Ajzen & Fishbein, 1980; Ajzen 1991), which allowed for a simplified and structured representation of social psychological attributes influencing the adoption or rejection decision of community renewables (detailed explanation in sub-section below). Secondly, individuals and their adoption behaviour are of central importance in the theory. This implies that micro-level behaviour and the emergence of macro-level diffusion patterns can be explored. Third, the theory accounts for *communication channels*, through which messages get diffused from one individual to another. Although the theory addresses the importance of communication, specific communication types for the context of community renewables need to be developed (Section 6.2.3). Fourth, the social system is an important element of the theory, which embraces the innovativeness of people and social norms. This fact indicates that the

theory may contribute to an understanding how the innovativeness of adopters, social norms and direct communication affect the time and rate of adoption. Furthermore, the theory provides five innovation characteristics: relative advantage (evaluation of the innovation); compatibility (perceived consistency of the innovation with existing values, past experiences and needs); complexity (perceived ability to understand the innovation and to use/implement the innovation); trialability (prior experimentation with innovations); and observability (visibility of results of an innovation to others) (Rogers, 2003). As mentioned above, the green innovations indicated to be quite specific in their nature, wherefore characteristics have been adapted given the study context.

The present theory of diffusion of innovations provides a promising framework to explore the diffusion process of innovations along different stages. Hence, the theory has been applied and their suitability is tested for exploring individual behaviour and social interactions in the diffusion process. However, the specific nature of renewable-energy technologies does not seem to be represented in the theory, so it was decided to equip and adopt the framework of households' behaviours and social interactions with empirical evidence. Furthermore, the theory of planned behaviour has been applied to a sub-model of the ComRET model for representing decision-making about the acceptance or rejection of technologies.

Using the theory of planned behaviour

Decision-making in ABMs can be based on various approaches, such as utilitarian approach, state transition approaches, opinion dynamics, econometric estimation of choice probabilities and social psychological approaches (review in Kiesling et al., 2012). Many models have been based on rational choice theory, although decisions in real life are often not rational (Epstein, 2006). Using a social psychological approach implies a change of perspective from *homo economicus* to formalising behaviour following the *homo psychologicus* (Jager et al., 2000). This approach incorporates a behavioural richness with which ABMs can deal: An agent-based approach provides the possibility to model 'societies of boundedly rational agents', which has been considered a powerful advantage (Epstein, 2011:27). Individual decisions are not considered to be rational, but are rather based on individually perceived attitudes, values and norms, and social interactions between individuals. A well-known social psychological framework for modelling agents' decision-making is provided by Ajzen's theory of planned behaviour (Ajzen, 1991). The theory has been widely applied in the context of human decision-making (Ajzen & Fishbein, 2005), and in application- and policy-oriented diffusion models in special (see Schwarz & Ernst, 2009; Kiesling et al., 2012).

The theory of planned behaviour stems from social psychology, and it is an extension of the theory of reasoned action (Ajzen & Fishbein, 1980). Ajzen stresses that the theory of planned behaviour is 'designed to predict and explain human behaviour in specific contexts' (1991:181). The central factor in the theory is intention, which captures decision factors and determines the performance of behaviour. Intention is influenced by attitudes towards the behaviour, subjective norms and perceived behavioural control (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980). Attitudes towards the behaviour include the cognitive and emotional evaluation of the behaviour, that subjective norms express the pressure of peers due to their expectations, and that behavioural control is the perceived ability to implement the behaviour (Ajzen, 1991). The relative importance of the three determinants for predicting intention is stated as depending on behaviours and situations. Perceived behavioural control and behavioural intention together are seen as the best predictors of behavioural achievement. Thus, the larger the behavioural intention, the more likely is the performance of behaviour.

The theory of planned behaviour is considered to provide a promising structured framework to study agents' decision-making in the context of a community-based energy transition. Nevertheless, the theory needs to be adapted to the specific study context, which has been done based on empirical evidence (Section 5.2.2).

Using empirics for informing the model design and behaviour

Empirically based ABMs have attracted an increasing interest (Janssen & Ostrom, 2006). There are different empirical methods used in the agent-based modelling community, such as statistical data sets, large scale case studies, lab experiments, surveys and interviews (for an overview, see Janssen & Ostrom, 2006). The empirically generated data can be used in a variety of ways, such as input data, to falsify or test the model, or for model validation (Janssen & Ostrom, 2006).

The ComRET model is grounded in empirical findings based on the case study municipality of Reußenköge and North Frisia (see Chapter 1). The municipality has been chosen because of its suitable size and the expected richness of data to be generated through the long-term development of renewable-energy technologies. In the course of the interviews, a standardised household survey (50 suitable household responses) and analysis of census data, empirical data could be generated to inform the model design, calibration and validation. This input means that the empirics could provide information on local agents and their motivations to adopt renewable-energy technologies (explanation in Section 5.2.2), the

boundaries of the environment in which the energy transition is implemented (explanation in Section 5.2.2), the interactions among agents and their environment (explanation in Section 5.2.3), the individual decision-making (explanation in Section 5.2.4), and the diffusion of renewables (Section 5.3.1). Because of the rich empirical evidence on agent interactions and the importance of communication types in specific, the focus of the model was allocated to them.

Due to the social and complex nature of the individual adoption decisions being made, it was useful to apply a theoretical framework, which has been equipped with empirical evidence. The application of this framework creates a model designed with the intention of being generalised enough to be applicable to other case studies but specialised enough for the issue of community renewables.

5.2   Description of community renewable energy transition (ComRET) model

Developing an ABM is not only science, but also a bit of an art (Axelrod, 1997). The ingredients of this art are based on theory, empirics and the actual model implementation and exploration. The different stages of the development are illustrated in Figure 5.1.

Because of the 'artistic' nature of the development, it is thus important to document and describe ideas and assumptions underlying the model. In this study, the main model description was informed by the guidelines of the 'ODD+D' (overview, design concepts, and details + human decision-making) protocol (Müller et al., 2013). This protocol is an extension of the ODD protocol (Grimm et al. 2006; 2010) which has been adapted for describing human decisions in ABMs. For a fluent reading of this chapter, it was decided to incorporate different protocol factors in comprehensive chapters.
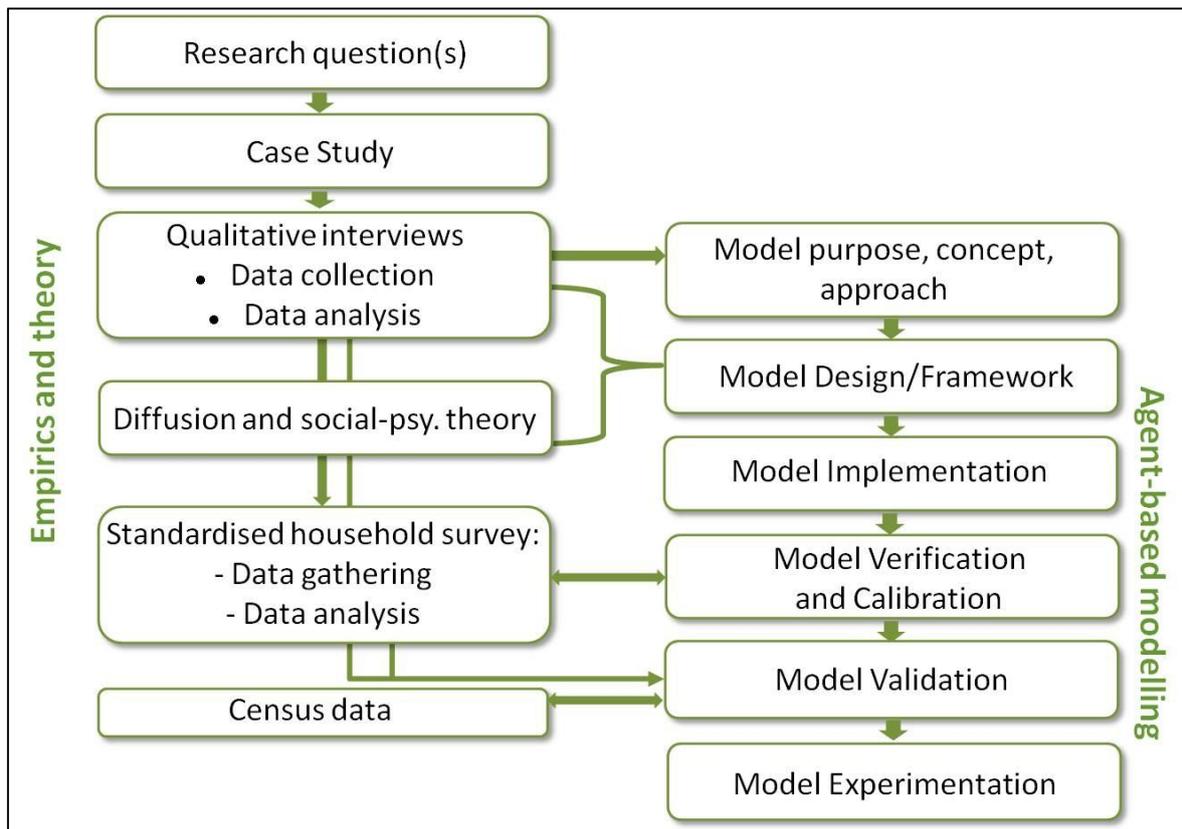
Figure 5.1: Stages of the agent-based model (ABM) development

5.2.1 Purpose of the community renewable energy transition (ComRET) model

The ComRET model has been developed to simulate the process of households' individual adoption of solar panels and collective adoption of wind turbines. The purpose is to explore how different communication types and social norms influence the households' adoption and societal diffusion of renewables in the 'virtual laboratory' of an ABM.

Hence, the main research questions are:

- What are the differences in the societal diffusion of solar panels and wind turbines?
- What is the role of household interaction for the diffusion of renewables?
- What is the role of innovation and change-agents in the diffusion of renewables?

The model has been mainly designed for scientists, who are interested in the study of community renewable energy. However, the model could also provide food for thought to decision-makers and practitioners, who aim to enhance community renewables.

5.2.2 Agents and modelling environment

Households as agents

Generally, agents are social actors within the program, which might be individuals, households, companies, or authorities. They are described by four main features: autonomous behaviour, ability to interact, ability to react to the environment and persuasive goal(s) (Wooldridge & Jennings, 1995). Agents can perceive their environment, such as other agents; they can perform behaviours, such as motion, communication and action; they can memorise past perceptions and actions; and they have a set of rules.

In the ComRET model, agents are heterogeneous households, who are modelled as houses. Households make decisions between investing and not investing in two renewable-energy technologies: solar panels, which are individually installed on the roof of the households' buildings, or wind turbines, which are collectively installed in the community landscape. The households have a three-stage decision process in which they decide (i) whether they accept or reject the renewable energy technology, (ii) if they accept, whether they have the possibility to adopt, and (iii) if they have adopted, whether they are satisfied, and in the case of wind, whether they want to adopt again (detailed explanation follows in Section 5.2.4). The decision process is affected by the characteristics of the household and its local physical and social environment.

Four different household types are distinguished: innovators, supporters, followers and opponents. 'Innovators' are provided with a high degree of innovativeness, and they are venturesome. In the ComRET model, innovators are consolidated with the early adopters, because they are assumed to be represented by the same people. Early adopters have the highest degree of opinion leadership. This characteristic implies that they may be the change agents, and they are sought for advice and information by others before adopting the innovation (Rogers, 2003). 'Supporters', who have a generally positive attitude towards innovations, are keen about adoption before the average person; however, they may deliberate for some time before adopting (Rogers, 2003). 'Followers' adopt new innovations just after the average, perhaps because of economic necessity or as a consequence of social pressure. The degree of peer pressure is important for the adoption, and uncertainties related to the innovations must be already reduced before adopting (Rogers, 2003). Lastly, 'opponents' have a generally negative opinion about renewable-energy technologies and require much persuasion for their opinions about renewables to change. They are equipped with traditional values and are likely to interact mostly with other opponents (Rogers, 2003).

This household category has been replaced by the laggards, implying an against-innovation attitude.

The differentiation of four heterogeneous household types is informed by existing theory and empirics (Figure 5.2). The household types are based on those from Rogers (2003), who distinguishes five adopter categories based on observations of reality. For comparability between the household types and to study the influence of the number of diverse household types, the main heterogeneity between households is based on the types, while a random float provides additional differences in the values (Section 5.3).

Besides the division into groups, the distribution of household types was of interest. One local expert in North Frisia (NF_Entrepreneur_2) stated in the interview that about one third of the people support renewables, another third follow the trend, while one third will never participate. In the case study Reußenköge, the survey results have also been analysed in respect to different household types and divided based on the adoption year and attitudes regarding renewables. The survey represents only a sample and the grouping was done indicative. A relatively low number of opponents was found. Based on the survey, a model standard of 19 innovators, 41 supporters, 53 followers and 7 opponents has been defined given 120 households based in the municipality (Figure 5.2). However, the number of each household type can be flexibly chosen for each model run.

ComRET model	Innovators	Supporters	Followers	Opponents
THEORY — Diffusion of Innovations (Rogers, 2003)	Innovators & early adopters	Early majority	Late majority	Late mass
	16%	34%	34%	16%
EMPIRICS — Expert interview statement (based on NF_Entrepreneur_2)	1/3		1/3	1/3
Survey categorisation (R) (number of households)	8	17	22	3
ComRET model standard (number of households based on the survey distributed over 120 households)	19	41	53	7

Figure 5.2: Household types

Households are highly complex agents, characterised by multiple motivational attributes or state variables (Table 5—1). To build analytical categories, three main attributes – namely attitudes towards the behaviour, social norms and perceived behavioural control – have been

incorporated, based on the theory of planned behaviour (Ajzen & Fishbein, 1980; Ajzen, 1991). According to the theory, *attitudes* include the cognitive and emotional evaluation of the behaviour; *subjective norms* express peer pressure due to peer expectation; and *behavioural control* is the perceived ability to implement the behaviour (Ajzen, 1991). The decision about adoption or rejection and the related intention to adopt the innovation are influenced by those factors.

Table 5-1: Household attributes related to renewable-energy technologies (RETs), based on interview results [1] and existing factors of behavioural theory: theory of planned behaviour [2] (Ajzen, 1991), diffusions of innovations [3] (Rogers 2003)

Core attributes	Sub-attributes	Explanation	Source
Attitudes towards the behaviour		cognitive and emotional evaluation of the adoption of RETs	[2]
	Climate benefit belief	to what degree the RET is perceived to be better for the climate	[1]
	Landscape change perceived	to what degree the RET is perceived as compatible with values and experiences in the landscape	[1] [3]
	Energy independence belief	to what degree the RET is perceived to contribute to energy independency	[1]
	Social benefit perceived	to what degree the RET is perceived to benefit the social system	[1]
	Economic advantage perceived	to what degree the RET is perceived to be of economic benefit	[1] [3]
Social norms		pressure of peers due to their expectations related to RETs	[2] [3]
	Social pressure	to what degree the technology is adopted by others	[1] [2]
Perceived behavioural control		the perceived ability to implement RETs	[2]
	Physical potential perceived	to what degree people perceive the physical potential of solar or wind energy in the place	[1]
	Technological knowledge	to what degree the RET is perceived as relatively difficult to understand	[1] [3]
	Personal ability perceived	to what degree people feel able to adopt the RET	[1]
	Openness for change	to what degree people are open for technological changes	[1] [3]
	Financial ability perceived	to what degree people perceive themselves to be financially able to adopt the RET	[1] [3]

The three core attributes have been equipped with sub-attributes illustrated in Table 5-1, which are based on the interview results and supported by diffusion and behavioural theory (Rogers, 2003; Ajzen, 1991) (see Source in Table 5-1). This implies that key aspects, which emerged during the interviews and seemed to be relevant motivational factors for the adoption of renewables, have been integrated in the conceptual model. Those aspects were environmental, technological, social, economic and individual in nature. This indicates that besides economic incentives, the individual ability, social context, and the characteristics of the technology were considered to influence the adoption. The identified characteristics of renewable-energy technologies were found be related to the innovation characteristics outlined in diffusion of innovations (Rogers, 2003).

The municipality of Reußenköge as model environment

The explicit space may consist of a physical and social environment. In the ComRET model, the modelled environment is a geographic space, consisting of a spatial grid to contain and visualise the model, which functions as model boundary. The ComRET model is based on a real shape file of the case study area of Reußenköge, Germany. The spatial units are grid cells. These grid cells, named patches, are not equivalent to structures of the real landscape and do not represent an explicit size. In consequence, the distribution of the landscape characteristics and housing infrastructure are artificial and occur randomly. The model represents green patches, available land for windmills, and brown patches, non-available land such as agricultural land and houses. The available-land for wind turbines can be chosen for each model run (0-200 patches; standard setting of 100 patches). Furthermore, households are represented by a specific number of houses located in the landscape. To represent the distance between houses and wind turbines, an in-radius of two patches has been defined. Randomly distributed and fixed-location houses represent the social environment. It is assumed that households can perceive each other and are able to communicate. Houses have available or non-available roofs for solar panels due to their orientation or monumental protection status. The roof's suitability for solar can be chosen for each model run, while the model standard is defined with 84% based on the survey data from Reußenköge. Eight of the 50 surveyed households answered to have no solar panels installed due to the monumental protection of their house. A setup view of the model is shown in Figure 5.3. During the model run, spatial patterns emerge.
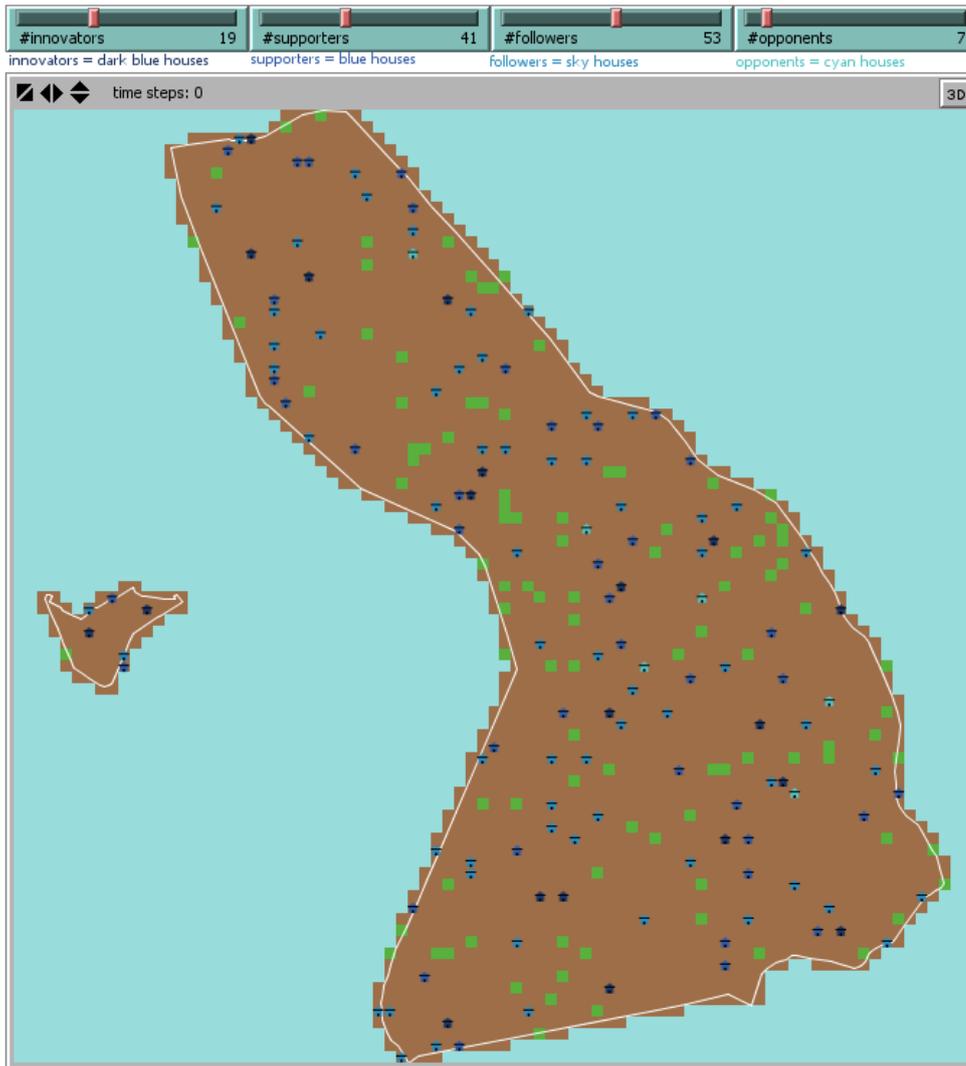
Figure 5.3: Model environment. Model view after set up: Blue houses are the different household types (innovators = dark blue; supporters = blue; followers = sky; opponents = cyan); brown patches are used land for agriculture and building infrastructure; green patches are available land for wind turbines

5.2.3   Agent-environment and agent-agent interactions

Agent-environment interactions

Agents are embedded in a model environment. Generally, it is assumed that the given wind and solar conditions are suitable for the implementation of wind turbines and solar panels, which equals findings of the region of North Frisia. The environment acts on the agents in two ways: First, the available land (brown patches) defines the amount of wind farms which can be built. Secondly, the suitability of roofs defines the ability to construct solar panels. It is assumed that people are aware of the available areas, and that they can only build further wind turbines as long as land is available. Concerning solar panels, it is assumed that people are able to proof the suitability of the roof alignment and status of monumental protection.

In consequence, agents act on the environment in two ways: Households build solar panels on their houses and wind turbines on the land. Hence, households change the landscape image.

Agent interaction types

A crucial feature of ABM is that agents can interact with each other. They can pass a message through direct or indirect communication, can influence each other and can learn according to the information they receive. Thus, agent interactions are explicitly modelled. Ideas about their interaction behaviour can be based on theory and empirics.

In the ComRET model, households interact with each other, influencing each other's attributes and thus decisions. It is assumed that all households have reciprocal relationships, and they are therefore able to sense the attributes of others when interacting. The developed interaction types are a novel representation based on empirical and theoretical understandings of ways in which households interact. Two different household interactions are distinguished: social norms and direct communication.

Households perceive the behaviour of other households, and adjust to *social norms* within the whole community (model environment) (Figure 5.4). Social norms are conceived as important arrangements of tolerable behaviour and serve as a guide or standard for individual behaviour (Rogers, 2003). Hence, they are represented as one central element of household decision-making. The degree of social pressure is mirrored in the percentage of households who adopted and are happy about solar panels or wind turbines. Therefore, the more people who adopt the technology and are satisfied with the adoption, the higher is the social pressure to adopt the technology.
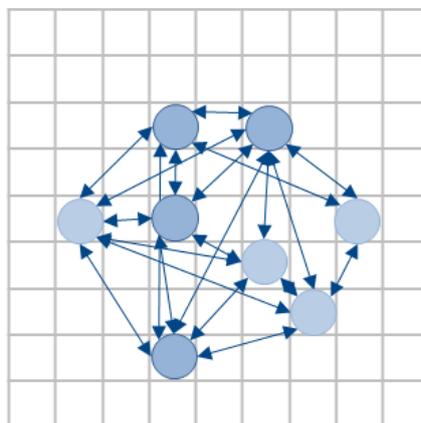
Figure 5.4: Social norms: Adjustment to social norms in whole community according to the percentage of households who adopted and are happy with solar panels or wind turbines.

The integration of social norms is grounded in theory and empirical research. Both diffusion of innovations (Rogers, 2003) and the theory of planned behaviour (Ajzen, 1991) incorporate social and subjective norms, respectively. Agents feel a social pressure to act based on their normative belief about how others view their behaviour (Fishbein, Ajzen 1975). Social norms are assumed to affect the whole model environment, because the interviews show that the whole municipality was perceived as a community. The survey results revealed that observations of developments in the community are seen as very important or rather important information sources for 36% of the households, in the case of solar panels, and 70% of the households, in the case of wind turbines. Furthermore, the people were asked whether their investments were motivated by the observation of others, referred to the acceptance of social norms. About 40% and 48% of the households 'totally' or 'rather' agreed in the case of solar panels and wind turbines, respectively. Finally, the interviews exhibit the importance of the community of common interest as motivation to invest in order to be part of it (see Chapter 4). Overall, the empirical results indicate the importance of social pressure for household behaviour.

In the ComRET model, four different communication types are distinguished: (a) influential communication, (b) advice-seeking, (c) wind community meeting, (d) all three combined (Figure 5.5). Communication is conceived as a 'process in which [individuals] create and share information with one another in order to reach a mutual understanding' (Rogers, 2003:5). In the diffusion of innovations, mass media channels (informing communication) are distinguished from interpersonal channels (interpersonal communication) (Rogers, 2003). The importance of face-to-face communication has been highlighted and is supposed to be more effective in order to persuade an individual (Rogers, 2003). The importance of local communication has been also found in the survey, whilst it seems to be of higher relevance for collective wind-energy generation compared to individual solar-energy generation.
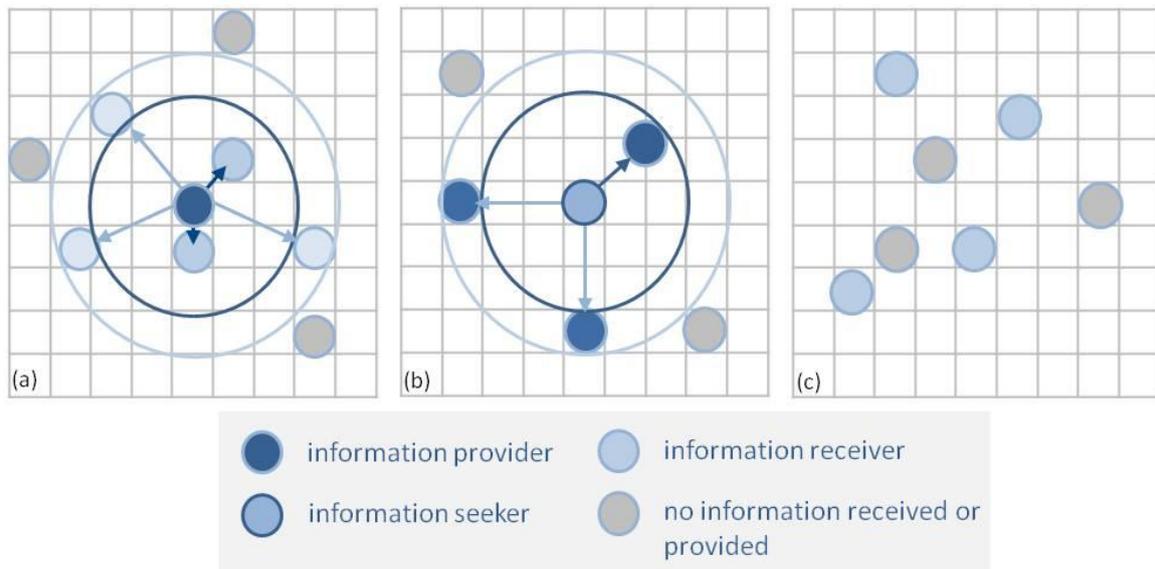
Figure 5.5: Direct communication: (a) influential communication in-radius 'solar-communication-radius' or 'wind-communication-radius'; (b) advice-seeking in-radius 'solar-seek-radius' or 'wind-seek-radius' if agent's utility is close to threshold; (c) wind community meeting in which a random-float of households (wind community-meeting participation) participate

The survey results underline the importance of direct communication as sources of information on renewables. Personal communication with other inhabitants was perceived as 'very important' or 'rather important' by 40% for solar and 74% for wind. So-called opinion leaders are people who 'lead in influencing others' opinions' by providing information and advice (Rogers, 2003:300). Although the interviews revealed a high level of social nearness between the people over the whole municipality, it was found that there is a difference in the communication between the polders, often equivalent to the streets, where people live. In the ComRET model, it is therefore assumed that influential communication takes place only between agents in the closer neighbourhood – in a flexible 'solar-communication-radius' or 'wind-communication-radius'. The theoretical setting for the communication *radius* has been adopted from the concept of social circles (Simmel, 1902; Hamill & Gilbert, 2009). A circle contains all the patches within a specific distance set by a radius between one and 10 (model standard of five), which limits the communication network (Figure 5.5). Innovators, who adopted solar panels or wind turbines can communicate within this radius with other households, and influence their 'openness-for-change', 'solar- or wind-social-benefit-perceived' and 'solar- or wind- economic-advantage-perceived'. This communication implies that the non-innovator households' 'openness for change', 'solar- or wind-social-benefit-perceived' and 'solar- or wind-economic-advantage-perceived' are replaced with the one of the innovator.

In addition to influential communication, households may seek advice from neighbours. The survey revealed that almost half of the households (11 for solar and 8 for wind) stated to sought personal advice either for solar panels or for wind turbines. Regarding solar panels, approximately 52% of the households, who adopted a solar panel, also gave advice to others, but only about 22% stated clearly giving advice again. In the case of wind energy, approximately 73% of the households stated that they gave advice for the investment in a community wind park, while an even a higher number (about 84%) would give advice again.

In the ComRET model, households of the type supporter, follower or opponent can seek advice from other households, if the utility of solar panels or wind turbines is close to the thresholds. A so-called knowledge-seeking household can ascertain whether there are any households who adopted solar panels or windmills and are satisfied with the adoption in 'solar- or wind-seek-radius' by a radius between one and 10 (model standard of five). As a standard setting, wind energy satisfaction is 95% higher than the solar energy satisfaction, which had 76% based on the survey findings. If such a household is around, it communicates information about the RET, entailing an update of the 'solar- or wind-technological-knowledge', 'solar– or wind–financial-ability-perceived' and 'solar– or wind–personal-ability-perceived' of the knowledge-seeking households equal to the households who provided the information (Figure 5.5).

Furthermore, 74% of the households stated information events as very important or rather important for receiving information about wind energy in municipality. Even in the case of solar energy, the information event was perceived as important by 30% of the households. The interviews underlined the importance of community meetings to get informed about developments and participation opportunities in the community. Hence, 'solar- or wind-community-meeting-participation' is assumed in the ComRET model, in which a random float of people participate (Figure 5.5). A standard for the percentage of people who participate has been defined as 74% and 30% for wind turbines and solar panels, respectively. Through the participation in the meeting, the households' 'solar- or wind-technological knowledge', 'solar- or wind-financial-ability-perceived' and ' solar- or-wind-personal-ability-perceived' increase by a defined value of 0.5 if the current utility of the adoption of the technology is below the threshold.

5.2.4   Individual decision-making

Decision-making and adoption behaviour in ABMs can be based on various approaches such as a utilitarian approach, state transition approaches, opinion dynamics, econometric

estimation of choice probabilities and social psychological approaches (review in Kiesling et al., 2012). A social psychological framework for modelling agents' decision-making is provided by Ajzen's theory of planned behaviour (Ajzen, 1991) in which individual decisions are considered to be based on individually perceived attitudes, values and norms, and social interactions between individuals. This social psychological perspective on decision-making has been applied in the ComRET model.

Households make decisions about the adoption of two different renewable-energy technologies: individual installation of solar panels on the households' roof and the collective adoption of community wind turbines on the land parcels owned by a community member. Each time step, a household can make a decision for each of the technologies and implement that decision. The model simulates adoption starting at approximately 20 years in the past. The intention of the model is to simulate dynamics, rather than specific adoption years. The households have no explicit objective when making decisions; they make a decision if they have the necessary motivation and the possibility to do so. *Adoption* implies that households decide to accept and invest in the technology and implement it or contribute to the implementation. It is assumed that the adoption of both solar and wind energy do not influence each other, because surveyed inhabitants stated that the choices are made independently from each other. Furthermore, the geographical location of households in the space does not influence the decision-making.

According to the diffusion of innovations theory, the architecture of a household innovation-decision process is based on five stages: knowledge stage, persuasion stage, decision stage, implementation stage, and confirmation stage (Rogers, 2003). In the ComRET model, the first three stages are incorporated in the acceptance decision stage. In this stage, the attitudes, values and norms of the technology are created and the intention to act is formed. This stage follows the implementation stage, in which the actual action is performed and proof of the action materialises. Finally, the confirmation stage, according to Rogers (2003), is represented by a satisfaction reflection stage, in which the benefit of the technology is evidenced and the innovation is promoted to others. The modelling procedure of renewables adoption is illustrated in the framework of the unified modelling language (Figure 5.6). This decision process is not adopted over time.
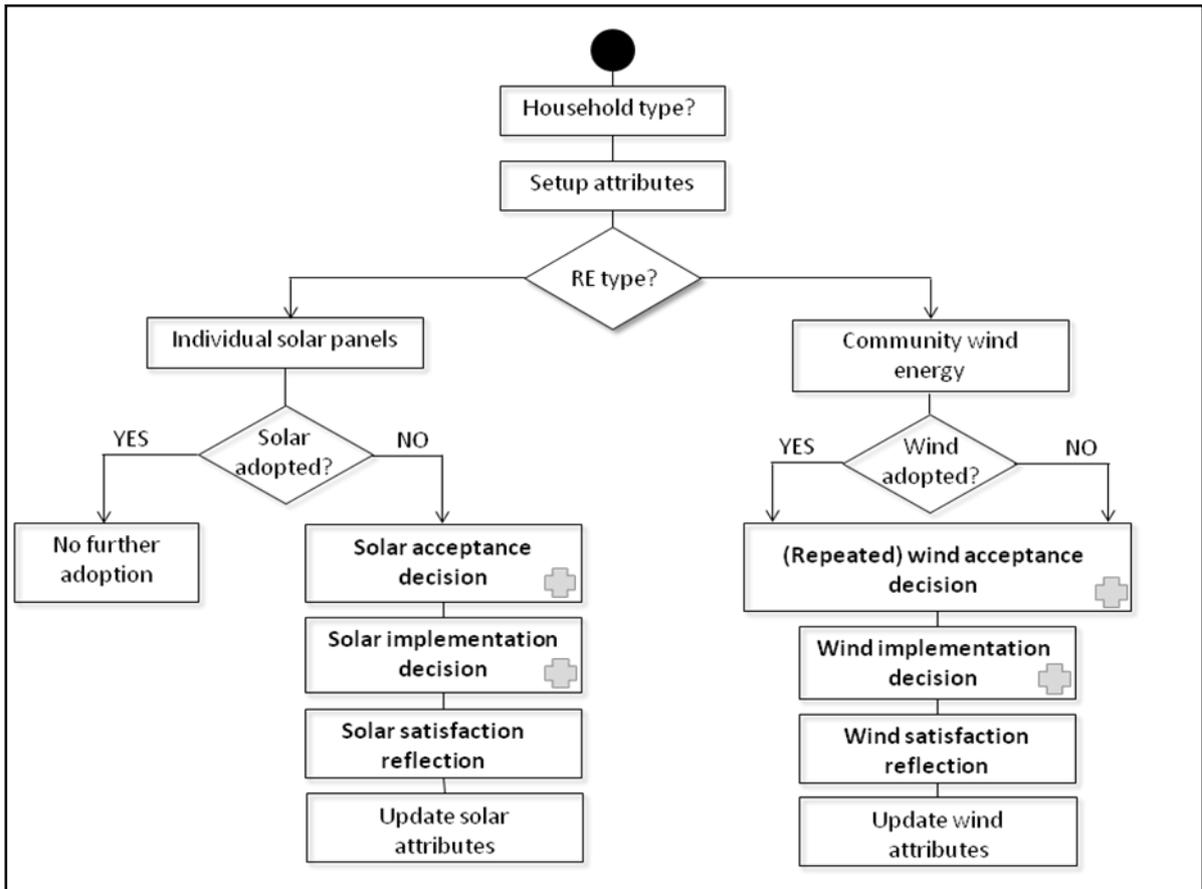
Figure 5.6: Households' decision-making process [RE = renewable energy]

As shown in Figure 5.6, the decision-making process is represented along three main stages: acceptance (or rejection) decision stage, implementation stage and satisfaction reflection stage.

Acceptance decision stage

The acceptance decision sub-model is represented by the decision about the acceptance or rejection of the specific technology. Both solar and wind acceptance decisions are assumed to be guided by three motivational attributes based on the theory of planned behaviour: attitudes towards the behaviour, subjective norms and behavioural control (Fishbein & Ajzen, 1975) (Figure 5.7). The theory was applied in the ComRET sub-model because it allows for the incorporation of attitudes, values and social norms in a structured and simplified way. The three core parameters are equipped with sub-parameters or variables (Table 5—1 in Section 5.2.2). The values of variables are adopted depending on the household interactions (Section 5.2.3). As applied by the study of Schwarz and Ernst (2009), the decision-making algorithm is comprised of the three factors – attitudes towards the behaviour, subjective norms and behavioural control – according to which the (expected) utility of the adoption is calculated (each factor ranges from 0 to 1). Utility is here used as a synonym for the acceptance or

rejection of the renewable-energy technologies depending on individual attitudes and the past decisions of other community households'. Depending on the household type and the technology, households compute the utility based on the following linear equation:

$$\text{Utility}_{h,t} = \alpha_h * \text{attitude}_{h,t} + \beta_h * \text{norm}_{h,t} + \gamma_h * \text{control}_{h,t}$$

$$\text{Attitude}_{h,t} = \sum (\text{values of parameters}_{h,t}) / n$$

$$= (\delta * \text{climate-benefit-belief}_{h,t} + \varepsilon * \text{solar-landscape-change-perceived}_{h,t} + \zeta * \text{solar-energy-independence-belief}_{h,t} + \eta * \text{solar-social-benefit-perceived}_{h,t} + \theta * \text{solar-economic-advantage-perceived}_{h,t}) / n$$

$$\text{Norm}_{h,t} = \text{percentage of people who had success in } (t-1)_t$$

$$= \text{social-pressure}_{h,t}$$

$$\text{Control}_{h,t} = \sum (\text{values of variables}_{h,t}) / n$$

$$= (\text{solar-potential-perceived}_{h,t} + \text{solar-technological-knowledge}_{h,t} + \text{solar-personal-ability-perceived}_{h,t} + \text{openness-for-change}_{h,t} + \text{solar-financial-ability-perceived}_{h,t}) / n$$

with agent type h, technology t, importance/weights of decision factors α, β, γ, δ, ε, ζ, η or θ, number of factors n.

The weights given for each variable have been defined according to the statements of the interviews and the results of the survey. For innovators and opponents of solar and wind energy, it has been assumed that attitudes towards the technology play a more significant role (factors 2). Furthermore, behavioural control seems to have a greater influence on the decision of whether to adopt solar energy for supporters and followers (factor 2). In comparison, social norms are assumed to have the highest influence on the adoption decision of wind energy for supporters and followers (factor 2). If the utility reaches the defined threshold (value of 2.5), then households decide to accept the technology, otherwise they decide to not accept the technology. The acceptance decision is repeated for each time step, as long as the adoption has been not made. Regarding wind turbines, even after the adoption, a repeated adoption decision is performed based on the present land-use for wind turbines and the number of households who adopted community wind.

Implementation decision stage

Once a positive decision has been made in the acceptance decision stage, households can assess their ability to adopt. In the case of solar panels, the actual implementation depends on the availability of a suitable roof. So, if the roof is not properly oriented or the house is

under monumental protection, the adoption in not possible (Figure 5.7, a). The availability or non-availability is randomly distributed along the households, and it has been based on the survey, which found that 16% of the households are under monumental protection. In the case of wind turbines, the investment in wind energy depends on the availability of land and others who also want to invest in wind energy (Figure 5.7, b). Households can observe the state of availability of land, and they are able to perceive if other households in the community want to adopt wind. As a result, wind turbines can be built only by a collective, a community of common interest. However wind turbines can be only built if the 'wind-community-size' is higher than the minimum number and land is still available. The minimum 'wind-community-size' can be flexibly chosen (5 to 20 households; model standard setting: 10 households). While in the case of solar panels an adoption is made only once, in the case of wind turbine, households can repeat the implementation, if the acceptance decision is still positive, meaning that the ComRET model accounts for repeated adoption. The model assumes that of up to 30 households who might want to adopt wind, about half a wind turbine per households is built (the integer part of the number of households who want wind divided by two). If more than 30 households want to participate in the community wind farm, 15 wind turbines per time step are built.

Satisfaction reflection stage

Once households have implemented the RET, households can reflect on their own satisfaction about the implementation decision and can perceive the satisfaction of the other households. The 'solar-satisfaction' and 'wind-satisfaction' probability within the community can be chosen for each technology in the setting up the model. Survey results indicated that 78% of the households who adopted solar and 86% of the household who participated in a community wind farm were 'strongly' satisfied. Therefore, these numbers are applied as model standard. The distribution of satisfaction and non-satisfaction is randomly distributed along the households. Ergo, households' own experiences and the experiences of others influence the future decision-making of the households.
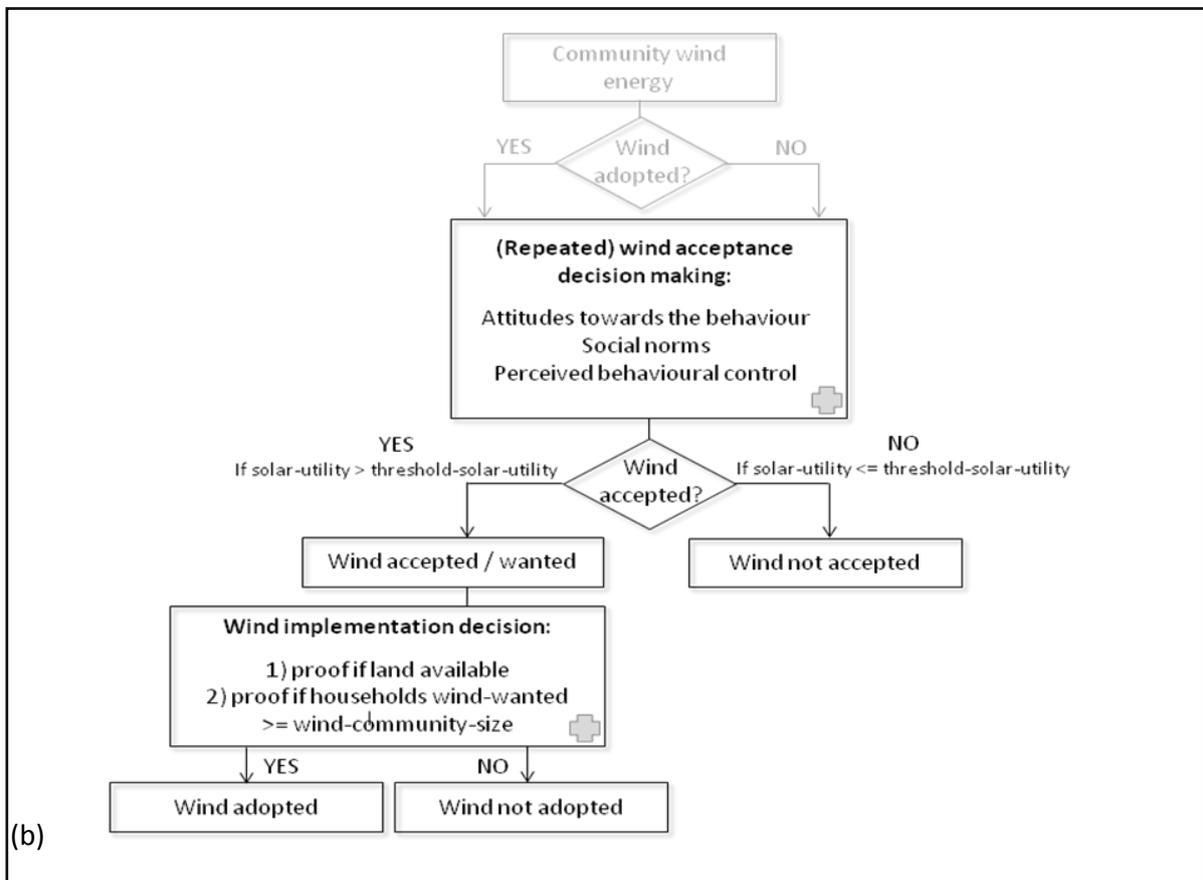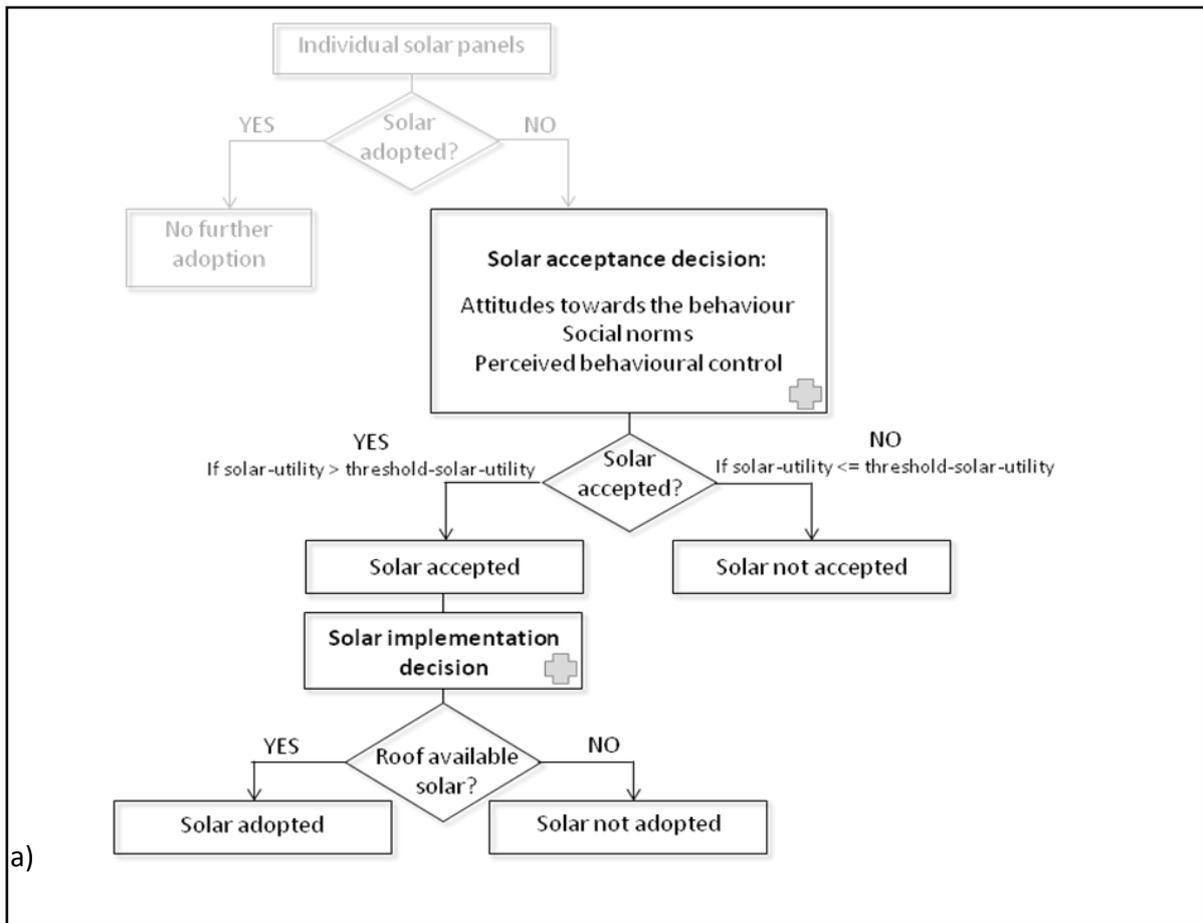
Figure 5.7: Households solar energy (a) & wind energy (b) acceptance and implementation decision

5.2.5 Implementation

The model was implemented in NetLogo (Wilensky, 2015), a programming language. NetLogo is currently one of the most popular agent-based simulation environments used by a large user community. In the program, three tabs are presented: the interface for the setup of pre-conditions and the output visualisation; the info for describing what the model is about and for and how to use it; and the code tab where the simulation program is written in the NetLogo-specific language and that is structured in procedures. NetLogo is relatively easy to learn and program. The program's documentation capability is good, and a link to the geographical information system (GIS) is provided. Therefore it was possible to implement a shape file of the municipality of Reußenköge by using the GIS extension for NetLogo.

5.3 Exploration of the community renewable-energy transition (ComRET) model

With the purpose and design of the ComRET model already described, this section presents the results of the exploration of the household behaviour framework and novel representations of household interactions types in the ComRET model.

5.3.1 Pattern-orientated modelling

As presented by Railsback and Grimm (2012), a pattern-orientated modelling approach was used. Pattern-orientated modelling has been defined as the 'use of patterns observed in the real system as the additional information […] need[ed] to make ABMs structurally realistic and, therefore, more general and useful, scientific, and accurate' (Railsback & Grimm, 2012: 227). Patterns are qualitative and can be conceived as regularities, signals or 'stylised facts' (Railsback & Grimm, 2012). The approach dictated that the ComRET model should be set up with data from the case study of Reußenköge, run with this data, and observed to see whether the model could reproduce macro-level patterns characterising the adoption of renewables in the community system. The qualitative pattern of the ComRET model could include the following: 'slightly less than half of households adopt solar panels', or 'there are six 'waves' of participation of community wind'. Such qualitative patterns can be assessed as 'weak' because they are less precise and descriptive. But as highlighted by Railsback and Grimm (2012:229), diverse qualitative patterns that 'characterise a system with respect to the modelling problem can be as powerful a filter as one very strong pattern', such as a photograph of a landscape. With this in mind, the ComRET model needed to reproduce several, three or more, patterns to be validated.

The municipality of Reußenköge was used as a case study to apply the pattern-orientated approach. The identified macro-level patterns are based on the semi-structured interviews conducted and census data, and the data collected through the household survey. Due to the different data basis, the patterns are assumed to be roughly accurate. Macro-level patterns identified for Reußenköge were as follows:

1) **Slightly less than half of households adopt solar panels**
   - ✓ The survey revealed that 45% of the households, who did not state to live in a house under monumental protection, adopted solar panels.
   - ✓ According to the statistical data by the DGS (2015c), 50 of the 120 households adopted solar panels. This equals to 42% of the households.

2) **Solar panels adoption rates are high at the beginning and then steadily increase**
   - ✓ 'But then the spark jumped over and all solarised their roofs.' (IR_#15:260)
   - ✓ The statistical data by the DGS (2015c) indicate high adoption rates at the beginning and a steady increase of solar panels later (Figure 5.8, left).
   - ✓ Furthermore, the data by the DGS (2015c) show high adoption rates at the beginning (2005) and a steady increase from 2006 until 2011 (Figure 5.8, right).
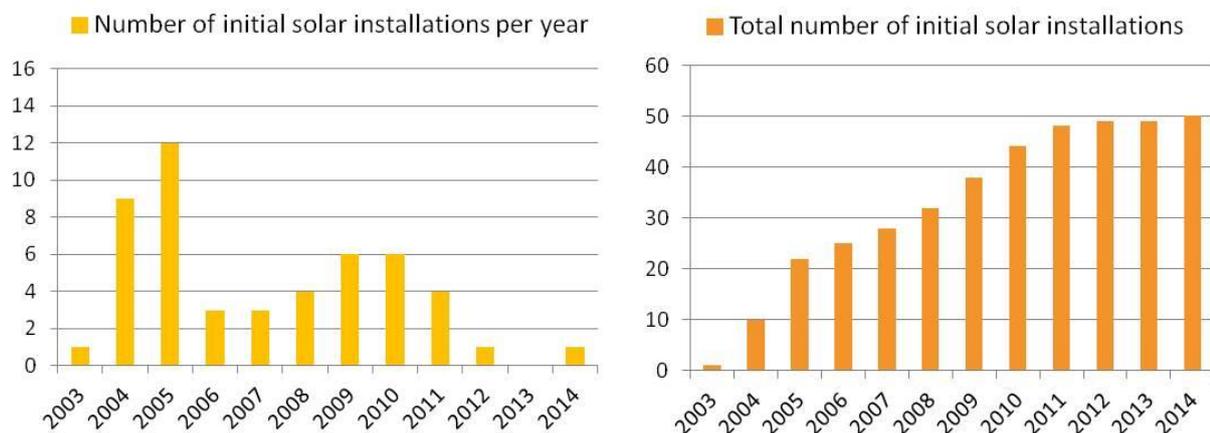
Figure 5.8: Diffusion of initial solar installations in Reußenköge; secondary installations etc. in the same household are *not* illustrated: initial installations per year (left), total installed number (right), based on the data from DGS, 2015c, initial installation based on the street names (data status 24.08.2015)

3) The majority of the households adopt wind turbines by becoming part of a community wind farm

- ✓ 'In the first group we were 28 [owners] and in the last 238 [owners] or something like that. We don't have many [people] older than 18.' (IR_#8:60-61). Nowadays about 330 people live in the community, including also children under 18, who cannot participate.

- ✓ 'There are a few, which are not involved, and although they had the possibility.' (IR_#9:187-188)

- ✓ There are 101 partners/owners in the 'Bürgerwindpark Reußenköge GmbH und Co. KG' (Creditreform, 2016) of the 120 households in the municipality. It indicates that about 84% of the households invested in a wind turbine.

4) There are six 'waves' of participation of community wind

- ✓ 'And at the end of the day, we have six community wind farms. 6 participation rounds so to say.' (IR_#8:59-60)

- ✓ The interviews and statistical data reveal 'waves' of adoption which, however, they may extend over several calendar years (Figure 5.9).
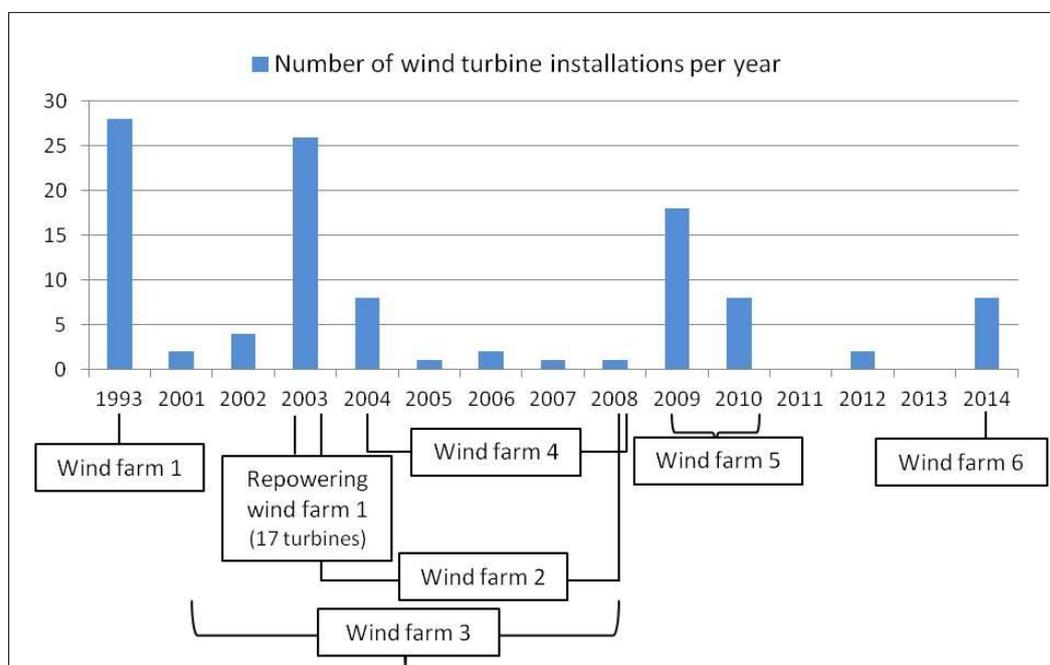
Figure 5.9: Diffusion of wind turbine installations in Reußenköge based on founded operating companies of wind farms (wind farm 1-6), based on the interviews (IR) and data from DGS, 2015c (data status 24.08.2015). Note: 1993 is the year where the wind farm was connected to the grid

5) Roughly 80 wind turbines are installed

- ✓ Nowadays, there are over 80 wind turbines in Reußenköge (Dirkshof, 2015).

The process of comparing the patterns produced by the model with empirical and census data represents the validation of the ComRET model. It was tested if the model can reproduce trends or results of the outlined macro-level patterns. This procedure implies that a simple model validation was performed by ensuring the similarity between the model behaviour and the qualitative patterns. This process might be seen critical by many 'traditional' mathematical modellers; however, the general difficulty of validating ABMs has been emphasised by various authors (e.g., Windrum et al., 2007; Ormerod & Rosewell, 2009).

Table 5—2 presents the micro-level data in the initialisation of the ComRET model. The data collection through the household survey revealed to be challenging. While for some variables values are based on the survey, others are estimated based on background knowledge of the region gained through the interviews. Secondary quantitative data were not available for the case study or even other regions. Hence, a rather pragmatic approach for the value setting had to be taken.

Table 5-2: Micro-level data: 'slider' or 'chooser'

Variable	Value (range)	Standard value	Data basis
household-type	Innovator and opponent: 1-50 Supporter and Follower: 1-100	Innovator: 19, supporter: 41, follower: 53, opponent: 7	Survey data
available-land	Number of patches (1-200)	100	Rough estimate
wind-community-size	Score (5-20)	10	Rough estimate
roof-suitability-solar	Score (1-100%)	87	Survey data
communication-types ('all', 'influential communication', 'seek advice', 'none')	On/Off	'all'	Survey data and interviews
solar/wind-communication-radius	Score (1-20)	5	Rough estimate
solar/wind-seek-radius	Score (1-20)	5	Rough estimate
solar-community-meeting participation	Score (1-100%)	30	Rough estimate
wind-community-meeting participation	Score (1-100%)	75	Rough estimate
solar-satisfaction	Score (1-100%)	79	Survey data
wind-satisfaction	Score (1-100%)	95	Survey data

Repeats for experiments

For the set-up of the experimental design it was required to decide on the number of repeats of each initialisation of the model needed to generate a reliable average output. The percentage of households who adopt solar panels and the percentage of households who adopt windmills were used to test it. As in Johnson (2015) it was decided to run one scenario (standard settings) hundred times, and to calculate the standard deviation and the mean for the outputs over 5, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 of these repeats. By comparing the standard derivations and the mean with the number of repeats used to generate it, it was aimed to identify the smallest number of repeats which gives an acceptable average and an acceptable standard derivation, relative to that of one hundred repeats. As shown in Table 5-3, that there is no additional reliability gained for a high number of repeats in both cases solar panels and windmills. Given the decrease of the standard derivations from 5 to 20 repeats and the increase of the means from 5 to 20, it was decided for repeats of 20. A repeat value of 20 seemed to be a reasonable sample size, and acceptable to keep the experiment run-time relatively low.

Table 5-3: Repeats of the model and size of the standard derivations and the means

Number of Repeats	5	10	20	30	40	50	60	70	80	90	100
Standard derivation solar panels	13.61	18.09	17.31	16.73	16.39	15.91	15.48	15.12	14.98	15.00	14.72
Standard derivation wind turbines	13.81	10.94	9.59	9.55	10.29	9.92	9.45	9.49	9.28	9.20	9.09
Mean solar panels	55	59	53	52	52	52	50	50	49	49	49
Mean wind turbines	97	102	95	94	96	96	96	96	96	96	96

5.3.2   Model verification, calibration and validation

Verification, calibration and validation represent three careful and thorough evaluative steps in the model. The verification step 'deals with building the model *right'* (Balci, 2003:135) by ensuring that the model is 'debugged' and 'correctly implemented and working as intended' (Gilbert & Troitzsch, 2005:19). In contrast, validation refers to the process of dealing 'with building the right model' (Balci, 2003:135) by ensuring that the represented behaviour in the computational model corresponds to the target phenomena (Gilbert & Troitzsch, 2005). The calibration step attempts to find and adjust values for model parameters that allow the representation of the behavioural patterns of a theory or real-world phenomena. Because the validation process has been already presented in Section 5.2.1, the implementation of

verification and calibration is represented in the context of the ComRET model as explained below.

Verification

The ComRET model was developed over several stages (Figure 5.1) based on theory and empirical findings. The interviews with inhabitants of and experts outside the municipality formed the general understanding for the adoption process and circumstances. Therefore it was possible to adapt the theoretical framework based on the empirical findings and to ensure that model was working as intended.

During the model coding, various verification techniques were implemented in order to reduce bugs and to identify them with greater ease (Gilbert, 2008). The coding was implemented progressively and carefully. After a change in the model code was made, the model was run and simulations were observed. Many monitors and plots were integrated into the model to make it easier to observe what happens during the model run. Furthermore, households have been 'followed' during the simulation in order to check whether the variables, values, and behaviours perform as intended. This step-by-step development was implemented in order to reduce the chance of including 'bugs' in the model code. Lastly, comments were inserted to describe what the blocks of program code do and how. These comments have been updated regularly.

Calibration

In pattern-oriented modelling, a clear focus on relating the model to real world phenomenon is intended, which makes a calibration of the model parameters necessary. Here, calibration of the ComRET model requires the calibration of the model 'against' patterns observed in the community system (Railsback & Grimm, 2012). It was aimed to see what parameter values are able to reproduce empirical observations and how well these observations can be reproduced.

In the ComRET model, there are 11 variables for the decision-making sub-model for which values need to be assigned. To conceptualise the variables in the model, the model was intended to be calibrated with empirical data. However, it appeared to be difficult to generate data for these variables in the household survey. The statistical assessment of the empirical data generated revealed mainly high values for all variables and all household types, though slightly higher values for wind energy than solar energy became apparent. The generally high values indicate that inhabitants were referring to present attributes and not

past ones. Therefore, the values for the parameters had to be estimated. This estimation was done 'inversely' by adjusting the parameters until the simulations best matched the observations (Railsback & Grimm, 2012). The values differ between the households types in a range from zero to one, including a random float 0.1 to include some variability between the households. Furthermore, a sensitivity analysis was performed in this calibration process by assigning different 'communication-radius' and 'seek-radius' while running the model. More parameters to be calibrated, however, often mean more uncertainty in their calibrated values. Table 5—4 and Table 5—5 present the assigned values for the different household types.

Table 5-4: Micro-level data for households' adoption of solar panels. Source: Estimated based on the survey results and interviews, some variables update during the simulation run

Variable	Values for each household type			
	Innovators	Supporters	Followers	Opponent
solar-climate-benefit belief	0.8 + random-float 0.1	0.7 + random-float 0.1	0.6 + random-float 0.1	0.5 + random-float 0.1
solar-landscape change perceived	0 + random-float 0.1	-0.1 + random-float 0.1	-0.3 + random-float 0.1	-0.4 + random-float 0.1
solar-energy-independence-belief	0.9 + random-float 0.1	0.6 + random-float 0.1	0.5 + random-float 0.1	0.5 + random-float 0.1
solar-social-benefit-perceived	0.8 + random-float 0.1	0.7 + random-float 0.1	0.6 + random-float 0.1	0.3 + random-float 0.1
solar-economic-advantage-perceived	0.8 + random-float 0.1	0.6 + random-float 0.1	0.5 + random-float 0.1	0.3 + random-float 0.1
solar-social-pressure	0 + random-float 0.1	0 + random-float 0.1	0 + random-float 0.1	0 + random-float 0.1
solar-physical-potential-perceived	0.8 + random-float 0.1	0.7 + random-float 0.1	0.5 + random-float 0.1	0.4 + random-float 0.1
solar-technological-knowledge	0.8 + random-float 0.1	0.5 + random-float 0.1	0.5 + random-float 0.1	0.4 + random-float 0.1
solar-personal-ability-perceived	0.9 + random-float 0.1	0.6 + random-float 0.1	0.4 + random-float 0.1	0.3 + random-float 0.1
solar-financial-ability-perceived	0.8 + random-float 0.1	0.7 + random-float 0.1	0.5 + random-float 0.1	0.4 + random-float 0.1
openness-for-change	0.9 + random-float 0.1	0.5 + random-float 0.1	0.4 + random-float 0.1	0.3 + random-float 0.1

Table 5-5: Micro-level data for households' adoption of wind turbines. Source: Estimated based on the survey results and interviews, some variables update during the simulation run

Variable	Values for each household type			
	Innovators	Supporters	Followers	Opponent
wind-climate-benefit belief	0.9 + random-float 0.1	0.8 + random-float 0.1	0.7 + random-float 0.1	0.6 + random-float 0.1
wind-landscape change perceived	-0.1 + random-float 0.1	-0.3 + random-float 0.1	-0.5 + random-float 0.1	-0.6 + random-float 0.1
wind-energy-independence-belief	0.9 + random-float 0.1	0.7 + random-float 0.1	0.6 + random-float 0.1	0.6 + random-float 0.1
wind-social-benefit-perceived	0.9 + random-float 0.1	0.8 + random-float 0.1	0.7 + random-float 0.1	0.4 + random-float 0.1
wind-economic-advantage-perceived	0.9 + random-float 0.1	0.7 + random-float 0.1	0.6 + random-float 0.1	0.4 + random-float 0.1
wind-social-pressure	0 + random-float 0.1	0 + random-float 0.1	0 + random-float 0.1	0 + random-float 0.1
wind-physical-potential-perceived	0.9 + random-float 0.1	0.8 + random-float 0.1	0.6 + random-float 0.1	0.5 + random-float 0.1
wind-technological-knowledge	0.8 + random-float 0.1	0.5 + random-float 0.1	0.5 + random-float 0.1	0.4 + random-float 0.1
wind-personal-ability-perceived	0.9 + random-float 0.1	0.6 + random-float 0.1	0.4 + random-float 0.1	0.3 + random-float 0.1
wind-financial-ability-perceived	0.9 + random-float 0.1	0.8 + random-float 0.1	0.6 + random-float 0.1	0.5 + random-float 0.1

5.3.3   Results

NetLogo provides a software tool named BehaviorSpace that allows the performance of model experiments. It enables one to run a model several times under systematically varying model settings, and it documents the results of each model run (Wilensky, 2015). This section presents the results of the simulations from the case study of Reußenköge.

First, it is notable how well the results of the simulations fit with the qualitative macro-level patterns identified in Reußenköge (compare Section 5.3.1). The simulation runs were each repeated 20 times (outlined in Section 5.3.1) under the standard setting informed by the data of the household survey and rough estimations (Table 5—3, Table 5—4, Table 5—5). It is important to note that the results for the communication type 'all' should fit well because the model was calibrated to ensure similarity between the model outputs and the qualitative patterns identified in the interviews, the survey and the census data (as described in Section 5.3.1). However, this procedure did not mean that the model must give precisely the macro-

level patterns identified, but rather that the model should come close to them, most of the time. Second, further simulation runs were performed to explore the influence of the distribution of household types, the influence of innovators and the variety of different communication types.

Qualitative macro-level patterns

1) Slightly less than half of households adopt solar panels

The results of the simulation show that about 42.5% of the households adopt solar panels (average of 20 runs; communication-types 'all') (Figure 5.10) This percentage equates to 51 of 120 households. The survey conducted in Reußenköge and the census data (DGS, 2015c) identified similar adoption rates (compare Section 5.3.1, pattern 1). Hence, the qualitative macro-level pattern of household adoption rates could be reproduced well in the model.

2) Solar panels adoption rates are high at the beginning and then steadily increase

Figure 5.10 illustrates the results of the simulations of solar installations. The plots show a substantial rise of adoptions from the initial starting point and a slowing down of the adoption rate after three time steps. A similar 'jump' was also registered in the interviews and census data (DGS, 2015c). However, the model produces a faster increase of adoption, resulting in an earlier cease of adoptions. Nevertheless, the ComRET model performs here relatively well in reducing general trends of the adoption of solar panels among households (compare Figure 5.8).
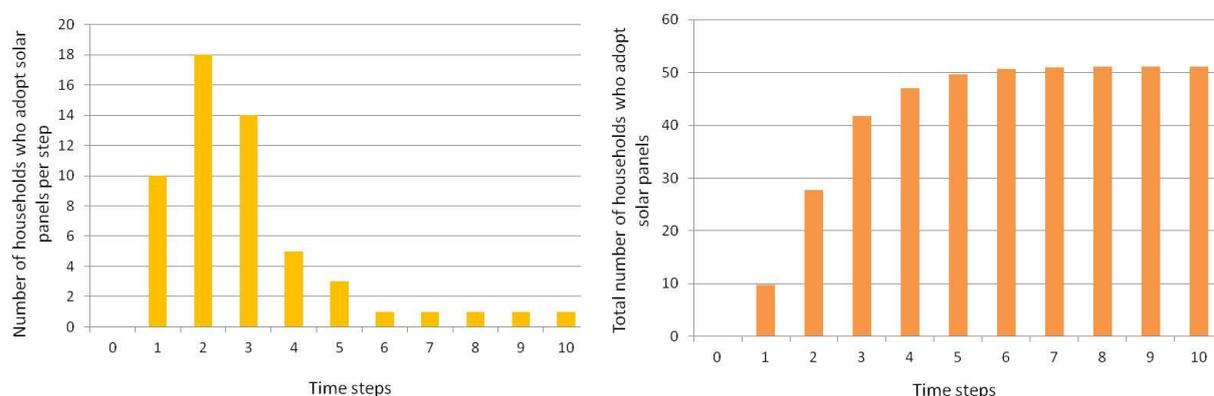
Figure 5.10: Households' adoption rates of solar installations for Reußenköge simulations (communication-type 'all'): and adoption per step (left), total number of installations (right)

3) The majority of the households adopt wind turbines by becoming part of a community wind farm

Figure 5.11 shows the adoption of wind turbines plotted against each time period. About 80% of the households (96 households) invest in a wind turbine. The result is that the majority of the households participate in a community wind farm. A similar high percentage was also identified in the interviews (compare Section 5.3.1, pattern 2) and the census data (Creditreform, 2016). Hence, the ComRET model seems to represent well the households' investments in community-based wind turbines.
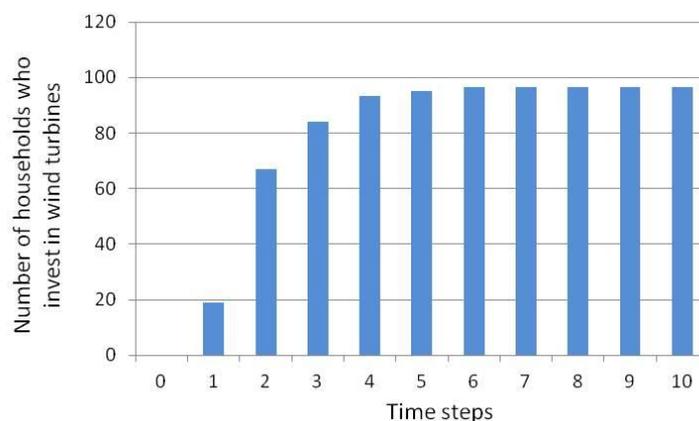
Figure 5.11: Household adoption of wind turbines for Reußenköge simulations (communication-type 'all')

4) There are six 'waves' of participation in community wind

In Reußenköge, six community wind farms were built in the 20 years leading up to 2014 (Figure 12). The real-world data revealed a quite irregular construction of the community wind farms over the years, which could be not represented in the model. Nevertheless, the ComRET model is able to reproduce the six 'waves' of decisions made to participate in a wind farm project (compare Section 5.3.1, pattern 4). Figure 5.12 illustrates the model output after a simulation run.
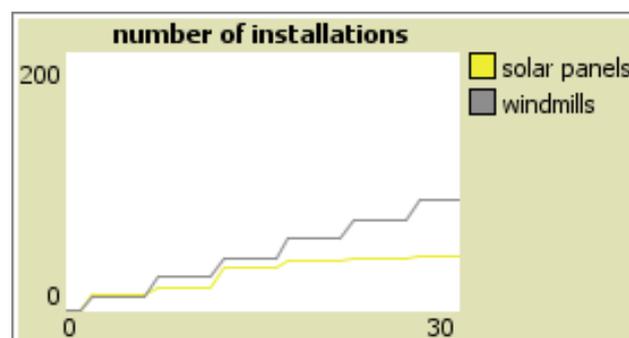
Figure 5.12: Output after simulation run: six waves of windmill adoption representing the wind farms built

5) Roughly 80 wind turbines are installed

The latest development in the case study of Reußenköge found that about 80 wind turbines have so far been installed (Dirkshof, 2015; compare Section 5.3.1, pattern 5). The results of the simulations show that on average 85 wind turbines are built (Figure 5.13). The plot, furthermore, represents six installation phases. Hence, the macro-level pattern of total installations can be realistically reproduced, on average.
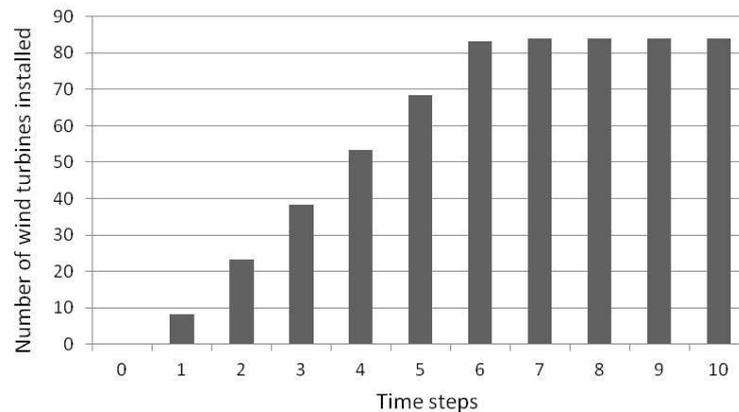
Figure 5.13: Development of wind turbines installed for Reußenköge simulations

Exploration of household types

The qualitative macro-level patterns identified in Reußenköge could be accurately reproduced in the ComRET model. In this section the adoption rates along the different household types are investigated, as well as the influence of innovators on adoption rates.

Figure 5.14 shows the plots of the household adoption rates of solar panels and wind turbines for the different household types, along each time step. The highest adoption rates are found in the early time steps, whilst especially supporters and followers also adopt technologies in the later time steps. It might be not surprising that innovators first adopt the renewable-energy technology and later on trail the supporters and followers. In the case of solar panels, quite all 'innovators' with a suitable roof adopt solar panels (89%). In the case of wind turbines, all innovators invest in a community wind farm as long as there are enough people around who also want to invest. Furthermore, about 70% of the 'supporters' adopt solar panels and nearly all participate in community wind projects. In comparison, about 29% of 'followers' adopt solar panels and 75% wind turbines. The probability of opponents investing in solar panel or windmills is very low, at 0.2%.
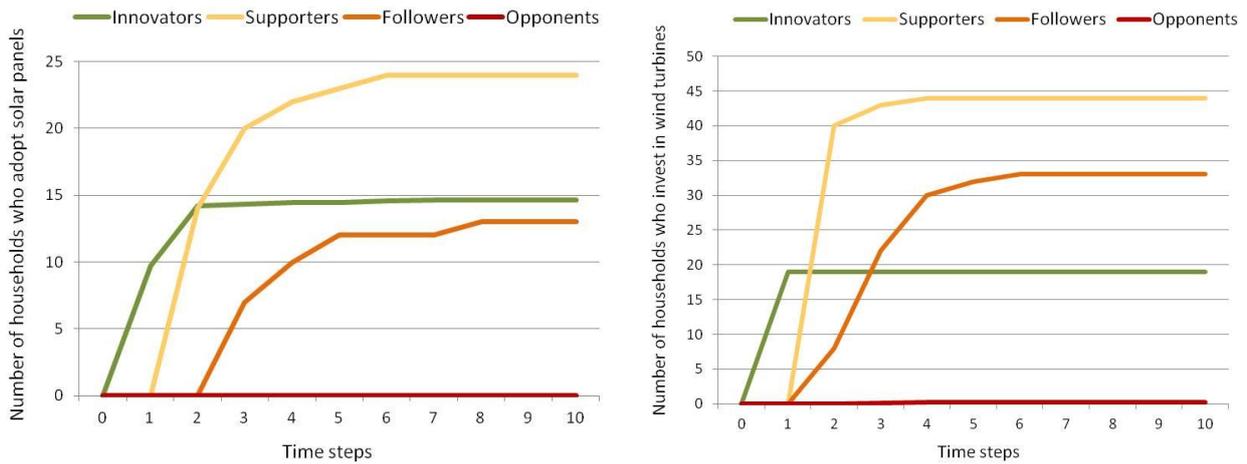
Figure 5.14: Household adoption rates of solar panels (left) and wind turbines (right) along the different household types for Reußenköge simulations

Of special interest was the exploration of the influence of innovators on adoption rates. Based on the fact that all types of communication take place in the community, different simulations were run with 3, 11, 19, 27 and 35 innovators. The number of the households stayed unchanged. The comparison of the results of the simulations show that the higher the number of innovators, the higher is the adoption rate for both solar panels (Figure 5.15) and wind turbines (Figure 5.16). For solar panels a substantial increase in adoption is found from 19 to 27 innovators, while for wind turbines, a substantial increase in the adoption rates is found from 3 to 11 and 11 to 19. The low adoption rates of wind turbines in the case of 3 and 11 innovators can be ascribed to the minimum number of people needed who want to invest in a windmill. Subsequently, no projects are realised unless a minimum number of people are interested doing so. This result indicates that, in particular for community wind projects, a critical number of innovators must be based in the community to facilitate the implementation of projects. In contrast, solar investments are done on an individual basis, wherefore the higher number of innovators critically influences diffusion along the community.
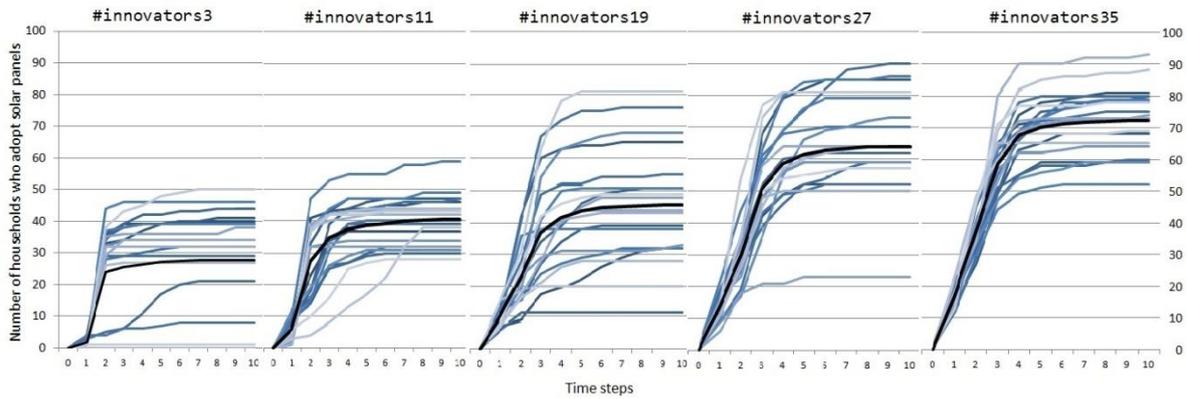
Figure 5.15: Influence of innovators on the adoption of solar panels (20 model runs shown; black curves represent the mean); communication type 'all'
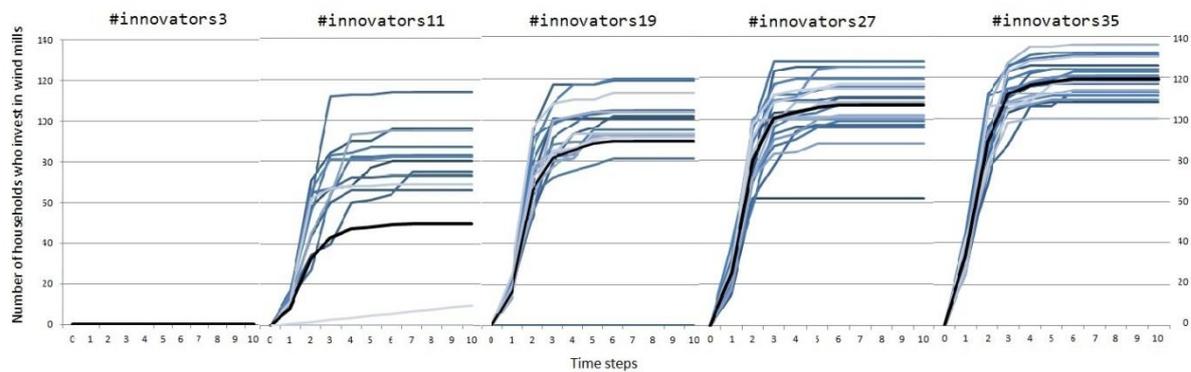
Figure 5.16: Influence of innovators on the adoption of wind turbines (20 model runs shown; black curves represent the mean); communication 'all'

Exploration of communication types

Chapter 5.2.3 described the four main ways of interaction in the ComRET model: (a) influential communication, (b) advice-seeking, (b) community meeting, (d) all three combined. To compare the influence of each communication type, the model had to be run with all 'on', with each alone, and without any.

Figure 5.17 plots the number of households who adopt solar panels, comparing the different communication types. 'All' gives the highest adoption rate with about 42.5% of households. 'Influential communication', 'community meeting' and no communication give similar results, but 'influential communication' provides a higher variation than the others. The low influence of 'community meeting' might be grounded in the fact that it is assumed that only 30% of the households participate in the meeting. 'Advice-seeking' results in higher levels of adoption with around 37 households, or about 30% of the households, adopting solar panels.
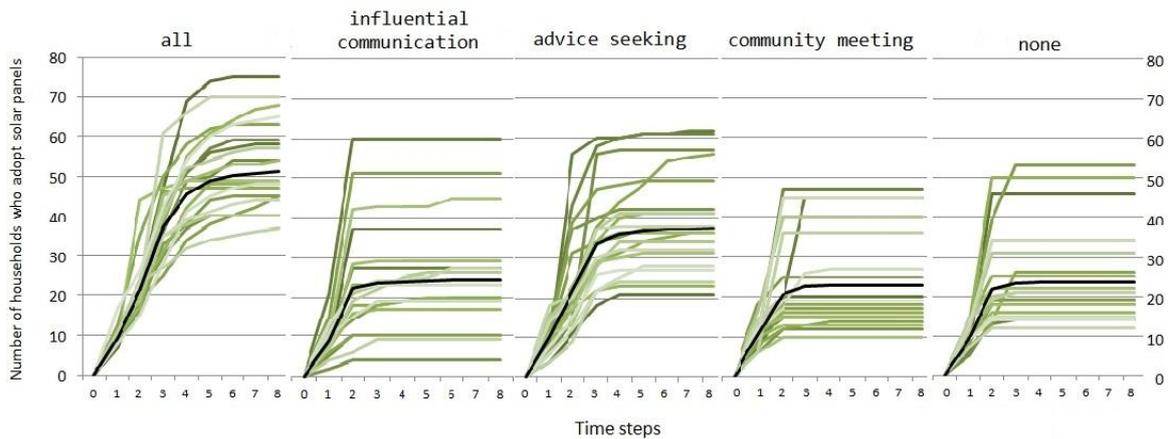
Figure 5.17: Influence of communication types on the diffusion of solar panels (20 model runs shown; black curves represent the mean); both 'influential communication' and 'advice-seeking' with radius of five

The numbers of households who invest in wind turbines are plotted in Figure 5.18. As in case of solar panels, 'all' communication types together result in the highest adoption rates. On average, about 100 households, or about 83% of the households, invest in windmills. 'Advice-seeking' gives the highest adoption rate among the communication types each run alone. Around 81.5% of the households adopt solar. Considering the diffusion, 'advice-seeking' facilitates investment in community wind also in the later time steps. In contrast to the adoption of solar panels, 'influential communication' shows here a greater influence on the adoption rate, with a mean of 57.5% of the households. Surprisingly, 'community meeting' does not perform well, resulting in similar adoption rates as 'none'.
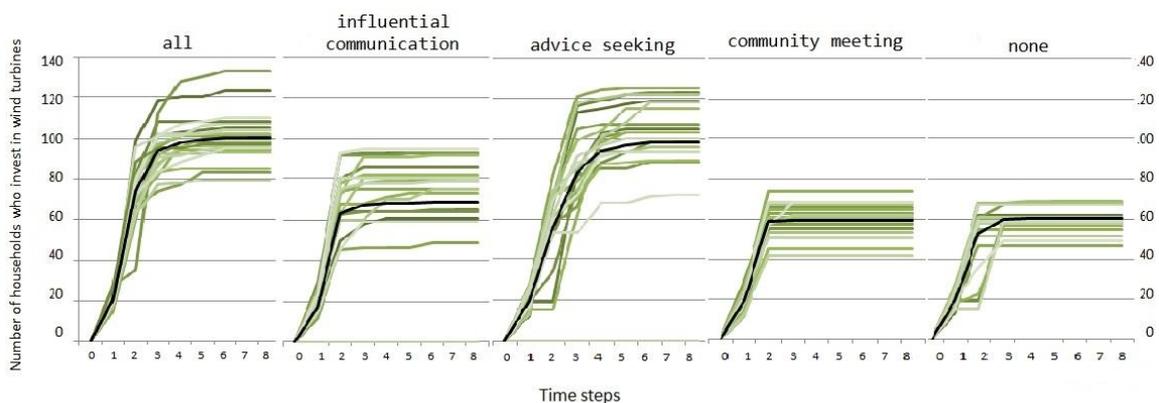
Figure 5.18: Influence of communication types on the diffusion of investments in wind turbines (20 model runs shown; black curves represent the mean); both 'influential communication' and 'advice-seeking'' with radius of five

To further explore the relevance of 'influential communication' and 'advice-seeking' each alone, simulation runs for different radiuses were performed. Figure 5.19 shows the results of the simulations for a radius of 1, 5 and 10. The findings indicate that a larger radius positively influences the adoption rate. This result holds true especially for 'advice-seeking'. In the case

of the adoption of solar panels, the adoption rate can even be doubled from a radius of 1 to a radius 10.
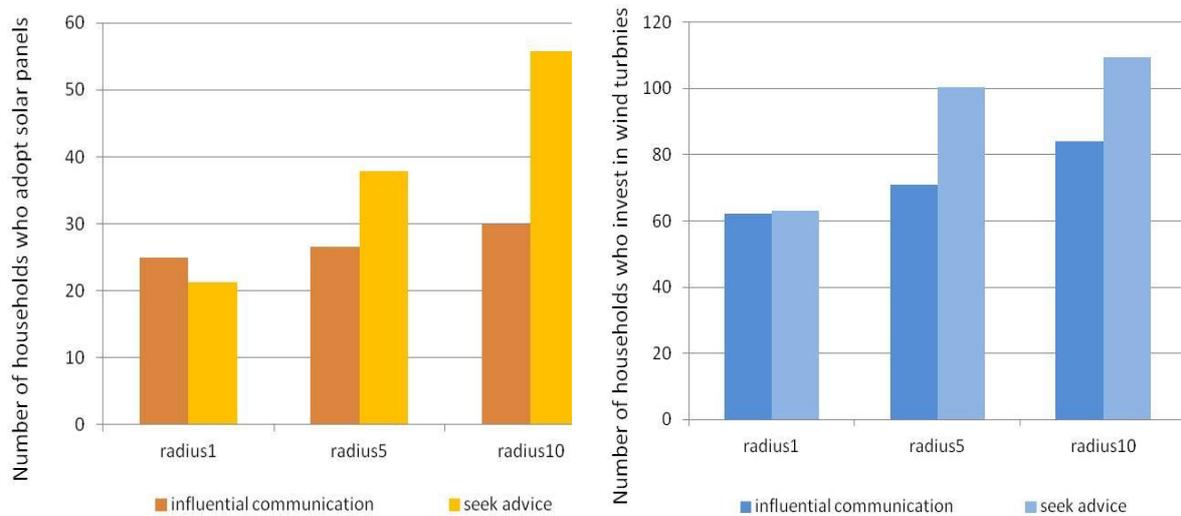
Figure 5.19: Influence of different communication radiuses on the adoption of solar panels (left) and the adoption of wind turbines (right)

5.4 Interim conclusion

The outcome of this chapter was threefold: firstly, it outlined different approaches for modelling the adoption and diffusion of renewable-energy technologies; secondly, it presented the description of the ComRET model; and thirdly, it explored the performance of the model in the case study of Reußenköge. The aim was to investigate the process of households' individual adoption of solar panels and collective adoption of windmills in the 'virtual laboratory' of an ABM. By developing a model based on diffusion and social psychological theory and informed by empirical data, the study was able to explore and reveal the importance of different interaction types and of innovators for the adoption of technologies.

The theories of diffusion of innovations (Rogers, 2003) and of planned behaviour (Ajzen, 1991) presented a suitable framework to be applied in an ABM. The development of the ABM in the context of community-based renewable energy reveals the importance of a suitable theoretical framework, which can be equipped with empirical evidence. The descriptive model developed based on interviews and a household survey has been incorporated and combined into a computer model. Furthermore, the ComRET model has been calibrated and validated based on empirical data in the case study of Reußenköge. The strong empirical focus was a main intention driving the development of the model and its integration in the broader context of the research. The ComRET met the qualitative macro-pattern identified in

the case study of Reußenköge. This research could thus explore the influence of different communication types on the household adoption of solar panels and wind turbines. The model simulations indicated that a mix of different household interactions results in the highest rate of adoption. Among the single communication types, 'advice-seeking' proved most important. This finding indicates that not the single provision of information makes the difference but rather the personal interaction and engagement within the whole process. Furthermore, the significance of innovators for the diffusion of renewable-energy technologies was documented. While individual adoption of solar panels can be done by individual households, the implementation of a community wind farm required several innovators or supporters from the beginning. If a community lacks such innovative spirit, other kinds of support, such as from regionally-based companies, seem to be inevitable to enable the development of community-based projects (see Chapter 4).

The findings presented here are based on a specific case study. With that said, the ComRET model has the potential to be applied and explored in other local contexts. It would be especially interesting to equip the sub-model of household decision-making with empirically rich data to increase the explanatory power of the model.

Overall, the ComRET model is a model – a simple representation of the complex and social process towards community-based renewables. The development of the model was an important part of this research because it represents a new way of thinking about the social phenomena of a community-based energy transition and the importance of interactions within it. Reflecting from the ComRET model to the real world, the simplified model was able to capture some critical social structures and processes underlying the development of community-based renewables. This structures and processes included the decision making process along different stages and the representation of how people interact with each other. However, it is important to have in mind, that other aspects could be not included, which might be also critical for the diffusion of renewables such as funding schemes. Nevertheless, agent-based modelling revealed to be a promising analytical tool for representing the complexities of decision about renewables, and the developed ComRET model can be used as basis and advanced for future studies on decision-making about renewables.

While this chapter has focussed on the household adoption of renewable-energy technologies, the next chapter will address perceptions and assessments of implemented community-based visions of community renewables. How do people reflect on the benefits and challenges that are induced by renewables for local places and communities?

6 'Renewables? YES, please!?' – Perceptions, assessments and visions of renewables and induced community transition

In order to carry a positive action we must develop here a positive vision.

Dalai Lama

'Yes or no to renewables?' is a question facing communities and local places anticipating a renewable-energy transition. Chapter 4 revealed the importance of a locally grounded energy transition implemented by and for people and the place they live in. Chapter 5 built on this conception and explored the process of the adoption of renewable-energy technologies and the importance of social interactions for the diffusion. Here, chapter 6 recognises the importance of socio-geographic circumstances and motivational components, but focuses on perceptions and assessments of renewable-energy technologies and of the transition in community structures and dynamics following their implementation. It is of interest to explore people's supporting and opposing views and to understand the trade-offs between the two. How do people perceive renewables in their local place and community? What opportunities and fears are related to the development of renewable-energy technologies? How does community-based energy transition affect community life?

'I am on the sunny side, on the windy side, in sense of the sunny side' (IN_#5:479-480), said one interviewee. The energy transition induces not only long-term structural change in energy systems, but rather a transition in places and communities involving local creativity, innovation and change. Such a transition implies the addressing of active configuration and continuation (IZES, 2015). In the framework of this research, the investigated local energy transition is, thus, considered a *community transition,* involving the benefits – sunny and windy sides of the energy transition – as well as the challenges and disadvantages – the shady sides. The community benefits of local renewable-energy projects have been of increasing interest over the past decade(s) in the scientific literature and in politics, especially in relation to wind farm projects, to mitigating conflicts around projects, and to their potential in regional development (Center for Sustainable Energy, 2009; Munday et al., 2011; IZES, 2015). So far, only a few empirical studies (Rogers et al., 2008; Munday et al., 2011; Rogers et al., 2012) have investigated people's perceptions and assessment of the opportunities underlying community-based energy generation. These studies mainly consider *hypothetically* expected

community benefits and not *experienced* benefits. Furthermore, non-benefits and challenges have been hardly addressed so far (except Rogers et al., 2008; Baxter et al., 2013). Hence, grounded research is needed that explores both the opportunities and challenges of community renewables perceived and assessed by people who (have) experience(d) a local energy transition. This chapter addresses these research gaps by investigating people's place-based perspectives on renewable-energy technologies and induced community-transition. In order to learn for further project developments, the chapter explores how different benefits and challenges are intertwined and considered against each other, and finally, how they are embedded in the broader social system. The following main research question is addressed: How do people perceive and assess community-based renewables and an induced community-transition?

To address people's perspectives on community-transition from energy *for* the place to energy *from* the place, a series of semi-structured interviews was performed in six different North Frisian municipalities. A standardised household survey and 15 semi-structured interviews were conducted in the energy community of Reußenköge, following expert interviews in six other energy communities in North Frisia and with politicians of Schleswig-Holstein (for detailed explanation see Chapter 2). It is important to highlight here that the feature of the study lies in exploring community-based renewables in- and post-implementation at the same time. This implies that community-based citizen's energy projects have already been implemented in local municipalities over the last 30 years in a form based on individual investments, or on collective investments in the form of private limited companies (GmbH & Co. KG.) and cooperatives (eG). Thus, people reflect on and assess their experiences of the development, and the current perceptions and implications of renewables. The survey was designed to address peoples' attitudes related to community-based renewables, and to explore changes in attitudes. Respondents were approached with the questions like the following: To what extent do you agree on the statements to renewable energy? Did you change your opinion about renewables, solar energy and wind energy? Furthermore, the in-depth interviews addressed questions on the local coping with climate change and the assessment of the (non)development of renewables in the specific municipality (six different locations in North Frisia), and the federal state of Schleswig-Holstein in general (two interviews). Questions relating to this were, for example, what do you think of how the municipality or federal state is facing climate change? What do you think enhanced the development of renewables in *X*? Below, the results of interviews are presented which

were analysed based on grounded theory (Charmaz, 2014; Corbin & Strauss, 2015) to identify analytical categories of community benefits and challenges. Furthermore, the following sections review existing approaches for investigating community benefits and challenges, and discuss them in comparison to the empirical results of the present research. Finally, conclusions are drawn and policy implications are provided.

6.1 Background on community benefits and the challenges of community-based renewables

This section attempts to find analytical and structural approaches and categories which could be potentially made use of in this research for assessing community renewables. In order to do so, it reviews empirical evidence on the community benefits and challenges of community-based renewables, analytical insights provided by research, and the conceptualisation of different facets of community benefits and challenges. It was decided to include peer-reviewed and non–peer-reviewed literature about the implementation of renewables.

Peer-reviewed literature

In the peer-reviewed literature, empirically grounded and practise-based approaches for investigating community benefits and challenges have been found. In empirically grounded studies, different benefits of community renewables have been exhibited. Most of the studies did not investigate an analytical categorisation of people's evaluations, but rather represented the empirical results. One exception is the study by Rogers et al. (2008), which explored with a questionnaire survey and semi-structured interviews the expected benefits and concerns of community-based renewable-energy projects. The study identified three main categories based on empirical answers: environmental benefits (conserve energy or resources; benefit environment, preserve environment for future generations; use local resources), social benefits (benefit or strengthen community; make the community an example; educate; provide better living conditions to enable people to stay), and economic benefits (attract visitors; save money; benefit individual, which is good for the whole community; employ locals). The three categories are filled with empirical answers (in brackets); however, no generalised sub-categorisation is provided. To build on the social, expected benefits catalysed by community renewables have been identified as sense of community and community capacity (Rogers et al., 2008). The qualitative research from Rogers et al. (2012) studied the social impacts of community wood-fuel heating projects. They found that the visible demonstration and local fit of projects led to an increased awareness

and adoption of wood fuel and to engagement with sustainable energy issues and other renewables. However, Cowell et al. (2011), who focused on the acceptance and acceptability of wind energy projects in Wales, underline that community benefits may not always contribute to a higher social acceptability. Another empirical study has been conducted by Cass et al. (2010), investigating stakeholder and public perspectives on possible community benefits and their evaluation of tidal stream and wave projects. Within focus groups by Cass et al. (2010), different issues could be identified explaining project support, including personal and local impacts and benefits, in-kind benefits and community engagement.

Besides the benefits, local challenges have been less prominent in the empirical studies. Rogers et al. (2008) have identified 17 concern categories, mainly referring to negative environmental impacts and the organisational matters of the project development. Munday et al. (2011) have added to the topic project development by addressing the risks of ownership if a wind farm is not operating as expected. Furthermore, Cass et al. (2010) have investigated stakeholder and public perspectives on possible community benefits and their evaluation of tidal stream and wave projects. The focus groups revealed different concerns, including negative impacts on tourism and the environment (Cass et al., 2010).

In contrast to the strongly empirically grounded investigations of community impacts, many reviewed studies have applied the categorisation of community benefits developed in reports for the practice of community project development across the UK, or have used similar categories without a clear reference to the categorisation process (Cass et al., 2010; Munday et al., 2011; Cowell et al., 2011; Bristow et al., 2012). Based on four articles, six categories could be identified: community ownership (some form of shares), community benefit fund (money provided by the developer), in-kind benefits (enhancement to local infrastructure, facilities and environment), local contracting (local employment during construction and operation), environmental mitigation and enhancement, and involvement in the development process (form of connection activity). This categorisation already indicates a strong focus on financial and material benefits, rather than social ones. Moreover, the benefits seem to be centred on wind farm projects. Furthermore, Aitken (2010) has conducted an empirical study comparing initial perceptions and perceptions after the construction of wind turbines. However, the three community packages in the focus of the after-construction interviews are as follows: fixed payments, variable payments, and an energy-efficiency fund. He identifies two continuous emerging themes: who the benefiting community is, and what a legitimate project to fund is. Due to the focus on the community

benefit package, other kinds of benefits and challenges have not been considered. Furthermore, the study by Baxter et al. (2013) used a questionnaire to study nine analytical sections of wind turbines: support for turbines, self-assessed knowledge and preferences for wind energy, aesthetic impacts, health impacts, animal impacts, economic impacts, siting process fairness, community enhancement and conflict, and socio-demographic information. The categories have been predefined to test underlying hypotheses. Except the latter two studies, the practice-oriented studies focussed only on the community benefits and neglected the possibly disadvantageous impacts of community renewables.

Non peer-reviewed literature

Due to the current political relevance of community renewables and the availability of applied projects conducted by or for political bodies or associations, it was decided to review also non–peer-reviewed reports in order to identify factors of community benefits and challenges.

In the German literature, a strong focus on regional added-value and long-term employment due to renewables could be found (Prognos, 2015; IZES, 2015; AEE, 2015b; Hirschl et al., 2010). Regional added-value generated through renewables has been characterised over the following elements: local or communal tax incomes, incomes of companies, lease incomes, income or employment effects (spending through employment) (AEE, 2015b; IZES, 2015; Hirschl et al., 2010), and energy cost-savings due to decreasing dependency on fossil fuels (IZES, 2015). Besides the regional added value, community renewables are found to create employment opportunities and to secure employment (Prognos, 2015; IZES, 2015). Local long-term employment might be fostered in the creation of new economic sectors in renewables, and related local and regional supply chain developments (IZES, 2015; BiGGAR Economics, 2012). Methodologically, most of the studies on added value and the employment effects of renewables used input-output analysis (review by Prognos, 2015). In contrast, the study by IZES (2015) is based on a literature review and expert interviews. The study identified four main effects: economic effects, energy economic effects, social effects, and the overlapping category of political-democratic effects. These have been characterised in analytical categories. Economic effects have been categorised in regional added value, employment and the creation or professionalisation of a new economic sector. Energy-economic effects consist of the following categories: realisation of installation only through citizen's energy, participation in energy generation, fair shares of revenues, and decentralised energy generation. Social effects have been characterised by acceptance, integration of citizens in a sustainable economic process, co-determination and transparency, creation of

identity, increasing engagement, engagement transfer, and earning of new competences. Lastly, the categories of self-efficacy or political participation and an increase of actor diversity belong to political and democratic effects. The study, however, found differences in the importance of categories assessed by the interviewed experts (IZES, 2015).

In the UK literature, four main categories of community benefit could be identified in the context of wind-energy development: local or community ownership, community funds, benefits in-kind and local contracting (Center for Sustainable Energy, 2009; Southern Uplands Partnership, 2011; BiGGAR Economics, 2012; Scottish Government, 2013; DECC, 2014b). Local or community ownership implies that local people hold shares in the project, which can be implemented through their own investment or through different profit-sharing or part-ownership schemes and benefit from revenues. In order to do so, developers or communities shall increase the community ownership and involvement in the development process. Another benefit might be provided by community funds or community benefit payments, in which case local residents receive a lump sum or regular payments into some sort of benefit fund. Furthermore, developments can provide or pay for local priorities, such as facility improvements, improvements to local infrastructure, environmental improvements, visitor facilities (tourism), school and educational support, and so-called benefits in-kind. Despite the fact that renewables, and especially wind farms, will impact the local landscape, in-kind benefits might be used for environmental enhancement or education in order to mitigate landscape and environmental impacts. The fourth category is local contracting, implying local employment during construction and operation, local businesses and accommodation benefits, and the provision of training or apprenticeship placements (Center for Sustainable Energy, 2009; Southern Uplands Partnership, 2011; BiGGAR Economics, 2012). The described four community benefit categories can be seen as guidance or as a toolkit for 'mak[ing] meaningful community benefits more routine and systematic in UK wind energy projects' (Centre for Sustainable Energy, 2009:5; Scottish Government, 2013; DECC, 2014b). As such, similar guidelines or toolkits can be understood as part of a wider strategy aiming to legitimise and encourage the community benefits of wind farm projects in the UK. The toolkit for wind energy projects from the Center for Sustainable Energy (2009) also represents case studies stating the kinds of community benefits to the local communities, while using mainly statistical input-output data for the assessment.

Considering potential benefits of community energy, diverse challenges arising from disadvantages or negative impacts must be also addressed. Despite local landscape impacts,

the non-peer reviewed literature is found to neglect resultant challenges. IZES (2015:2) argue in their study that their literature review and the expert interviews did not reveal any negative social impacts of renewables.

This review of different approaches for exploring community benefits and challenges has revealed that there is no existing framework which is able to satisfy the complex and social nature of the community renewables research context. In the literature, there have been scientifically and empirically grounded approaches, and practical and politically oriented approaches for investigating community benefits and challenges. Overlapping economic, social, environmental, political and planning aspects have been discussed. However, there seems to be no conceptual framework for and hardly any grounded analysis of assessing community benefits from the common people's point of view. Furthermore, disadvantageous impacts and challenges for local communities seem to be rarely addressed so far, despite the large discussion in practice about visual environmental impacts. Thus, it has been decided to apply an empirically grounded approach for identifying and structuring the analytical categories of community benefits and challenges perceived and assessed by local people.

6.2 Empirical findings

In this section the empirical findings of the standardised household survey in Reußenköge (SR), and the in-depth interviews in Reußenköge (IR) and the North Frisia/Kiel (IN) are presented. The aim is to analyse how people assess the community transition induced by community renewables and how this is informed by different perceptions of renewables. Three perspectives of community renewables are examined: community benefits of renewables, community challenges involved, and future community visions.

6.2.1 Benefits of community renewables in North Frisian municipalities

The analysis of the interviews revealed that community benefits can be distinguished in four main interlinked analytical categories: environmental, social, economic and planning. All these categories were found in the interviews and further structured in sub-categories permeating the process of renewables-driven community transition.

Environmental benefits

To start with, renewable-energy technologies such as photovoltaic, windmills, biogas and geothermics, are generally perceived as clean energy sources, which contribute to climate-change mitigation. One interviewee described the climate benefit of renewable energy:

Yes, we try to do climate-friendly energy generation with all our windmills. So, I think, we make quite a good contribution, and there are not only windmills, but also solar panels and biogas. We do have a lot. (IR_#9:67-68).

'We try' expresses peoples' perceived collective and local contribution to a climate-friendly energy generation. The localised and renewable nature of renewables has been furthermore underlined by one interviewee: '[…] generally, renewables lie in front of our doorstep with wind power, photovoltaic and biogas' (IR_#13:87-88). Renewable-energy generation was even described and compared with the life cycle of agriculture: '[…] from agricultural perspective, we always think from the base: You have to plant it, you have to grow it, you have to harvest it. It must have all a cycle' (IR_#6:281-282). This remark indicates the linkage between the environment and local practices ('plant', 'harvest') in agriculture and energy generation.

Almost 80% the surveyed households in Reußenköge 'strongly' agreed, and the rest 'rather' agreed that renewables contribute to climate protection (Figure 6.1). Approximately 88% of the households in Reußenköge, furthermore, 'strongly' agreed that renewable energy is important for the energy transition (Figure 6.1).
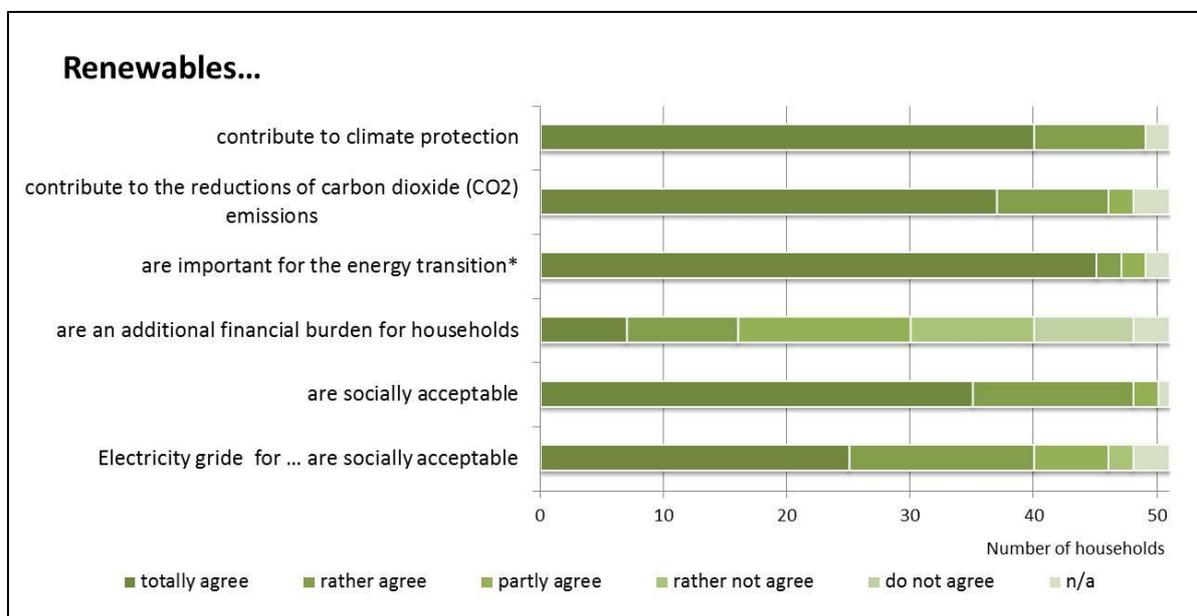
Figure 6.1: Perception of renewables. Household survey Reußenköge, 2014, N=51
*Transition towards a sustainable energy supply based on renewable energy

Also, I can say only that we try to build many photovoltaic plants and to turn some windmills in order to maybe avoid that a coal power plant is running somewhere, um... this would serve the environment a bit. (IN_#6:182-186)

This quotation nicely underlines the potential of renewable-energy transition to phase out coal ('avoid that a coal power plant is running') and thus, to **enhance the environment** ('would serve the environment'). Considering alternatives to renewables, interviewees were clearly averse to nuclear, coal, carbon capture and storage (CCS), and hydraulic fracturing (fracking) in Schleswig-Holstein. One interviewee described the movement against CCS:

> Yes, the citizen of the year was my friend X, because he has founded the CCS initiative. And thereon you could recognise it: enormous resistance. We don't need that. Stop with CCS, stop with fracking. (IN_#5:653-657).

The phrase 'enormous resistance' clearly indicates the strong refusal to fossil-fuel energy generation and capture in local places, whilst renewables are perceived as the best available solution for energy generation in order to secure the 'livelihood for us, our children and grandchildren, and future generations' (IR_#15:136-137).

Social benefits

To build on people's livelihoods, the social system was perceived to benefit greatly from community renewables. First, community renewables created much **community support and acceptance** for local energy transition. 'But I believe that most of the citizens stand behind the energy transition, and also want it' (IR_#8:291-292), underlined one interviewee, emphasizing the perceived support for renewables in local municipalities. This attitude is well represented in the survey, in which approximately 70% of the people 'strongly' agreed that renewables are socially acceptable (Figure 6.1). Surprisingly, almost 50% of the surveyed households 'strongly' agreed and a further 30% 'rather' agreed that electricity grids are socially acceptable. The recipe for such a high level of acceptance was explained by one interviewee:

> Transparency creates trust. Telling the environment [—the local people—] what you want, listening to voices and letting them co-determine, then you can also get through cable routes and other things. (IR_#8:288-290).

The statement exhibits that the high level of social acceptance was rooted in the engagement of citizens, the creation of awareness for the necessity of measures, and grounded trust-building. Furthermore, social acceptance seemed to have its source in municipal support for the transition towards renewables: 'And on this event, the sitting mayor Mr. Volquardsen said that he feels responsible for the energy transition' (IR_#5:135-136). In the household survey, about 80% 'strongly' or 'rather' agreed on the importance of municipal support for the

investment in wind farms, and about 40% 'strongly' or 'rather' agreed in the case of solar panels (Figure 6.2) The development of wind energy was even described as a community movement:

> Till then, we had seven or eight mills standing behind the farms, like as I had. There were also others here, or others who also started. And there were so many plans till then that there would have been growth in the ranks. And this was the hour of birth for the community wind-farm movement in Reußenköge. (IR_#8:54-57).

This movement was signified in the increasing engagement of people in community wind projects. One interviewee explained that 'the first were like 20 or 30, and slowly the number increases of people who participate' (IR_#10:238-239).
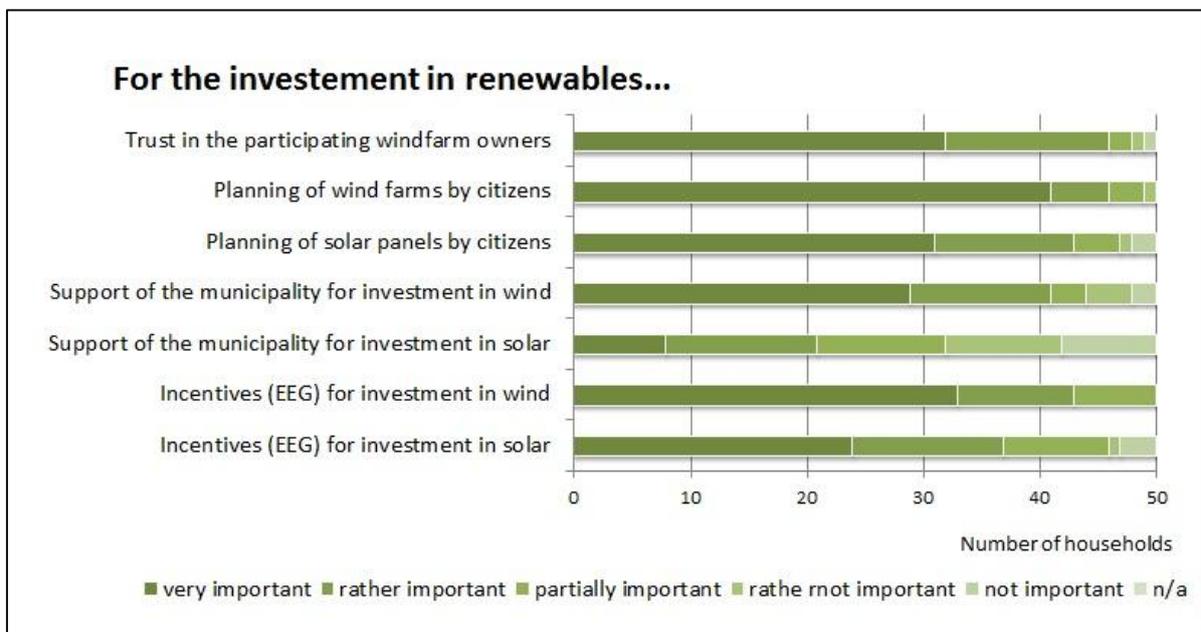
Figure 6.2: Assessment of aspects related to the investment in renewables. Household survey Reußenköge, 2014, N=51 [EEG = Renewable Energy Sources Act]

The interviews reveal that the development of renewables has increased the **communal spirit and cohesiveness** between the community members. Through community-based energy projects, people had to work together and exchange more than before: 'But especially the community wind farms [...], where the people meet more often, they have developed much community spirit, in my opinion' (IR_#1:23-25). Thus, community renewables have been perceived to influence community life:

> [The interest in community wind farms] is also a brick, also if it is partially based on the material. But it is a brick, which has also changed the social structure. And overall,

cooperation has improved. It was before more individual and now it is more a togetherness. (IR_#7:37-40)

The brick symbolises here an accepted, collectively-used module to create something. Hence, this collectively-shared brick is perceived as the driving force of a community wind farm transforming individualism ('more individually') into collective individualism (now it is more a togetherness). It facilitated a common interest and cooperation in renewables.

Community renewables furthermore created **social stability and diversity**. Community revenues of renewables have enhanced the social life and decreased financial threats: 'Also, without the renewable energy it would look quite different here' (IN_#6:307-308). The problems for non-renewable rural municipalities, as described by one interviewee, are 'no jobs, no money, drug problems and [the community] dying out' (IN_#2:784). In contrast, community renewables are perceived as an opportunity to stop exodus and provide social support in rural areas, which are often concerned with low job prospects and demographic change. Interviewees stated that limited local and regional employment has caused the migration of the youth, whilst renewable energy can counteract this trend:

> And through the activities of renewable energy we can secure the continuance of the young people and the farmers, generally. Otherwise, half, at least, would be going away. And now we do have another income and we can continue with agriculture. The departure is stopped. (IR_#8:153-156)

This explanation nicely exhibits that employment in community renewables stops the departure of the young people, but also farmers, who can create economic security. Furthermore, renewables even provide the potential to make municipalities more 'attractive for other people. [...] That's what you want, to inspirit it with people. That's great' (IN_#8:330-331). Related to this point, one interviewee highlighted the social diversity created through the diverse jobs practised and the arrival of non-agriculturalists in the municipality: '[…] it has an extreme influence on the social environment, yes, the community, because there are also people who do other jobs, not only farmers. There is a qualified engineer, who brings in his experiences, and who forms the society differently. Also, I believe such influence is big' (IR_#15:399-402).

Community renewables can furthermore enable social support for education and to families and seniors. One father explained his experienced support in the municipality of Reußenköge:

[Our municipality is quite well situated through the community wind farms.] Thus, we can help young families, often quickly. For example, every family gets, per child until the child's 18th year, a unique financial support of 200€ [per year] from the municipality for transportation. And we can actually also only afford that because we have a good nest egg due to the wind power. (IR_#2:37-41)

This statement exhibits that families, for example, can indirectly financially benefit from a good budgetary situation of communities – the nest egg due to wind power. Many '[municipalities] try to do something' (IR_#9:190) not only for families, but also for seniors. 'We do senior evenings with card-playing and trips in the summer. And at the beginning, the seniors had to pay for that and now it's only a small bonus for recognition, or let's say a small contribution' (IR_#9:193-195). Besides the benefits for families and seniors, locally-based companies provided or supported educational institutions and programmes: '[...] building projects with schools, and it involves warm water preparation via the sun; we have just built a big project with a school together' (NF_#6:464-466). Such cooperation with educational institutions enables the creation of awareness for renewables, and an early interest in renewables from young people.

Hand-in-hand with social stability, municipalities are also able to benefit from prosperity with good local infrastructure. Interviewees cited investment in facilities, such as community halls, schools or swimming pools; facilitation of the broadband internet expansion; and transportation, such as maintaining streets, building bicycle lanes and setting up charging stations, which 'has positive impacts, certainly, on village live' (IN_#7:500-501). One interviewee pointed to the benefits for the broader population: 'Prosperity is rarely reflected in a new Porsche – we also have that – but prosperity is also reflected in a new green at the sports association, um... in a street light, which also functions well; you can really recognise it' (IN_#2:946-950). It implies that community renewables hold a common benefit, which contributes to the stabilisation of the social structures and the social exchange:

Mainly older people do live here in the centre of the place, and they were really happy that we do now have lighting all night here in the place. But we could [only] implement it with [renewables]. [...] And the community hall is also such a thing, where we have created a meeting point for the municipality, and otherwise it would not have been possible. (IN_#8:399-402)

Lastly, interviewees assigned the role of a **model region** of renewables to North Frisia and North Frisian municipalities. People were proud of their front-running role in regional energy

generation: 'Not worldwide, but here locally, we are leading' (IR_#12:72-73). The importance of local anchoring ('but here locally') and role-modelling was also highlighted by another interviewee: 'And if not here, then nowhere, I would say. We can become a good flagship, I believe, yes' (IR_#15:324-325). The *German Energiewende* (energy transition) is perceived to be not only of strong local relevance, but also the right signal on the national level: 'Who is so far in the energy transition as we are? Nobody in Europe and anywhere. And I think we do it right in Germany' (IR_#1:317-318).

Economic benefits

In addition to the economic aspects already indicated in the social benefits, economic benefits are also yielded by community renewables. North Frisia has been assessed as an energy-economically valuable location for the **decentralised energy generation** of wind. 'Here at the coast, is a good location' (IR_#8:298), said one interviewee, with another explaining, because 'a lot of wind blows and it is relatively sparsely inhabited' (IR_#10:483). Due to this location, municipalities '(should) have recognised that [they] are able to produce the cheapest electricity worldwide, besides water power [...]. And that you can manage it, here in the north' (IR_#15: 289-292). People value the possibility of producing electricity locally and in a decentralised manner ('you can manage it, here in the north'), of producing it at a good price ('cheapest electricity worldwide'), but moreover of 'supply[ing] it to somebody' (IR_#15:301). This valuation exhibits the supra-regional importance of renewable-energy generation from place to place.

Considering many rural municipalities, said on interviewee, '[they] have no money, and you can see that they try to throw the sheet anchor by building a community wind farm. Because a community wind farm is sustainable, also the only demonstrably instrument, which can diminish the threat to the financial future, because [the municipality] gets the trade tax and because the citizens get their payouts, and because the farmers get their rent' (IN_#5:107-112). This observation nicely points out the diverse financial benefits to the citizens and the municipalities, as such. **Individual households** are found to **economically benefit** from the distribution of windmill profits, lease receipts, compensation, and energy cost savings. Interviewees valued that an economic benefit is generated directly or indirectly to all members of the municipality:

> And the idea of community wind farms is super. It implies that, for example, all members of the municipality profit from the windmills, and not individuals. (IR_#1:301-303)

People assess it furthermore as fair that the ones who have risked much and invested much effort and time in the early stages of community renewables benefit from it: 'And there are some people, who took high risks in the past and who have greeted with smiles. And it is also...they have to be rewarded afterwards. I find it totally okay' (IN_#2:970-973). However, not only the early investors, but rather all citizens who invested later collectively in windmills or individually in other renewables, such as photovoltaic and biogas, were able to increase their income:

> Also, the municipality is relatively affluent through the renewables. We can say....all citizens of the municipality plus every individual has developed themselves an income. (IR_#10:38-40)

> Because I have participated now in three community wind farms and this is nice extra income; you have to look on that like this. (IR_#2:155-156)

Sixty-one percent of the surveyed households in Reußenköge 'strongly' agreed that they benefit personally from wind energy, while 67% 'strongly' agreed that wind energy is an important source of income. In contrast, the importance of solar energy was comparably low (Figure 6.3). Furthermore, households may benefit from reduced energy costs through the heating of houses and stables with heat loss from biogas: '[...] the concept of heat loss [...] works here quite well, because we can heat well our vacation apartments and also our stable' (IR_#1:234-235).
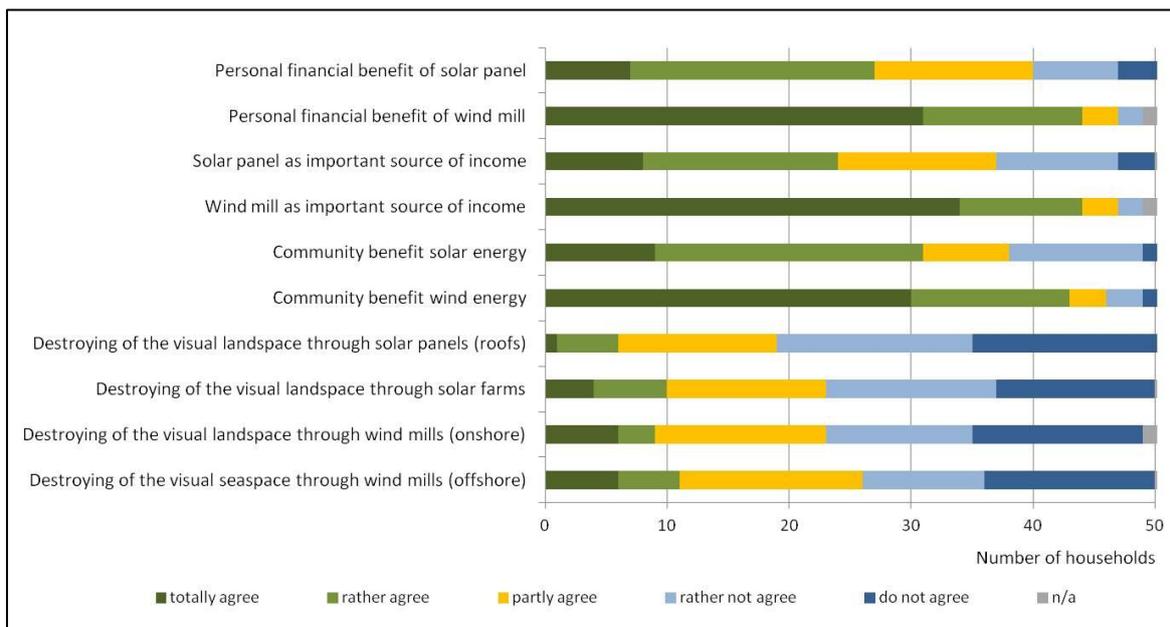
Figure 6.3: Assessment of community-based renewable energy. Household survey Reußenköge, 2014, N=51

In addition to the personal benefits, community renewables have been assessed as beneficial for **community and regional added values**. Wind energy, especially, was found to stabilise the financial situation of rural municipalities:

> Till three years ago, our municipality was [...] a municipality of need, meaning that we had no money and we had a social grant. Okay, now we have so much money that we don't need to get any grants, exactly, and we have to give money away from our wallet to the district. (IN_#6:312-318)

This recounting illustrates how municipalities were able to become financially independent ('now we have so much money that we don't need to get any grants'), and generate benefits in and for other small rural municipalities ('give away money from our wallet'). Almost 60% of the surveyed households 'strongly' agreed that wind energy has a community benefit, whilst in case of solar energy approximately 18% 'strongly' agreed and a further 43% 'rather' agreed (Figure 6.3). This community benefit was mainly generated through the increased communal taxes: 'The increased communal taxes benefit all of us who live here' (IR_#2:152-153), and thus, 'we are relatively well situated' (IR_#9:196-197). These land and trade taxes flow in from the municipal fund, and thus, stay locally where the farm is located. Community foundations were created, led by local citizens, such as the mayor and heads of associations. Foundations were also assessed to provide a long-term financial basis for municipal investments and beyond: '[...] and then you have to look, can I put [the money] in a foundation where the whole community can benefit from it, a special financial body or something like that [...]' (IN_#5:579-581). Community benefits stay in the focus of such foundations. In cases where municipalities were not able to construct own wind farms, voluntary compensation payments were introduced to compensate for the social impacts of wind farms: '[...] in places, no wind turbines can be implemented. Um...but in the neighbouring municipality where they are, and they look on [the wind farm], if there is not, a certain compensation between the municipalities can be paid. And in my eyes it must be, because I cannot say here in the municipality I can't, here I can, but I look on it....the neighbour looks on it' (IN_#7:520-526). So, payments provide a system of financial equity between municipalities concerning trade taxes ('a certain compensation between the municipalities can be paid').

Furthermore, community and regional added values are provided by employment effects resulting in reinvestment. One interviewee described the regional economic benefit:

That is a good development for our municipality. Yes the combination of clean energy production and citizens' profit from it. And this is also good for our region, because the money we earn with the windmills stays in the region; it is reinvested. If it is in the agriculture or in the private households, who benefit from it, you invest the money in some buildings or machines for the agriculture. The money stays anyway in the region. The downstream companies also profit: craftsman, land trade, and otherwise North Frisia would look a bit poorer. (IR_#11:210-212)

A strong intertwining was expressed between local profits, and local and regional reinvestments. As another interviewee added, the regional economy is boosted if the 'money must just stay in the region, and it mustn't go to the big business companies' (IR_#1:312-313). In addition to regional reinvestment, neighbouring municipalities also benefit from the district and federal shares provided by the wind energy communities: '[...] we are not independent from our environment; often only 25% stay in the municipality and the other 75% are district and federal shares, which go to the neighbouring municipalities' (IN #5:474-477). People assessed this sharing as something which is presented in the overall municipal benefit, which they feel proud of.

The interviewees furthermore revealed that community renewables was expressed as **new economic sector** for the local companies:

[Renewables and especially] wind energy have much significance...um, economically for many companies. There are many companies that can exist only through wind power. (IR_#1:199-201)

This explanation exhibits not only the economic importance but also the economic dependence on renewables for securing existing local companies. Community renewables enable the foundation and settlement of companies in the renewable-energy business. Many entrepreneurs described that they consciously decided to settle their company in a local municipality:

That's also a motive for staying within our municipality *X* and we did invest anew, because we want to show that you can also provide attractive and interesting jobs away from cities. (IN_#8:110-113)

The statement indicates a strong attachment of the people to their local place, which resulted in the need for local creativity and innovation. **Local employment** opportunities have been assessed as highly relevant for rural areas with low prospects:

These employment effects. We always talk about resources and about income and about creating awareness, and I think it comes to show that alone the wind branch in Germany....has now created about 140.000 jobs. (IN_#5:706-709)

These employments are perceived to be placed more at centre stage, because they provide new possibilities for local and locally re-located people: 'And [there are] many people employed who have worked already in Hamburg and who have used the chance to work again here in the North; because where can you still create such jobs? [...] from the accounting, to the engineers, interns, PhD's, who work here with a relatively high income level' (IR_#15:394-399). This statement exhibits how community renewables benefit by creating and securing local jobs.

Lastly, the interviewees revealed that **tourism** seems to be not negatively affected by renewables but rather offers potential to tourism. However in some regions, municipalities may have to decide to be mainly an energy community or a tourism community. Nevertheless, even tourism and renewable energy are found to be intertwined. One interviewee described the potential of tourism:

I don't do something if I create something in my own district of North Frisia, climate-friendly, but if I use the 2.8 million island tourists as multipliers, if I have them as guests and if I talk to them. (IN_#5:314-317)

The account reveals tourism as economic sector to advertise and spread the benefits of renewables beyond North Frisia by using island tourists as multipliers.

Planning benefits

To provide social and economic benefits, the **local participation and operation** of community renewables is important. Participation implies financial but also a planning participation, because involvement in the planning process enables people to 'bring in [their] private interests' (IR_#12:87-88), and 'it maintains a level of local control. You also want to have a say' (IN_#2:1083-1085). The survey found that over 80% of people 'strongly' agreed on the importance citizen's planning of windmills, and over 60% 'strongly' agreed in the case of solar panels (Figure 6.2).

Due to the collective planning of wind farms, trust in the participating wind farm owners seems to be important. Approximately 63% of the surveyed households 'strongly' agreed and a further 27% 'rather' agreed on the importance of trust (Figure 6.2). 'One reason that you operate wind power together is because the influence on the cultural landscape is immense.

[…] and you can manage that only if you involve citizens' (IR_#15:355-356). This comment exhibits the importance of a participatory planning approach for the acceptance of renewables and the implementation of community wind farms and solar farms, which have also been successfully managed collectively. For community wind farms, continuously open participation could be found for each wind farm built and in the repowering phase:

> But 12 years later we had to think about repowering and a prudent mayor […] said: "You have asked really exemplarily all the people back then, but some may have mistrusted, couldn't have or mustn't have, so could you please find a way to give them a chance again to participate?" […] And so we decided to tell them that we want to build higher installations and we asked them, "do you want to be part of it, yes or no?" And many also took the chance. In our municipality, now, here, 95% of the households are on board. (IN_#8:436-338)

The new chance given to participate reflects the exclusively open and collective development process. Besides the municipally based projects, interviews revealed that inter-municipal cooperation and participation opportunities were valued highly. Such projects were implemented in cases where better collective planning was suitable, where neighbouring municipalities might have been affected by visual impacts, or where place-based projects could be not implemented due to conservation restrictions:

> And for the farm we have built here, we gave away 20% [of the participation] to the so-called North municipalities [...] which are regarded as landscape protection areas, and where no windmills can be built. And hence, they get also a bit of the added value, which the other municipalities have; we have given them 20%. It certainly brings a good mood. (IN_#6:361-368)

The cooperation between municipalities is here shown to provide community benefits ('they get also a bit of the added value'), and to increase the acceptance ('it brings certainly a good mood'). The implementation of the **planning concept of community renewables** has been assessed as highly beneficial for municipalities and other regions: 'It shows me that overall we hit the bull's eye with the concept of citizen's participation' (IN_#8:337-338). The collective and participatory planning approach 'is strongly driven by […] local companies, who work on that and plan it. And they also employ many' (IR_#13:173-174). The mentioned locally grounded planning companies are not active only locally ('work on that and plan it'), but they also offer the implementation of the existing concepts in other regions:

[We] are practically a service provider for such communities. There are some and we say, "Yes, we are helping you. We bring the know-how, we bring our networks and we give you a leg-up. If you are good you can do it afterword alone, or you can do relatively much alone." (IN_#8:566-569)

This quotation exhibits a supra-regional benefit for the concept of community renewables, because local companies provide and share their expertise.

The categories of the above outlined community benefits in North Frisian municipalities are summarised in Table 6—1.

Table 6-1: Categories of community benefits in North Frisian municipalities

Categories	Sub-categories	Examples from interviews
ENVIRONMENTAL		
Climate-change mitigation		
	Clean energy supply	'We have to face climate change and we must go away from fossil fuels.' (IR_#5:137-138)
Environmental enhancement		
	Avoiding nuclear, coal, carbon capture and storage and fracking	'And it is extreme if you know what damage is caused by coal' (IN_#1:141-142)
	Livelihood for future generations	'that it stays long-term a place of home for the people' (IN_#8:26-27)
SOCIAL		
Community support and acceptance		
	Citizens engagement and trust	'The acceptance is quite high overall, I would say.' (IN_#2:982-983)
	Wind community movement	'And this was the hour of birth for community wind farm movement in Reußenköge.' (IR_#8:56-57)
Social spirit and cohesiveness		
	Common interest	'a certain unity through the community wind farms' (IN_#8:495)
	Collective individualism	'[T]he individualists stay together if needed. They have same aims and fight for it.' (IR_#13:23-24)
Social stability and diversity		
	Stopping departure of people	'[...] it ensures that people will stay in the municipality, because they can afford it.' (NF_#6:2328-330)
	Arrival of people	'And our intern will may work for us for a few years, no?' (IR_#8:118-119)
	Social support (i.e. education projects support for families and seniors)	'Thus, um... we can provide much more for our municipality and population.' (IN_#7:482-484)
Benefits to local infrastructure		
	Facilities (i.e. community hall)	'Clearly the community hall [which] is renovated and converted' (IR_#4:55-56)
	Networks (i.e. broadband)	'[...] help with other municipalities financially to support broadband expansion' (IN_#6:284-285)
	Transportation (i.e. traffic lights, charging station)	'And we also support things like e-mobility, I mean the charging stations.' (IR_#9:69-70)

Categories	Sub-categories	Examples from interviews
Model region		'[…] optimistically, I have the impression we do model increasingly the labour for other regions.' (IN_#2:1168-1170)
ECONOMIC		
Decentralised energy generation		
Citizens' and households' economic benefits		
	Distribution of windmill profits (ownership)	'For the population it is a financial aspect. Nowhere else are the returns as high as for wind power.' (IN_#7:484-486)
	Lease receipts	'Farmers get their rent.' (IN_#5:112)
	Energy cost savings	'[W]e can heat well our vacation apartments and also our stall.' (IR_#1:235)
Community and regional added value		
	Communal taxes	'Yes, and our small municipality profits highly from the wind energy, because we do have a lot of locations.' (IR_#11:201-202)
	Community foundation	'A foundation has been pushed forward […] that we have available capital for work with the municipality or beyond that' (IN_#8:467-470)
	Compensation	'[community payment] is compensation for it, that I have to look now on such a plant.' (IN_#7:530-531)
	Employment effects (reinvestment)	'[T]he newly earned wealth is invested in new things, which are also good somehow.' (IN_#2:974-975)
New economic sector		
	Securing existing (agricultural) companies	'Because of that many [people] can still live and exist here for many years, and can continue with their companies.' (IR_#12:88-89)
	Foundation of new companies	'Yes, we do have in our municipality also two firms which deal with renewables and push things forwards.' (IR_#3:136-137)
Local employment		
	Creation and saving of local jobs	'It certainly creates jobs. And this means a lot.' (IN_#2:952-953)
Tourism		
	Renewable interest and advertisement	'Ninety-eight percent of the tourists said, "No, that's okay. Um, that's …we like it."' (IN_#2:770-772)
PLANNING		
Community ownership and operation		
	Participation and transparency	'[…] we have only let 100% citizen's wind farms be built.' (IN_#6:355-356)
	Project planning and fairness through citizens' energy	'[…] um, if you have some plans, don't finish them, then present them, but rather the other way around. […] And take care that people won't be over-advantaged.' (IN_#2:1069-1073)
	Inter-communal cooperation and participation	'And then we have said, because we wanted to work inter-municipal, if you work together with X, then you can construct in a relatively big area.' (IN_#7:581-585)
Planning concept of community renewables		
	Locally based planning companies	'And [the municipality] wants that we implement our concepts somewhere else and take action.' (IR_#8:90-91)
	Support of other regions	

(Continued Table 6—1: Categories of community benefits in North Frisian municipalities)

6.2.2 Challenges of community renewables in North Frisian municipalities

Besides the perceived local and regional benefits of community renewables, the analysis of the interviews revealed the challenges involved in development and the consideration of negative impacts. Five interlinked analytical categories could be found in all interviews: environmental, physical, social, economic, and political and planning. These categories were further structured into sub-categories permeating the process of renewables-driven community transition.

Environmental impacts

The development of renewables is perceived to induce a **(re)shaping of the landscape**. Considering the aesthetic impacts of visuals and noise and considering land use changes, various renewable energy sources have been assessed differently. The most notable visual impacts have been perceived in windmills: 'Over the last 20 years, [it is] certainly notable how strong the wind power history has developed, also visually (IN_#4:108-109). Such impacts have been not always positively assessed:

> Wind turbines don't make so much fun, but they are...um...there. You have to accept it. Also, you have to go a bit closer to the coast to perceive them not as disturbing. Um...if you go further away, the more is there a wall, which you can see there. (IN_#7:381-385)

This quotation exhibits aversion to windmills ('don't make much fun', 'disturbing', 'a wall'), the way to find a 'clear' view ('go a bit closer to the coast'), and the perceived need to live with the impacts ('you have to accept it'). Thus, the impacts of windmills are perceived to directly affect the local landscape. '[M]y personal opinion: too many at the location, too many in the region', declared one interviewee (NF_#1:251-252). This fact implies that social acceptance limits of the expansion of renewables regarding density and heights of wind turbines seem to be of critical relevance.

The household survey found a broadly divided opinion of landscape changes (Figure 6.3). The majority of the people – 27% for onshore and 29% for offshore – 'partially' agreed on a negative image of the landscape. The destruction has been assessed as higher in the case of windmills both offshore and onshore than in comparison to solar panels on the roof and solar farms. In the survey, the majority 'rather' did not agree on the negative impacts of solar panels on roofs (31%) or solar farms (27%). The higher assessed impacts of solar farms are found to be related to the higher demand on space, and their location sometimes even on fertile land.Biogas has been assessed to have the highest impacts on land demand and land

use: 'they are a bit of a thorn in my eye, these things, because they eat a lot of land and much diesel' (IN_#6:442-443). The phrase 'they eat a lot of land' refers to the cultivated biomass monocultures, such as corn, and 'quite much diesel' stands for the associated transportation of biomass. It implies that landscape changes are intertwined with the structural change in agriculture:

> 'What I see a bit critically in the municipality is, in the end, the structural change; also we are coming from an agricultural community; now there are biogas plants, we have buildings [and newly constructed barns] with photovoltaic plants, and all the community wind farms.' (IR_#5:251-254)

This quotation expresses a critical perspective on the energy economy on and within the landscape. What became important from this issue was that the further development of renewables must be in conformity with nature and **nature protection**. Environmental impacts must be minimised, nature protection areas must be respected, and additional measures might be required in order to protect specific species. In relation to the planned cable route from the city of Brunsbüttel to North Frisia, one interviewee mentioned 'a bird mark, which comes on the top of the cable every 20 meters, isn't it? In order to minimise the risk of collision' (IN_#1:442-443).

Furthermore, aesthetic aspects were found to influence the assessment of renewables and their integration in the landscape:

> Also until now, if I see it, 99% of the mills have three wings and there is from time to time one with one wing. This I have also seen….or with two or something like that. But I don't like that. For me, an aesthetic mill has three wings. I like them more, I have to admit. So, the ones with one wing, they look ugly, I think. (IR_#10:356-370)

Wings of a wind turbine were subject to aesthetic evaluation ('an aesthetic mill has three wings'), and the visual habituation of such windmills ('99% of the mills have three wings'). One interviewee also touched on the habituation of renewables by stating their integration in the so-called cultural landscape:

> And it developed also quite quick, that the expansion has been pushed forward. And this also caused a very strong change in our landscape. But we are a cultural landscape and we can get used to it. Yes and it became natural with the renewable energy, absolutely with the wind. (IR_#15:249-253)

The phrase 'our landscape' articulates a collective place attachment, and not only the common relevance of place changes due to windmills but also their integration ('natural'). The same held true in the following response:

> And I would say, now there is a change and everything needs to be reshaped. There are certainly differences and bottlenecks or something like that here, anytime it is all reshaped here, and then everybody will habituate to that. (IR_#10:333-336)

It became apparent that renewables are perceived and expected to (re)shape current and future places, and habituation to energy generation in the place is expected to be reached in the future.

Physical challenges

The interviews revealed physical challenges in the operation of different kinds of renewables. 'Whereas we have the problem that wind power is not basic load able, so….yes', stated one interview the physical disadvantage of wind and solar energy (IR_#5:139-140). In contrast, people see in biogas the potential to provide this basic load: '[...] the hope with biogas is still that it is something that also operates if no wind is blowing and no sun is shining. Also, that you have a bit of basic load, yes' (IN_#8:875-878). The words 'problem', 'hope', and 'a bit' express that the uncertainty and future perspective relate to an intelligent mix of different renewables. Nevertheless, storage and grids are perceived as further measures counteracting this challenge.

It could be found that electricity **storage and transport** via grids are perceived as essential measures for dealing with peaks of overproduction.

> We cannot give our power to the grid. We are adjusted and then the mills are stopped. That's the negative. Therefore, grid expansion is important, or storage, that you can absorb it somehow. (IR_#8:307-309)

This concern conveys its commonality ('we') and the perceived requirement ('is important') of either storage or grids, or both. Locally, people perceived it as an urgent theme 'to approach a storage medium for wind-power–generated electricity' (IR_#9:132). Even beyond the locality, electricity transportation and grid expansion are assessed as urgent measures: 'We have to build more electricity grids; hence, it goes there, where it is needed and where it can be traded' (IR_#8:279-280). A European network of smart grids has been perceived as a possible strategy to optimise generation and trade beyond borders:

In fact, if I think about all of Europe and the grid, then there will be always [a place] where the wind blows or the sun is shining, or in middle Europe also biogenetic substances, which can be transformed in some kind of form for the energy use. [...] then we need huge interconnection. (IN_#8:643-647)

It became apparent that a strong link has been drawn between local and collective concerns about overproduction ('we need'), and over-regional trading and selling of electricity.

Social challenges

Further challenges have been found to be related to the social. Energy generation in local places provides **acceptance** of **and opposition** to projects, influenced by visual and noise impacts. Such impacts on social life have been assessed to be higher for windmills than for solar panels:

It is just a fact that a windmill has a higher impact on my social life than a solar panel. I look on it, I can hear it, I can see it, and it casts a shadow on the plate at the breakfast. It has a big impact. (IR_#15:348-350)

The quote exhibits the everyday impact of windmills due to noises ('I can hear it'), the appearances ('I look on it … I can see it'), and disturbance of routines ('casts a shadow on the plate at the breakfast'). The importance of the location and the extent of windmills for their acceptance were even further elaborated by one interviewee: '[B]ecause there are also, still, areas here around which you can build windmills. However, there they would stand so stupidly, in plain German, um... that it would destroy the village life. Um... and for that reason it cannot be' (IN_#7:605-609). Impacts on the social life were found to be a palpable issue surrounding the development of windmills, and a reason for the remaining challenge of 'citizens involvement and taking seriously citizens who live there' (IR_#14:53). Decisions about renewables projects are found to be therefore based on a principal of majority rule: 'And that we still have the principle of majority rule and that in a town meeting […] 90% of the citizens of the municipality decided on it' (IN_#6:416-421). However, attention must be also given to opponents:

Then you try to react to arguments, and partially we also did that in a case where we constructed the mill not 800 meters but 850 meters away, agreeing to [an objector's] wish to do something. (IN_#7:627-631)

The account reveals the importance of talking and negotiating with non-supporters to find a compromise. Nevertheless, many regions in North Frisia are characterised by a high density of

windmills, which caused acceptance problems and protests, especially by so-called 'foreigners':

> [We did have] protests here in the municipality, because the density is a bit recognisable, if anyone is driving through, or… Here, there are quite many windmills, or… [...] But these ones (pointing to windmills out of the window) do not belong to us. That is another municipality, but there we have relatively few problems. Where we have more problems, these are the foreigners, who have a house or land or something, and they quack a bit. But this we have always, we have averted this well. (IR_#10:244-249)

Differences in the perceived visual disturbance or acceptance of disturbance could be found between locals and 'foreigners'. This indicates that acceptance is highly intertwined with residence and ownership. One interviewee stated that ownership implies financial benefits, which aided acceptance much, especially of community wind farms: '[...] for the community wind farm acceptance is quite prevalent. And every turn means a cent in the bank account (laughing)' (IN_#2:990-991). The interviews revealed a bonding to the windmills through planning and financial participation that overcomes visual and noise-related impacts:

> There are also opponents of mills. But if I benefit from it, then they don't disturb me. Although, I never hear mills, or I do hear it, and I say to myself it belongs here. (IR_#11:208-210)

> [...] and you identify with your wind farms. [People] are part of it (the wind farm) and they are happy every day that they can hear the mills. (IN_#5:497-498)

The interconnection between impact ('don't disturb me'), ownership ('you identify with your wind farms') and benefits ('I benefit from it') became apparent. However, not only the direct financial benefits, but also the social benefits of renewables seemed to require much recognition: '[…] the biggest social problem of the future will be to always attribute the permit for renewable energy, on the one hand, and to recognise the social benefit more strongly' (IR_#15:458-460). Here, community renewables are perceived to hold a high social potential, a discovery which has not been noted so far.

Nevertheless, community renewables have been perceived to cause **social splitting** in municipalities.

There are wind supporters, the big beneficiaries, and wind opponents – totally split; similarly to biogas and the farmers. And in so far is there a real explosive power, which could cause a social explosion. (IN_#5:609-611)

This remark emphasises the discrepancy between benefits, on the one hand, and the social challenges of equality underlying community renewables, on the other hand. It may cause social differentiation and the exclusion of people, or even envy within the municipalities. 'Renewables did bring a lot of envy here' (IR_#15:280-281), described one interviewee, acknowledging the resentment and the envy caused by renewables. This envy was perceived to be an evolving challenge, which can be only overcome with respect, fairness, and the willingness to share:

Yes, the more the people have, the less they want to give away. It is like that. Also, if the people have too much, social [aspects] falls behind. […] but you also have to grant something to someone else. (IR_#10:41-43)

The quote reveals two aspects: firstly, the challenge of meanness ('the less they want to give away'), and secondly, 'the importance of a social thinking ('you also have to grant something to someone else') in order to secure a long-term social cohesion. A quick 'gold rush mood' was considered to risk and destroy the concept of community renewables and the whole communal life (IN_#5:602-607).

Economic challenges

Besides social changes, the development of renewables has caused economic changes, and especially a 'renaissance in agriculture, also through different means'. (IR_#15:28-29). Interviewees mentioned that the agricultural change transformed *agri*culturalists into *energy*-culturalists. Farmers, who had the ability to increasingly focus on the energy economy, profited, while 'farmers, who couldn't become energy farmers will be pressed against the wall by energy farmers' (IN_#5:402-403). This recounting impressively affirms the economic discrepancy between conventional and energy agriculture, and the resultant threatening financial and social situation experienced by conventional farmers ('pressed on the wall'). One interviewee even critically underlined this competition by saying that 'renewable energy has brought censorship in agriculture' (IN_#5:411-412). This censorship symbolises unequal profitability between farmers, which has caused a splitting in agriculture. Energy farmers mentioned changes to the economy, but also the social life on the farm:

Um, and you are fully into the renewables. But that has also changed the life on the farm quite a lot, especially the building of the biogas plant. Because you are busy all year, I say with the 'foraging'. You have to feed the bacteria the whole year, and it requires a lot of tonnage and area. And that's not always easy. (IR_#1:226-230)

Especially biogas has been assessed as complex and time-consuming business, transforming an agricultural farm. The economic interest in renewables has, however, also caused overlapping interest, which may be accompanied with competition. 'Yes, a big problem [...] I see in relation to overlapping business portfolios, which we have here. We have...um, the social structure we have is highly dominated by one power, and that is the wind energy. With the wind energy, people earn their money' (IR_#15:36-38). The symbol of wind energy as 'power' discloses its dominant position. Thus, this driver challenges not only the economy but also the social life of municipalities. One interviewee mentioned that he has experienced a personal change: 'Also, I say it like this: it is actually that I have experienced a change in mind. Also, I am a farmer with heart and soul, meaning one who works conventionally. I'm also a hunter, but also a nature protector. [...] But I have experienced a bit a change of mind, also because [I'm] becoming older, but also because renewable energy is such a big economic power for me' (IR_#1:388-394). This explanation exhibits that the change of heart might be grounded in agricultural changes, and the benefits, but also dependencies, perceived as related to renewable energy.

Building on the financial benefits of renewables, the findings suggest challenges related to **households economic benefits**, including the fair sharing of benefits. One interview described his strategy for fair sharing among the members of a community through a negotiation process:

Yes, and the land owner should do it themselves....that is the nicest. [...] [When I met the community members] I did bring optimal planning for our [wind-mill] areas, but [I told them]: "I do have a blanket on top of it, and I just lift the secret if you have decided about the share of the money pot [for the wind farm]" [...] And they think about it, half an hour, and hour...what happens if I get a location [for a windmill], what if I don't. So, and then [the shares] are fairly distributed. (IN_#5:567-576)

The quote reveals two aspects: firstly, the importance of citizen's distribution of shares ('land owner should do it themselves'), and secondly, the overreach of individual people, which can be excluded ('then it is fairly distributed'). Consequently, land owners with a windmill located on their land will not get much more money than others; however, people 'who live next to

windmills, who can see the foot of a windmill, they can [may] participate double, because they are close neighbours' (IN_#5:508-510). In the case of Reußenköge, interviewees revealed that envy was caused by differences in the revenue earnings from the different wind farms:

> Also, we can do still something better, that there is a better cohesiveness between the wind farms, because they are quite different. We have six wind farms and one is under construction. But six are there, and they are quite different and people earn differently from them. There are people who have a share in all six, and others in only one or two, the other is only the provider of the location. Do you understand? Everybody has a different earning. And it is a big art to create still a community. That not the one or the other is saying "you earn much more than me." (IR_#4:78-84)

'We can do still something better' expresses a demand for action in this matter. To decrease the differences between the wind farms, and thus, to increase cohesiveness, the six wind farms were merged into one big wind farm in 2015, after conducting the interviews (Dirkshof, 2015).

Besides the household benefits, the **community added value** might be challenged by the moving away of members from the wind farm companies, and competition with big companies and investors. The moving away of profiteers of wind energy was perceived as a possible challenge for the stability of community and regional benefits:

> But we are all here and profit all. Then, there are the second and third generations, who live in Munich or Frankfurt later or somewhere, and they are then not interested anymore in what is happening with wind power locally. They see then only the cheque, which is coming twice a month, and most importantly, that it is big. That's always the threat I see, which is coming. (IR_#4:85-89)

Here, the relevance of the community benefits underlying the development of renewables became apparent: the relocation of interest in local dealings and added value is expected in the future. An additional threat was perceived in companies and innovators who might be interested in the planning of local wind energy projects:

> Any big interests from all over the world would land right in front of and nearby our doors. The acceptance from our people would be gone, because if 400 or 500 meters from my door stands a windmill and I don't have anything of it, and the profits go to Spain or the USA or to Sweden or somewhere [else] to the energy companies, yes, then something is going wrong. (IR_#7:226-230)

The report draws attention to how bidding – a change in the political support system for renewables – is expected, firstly, to risk the social acceptance ('acceptance from our people would be gone'), and secondly, to transfer the added value outside the municipalities ('profits go to Spain or the USA'). Interviewees related, as an example, to the offshore wind farm Butendiek, in which case the citizen participation corporation had to sell the project due to financing problems: '[...] a classic problem is Butendiek, um, the offshore wind farm project Butendiek. Exactly, um… there were many small investors, who had it, and now it has nobody anymore. That's in the end, bit by bit, and quickly it belongs to one big investor, who built it. And there is Eon and Vattenfall, who build huge things [...]. Nobody gets a cent from it' (IN_#6:601-609). The concern communicates the perceived threat of a shift from an energy transition made by locals, many small investors, to an energy transition made by others, one big one.

The challenges of renewables were, moreover, related to their **economic affordability**. The economic assessment of renewables differs between the different sources. Wind energy was assessed as the cheapest form of renewables, while the economic costs of photovoltaic energy have been perceived as high:

> 'And from my point of view, wind energy is the most affordable alternative of all renewables. (IR_#5:138-139)

> For example, solar energy was very, very, very expensive at the beginning. From my point of view, [the high funding] was stopped too late. This will burden as for quite a while. But wind energy burdens the electricity price by 0.25 cent. It is actually the 'cheap doer' among sources of electricity generation […]. (IR_#7:218-221)

These views highlight differences in the economic affordability of renewables, and their impacts on the electricity price. They might also explain the divided perspective on household financial burdens of renewables. At 27%, most of the surveyed households perceived a financial burden 'partially' (Figure 6.1).

Political and planning challenges

The findings revealed interwoven political and planning challenges. The energy transition was perceived as a political decision, challenged by uncertain and inconsistent energy policy: 'Back then, after the drama of Japan, Frau Merkel – more or less alone – declared the energy transition. Anyone has followed that. And now, they do partially back-pedal' (IR_#7:216-218). Here the 'back pedalling' represents the lack of continuously manifested political support.

Even beyond that, one interviewee stated that 'federal politics puts only obstacles in the way' (IN_#2:1125). Hence, people demand support in terms of encouragement and incentives:

It is important, that the government is supporting us still. Otherwise [local energy transition] drops really and then nothing will be done anymore [in the perspective of renewables]. Yes or you leave [the development of renewables] to the big companies to do it. I think this is not right. These are the things which concern you. (IR_#12:216-218)

The phrases 'supporting us', 'concern you', and 'nothing will be done anymore' express personal dependency on political support. In contrast to the locals, big companies are perceived as the beneficiaries. **Lobbyism** has been assessed as one reason for the current, difficult political situation, because politicians seem to 'be keen on the industry' (IR_#13:95), and too-much influenced by the interests of their lobby groups.

Furthermore, the Renewable Energy Act (EEG) was considered an important instrument for the development of community renewables: 'Also the political discussion about the EEG is difficult for us, that they don't see from outside that wind locations – a real wind location – are wanted for the energy transition' (IR_#4:89-91). This conviction is also conveyed in the survey results, in which about 65% and 47% of the households 'strongly' agreed on the importance of incentives for wind energy and solar energy, respectively, through the Renewable Energy Sources Act (Figure 6.2). Interviewees mentioned that they do not see a clear political line and perceive that the politicians 'forget that [they] wanted the energy transition' (IR_#6:278-279). Changes in the EEG are perceived to result in difficult financial planning for new projects: '[…] and that also affects the financing of new projects – it is not calculable anymore. And if it has to work without rewards in the future, then community wind farms will be hardly financeable' (IR_#8:312-313). It is indicated that uncertain financial planning may even risk the further development of community wind farms.

Related to the future, interviews also revealed the importance of the **planning law**, because dealing with the priority areas for renewables determines their future expansion. One interviewee mentioned the importance of recognition and support for rural areas in planning matters:

Yes, and they (politicians) should approach the [...] rural community um... and act together with the rural community, which profits the rural areas, but which are also

good for the climate and so [...]. Without the rural areas, too much is done which is not accepted and that is not suitable. (IN_#7:826-836)

This respondent asserted that a stronger collaboration seems to be required in order to support a suitable rural development, such as in terms of local energy transition. Recognition and political support for local planning concepts have been thus assessed as required.

The above presented categories of community challenges are summarised in Table 6—2.

Table 6-2: Categories of community challenges in North Frisian municipalities

Categories	Sub-categories	Examples from interviews
ENVIRONMENTAL		
(Re)shaping of the landscape		
	Visual and noise aesthetic impacts	'For many, it is disturbing the landscape image.' (IN_#4:311)
	Land use	'transition from the agriculturalist into energy-culturalist' (IR_#1:92)
Nature protection		'[...] the grid goes under the earth, as compensation for the natural protection. Because I have seen it myself, which dead birds lie under the grids.' (IN_#1:446-448)
PHYSICAL		
Basic load ability		
Overproduction		
	Curtailment	'Whilst the big plants will be shut down if there is too much electricity. [...] That's not sensible, no.' (IN_#7:735-739)
	Storage and transport	'[transportation beyond] political and grid borders' (IR_#8:283-284)
SOCIAL		
Social acceptance and opposition		
	Aesthetic, visual and noise	'Here, next door stands the oldest installation in our municipality, which I've heard formerly. But I like it.' (IR_#15:367-368)
	Negotiation and democratic decision	'It is not that a community wind farm is constructed only to generate profit with all power, but rather to react to the people.' (IN_#7:651-653)
	Resentment	'Yes, the more the people have, the less they can give up.' (IR_#10:40-41)
Social splitting		
	Meanness and envy	'The renewables have caused much envy, you have to say that.' (IR_#15:280-281)
	Interest groups	'There are a few, which are not involved, and although they had the possibility [...] but for those, it's always a bit of a difficult situation.' (IR_#9:187-189)
ECONOMIC		
Agricultural change		
	Censorship in agriculture	'the renewable energy has brought censorship in agriculture' (IN_#5:411-412)
	Overlapping economic interests	'[...] certainly some profession overlap, competition, clearly' (IR_#15:33)
	Economic-driven personal change	'I have experienced a change of mind [...] also because renewable energy is such a big economic power for me.' (IR_#1:388-389)

Categories	Sub-categories	Examples from interviews
Citizens' or households' economic benefits		
	Sharing of benefits	'And if everybody benefits from it, it's good. If only individuals benefit, it's bad.' (IN_#6:344-346)
	Differences in wind farm profits	'But we have six wind farm, and they are all quite different and everybody also earns differently on them.' (IR_#4:80-81)
	Financial household burdens	'[...] that it is socially acceptable. I cannot make the incentives to high [...]'(IN_#4:166-167)
Community added value		
	Moving away of members of wind farm company	'[…] that something from the economy stays here, [because] the entire company members to a large extent live here. Meanwhile, there are also children or grandchildren who live farer away...that's clear.' (IN_#8:281-283)
	Competition with big companies and investors	'[…] because now with the decision of the highest administrative court also Eon and RWE will certainly go into the areas and try to build windmills. Of course! It's like that; they also want to make money.' (IN_#6:614-617)
National-wide economic affordability		'[...] what you get on money per feet in kilowatt hour, that's exorbitant. Um… if you would have controlled that a bit more reasonably from the beginning, yes, I think than it would have gone better.' (IN_#6:557-561)
POLITICAL &PLANNING		
Energy policy		
	Discussion about Renewable Energy Act (Cap for expansion and bidding)	'The bidding model is a cheek. […] Yes, and how you come up with such as idea, I don't know. Why you do something like that.' (IN_#6:547-552)
	Financial planning insecurity	'[…] starting 1.1.2017 there is a bidding system, this implies I miss an economic calculation basis.' (IN_#8:588-589)
Planning law		'[…] regional planning is important, but that we get more freedom in the end for individual decisions at the bottom level.' (IR_#5:197-198)
Lobbyism		'politics depend too much on lobbyists' (IR_#7:215-216)

 (Continued Table 6—2: Categories of community challenges in North Frisian municipalities)

6.2.3 Future community visions

'The renewable energy will be always a topic here. Certainly it will develop here. And this is a continuing transition' (IR_#11:268-270), said one interviewee. This statement highlights the expected position of renewables in local place – the 'here' – and induced community transition in the future. Future visions involved with community renewables can be categorised into three themes: local direct usage and storage, settlement of new companies, and long-term benefits for the municipality.

First, **local direct usage and storage** are perceived as big challenges for the future. The first people initiated the development of renewables with the 'aim [...] to become independent in respect of energy' (IR_#8:28-29), and they still are. This self-sufficiency involves an

independence from non-renewable-energy sources, such as coal, oil and gas, and the increasing direct use of renewable energy also for electrical heating and transport: 'It is also on the mind of many people that you try to become independent, dependencies of oil, dependencies of gas, to get rid of these' (IN_#4:154-156). In order to increase the local energy supply, people were intensively dealing with local storage opportunities, and even supporting pilot studies:

> We are intensively thinking about how we can store the electricity generated by our wind farms and how we can supply our farms. Technically it is possible, but the legislation has to admit it or create it. We are also thinking about that. But there are also battery storage opportunities, which we are accompanying now. There is power to gas, there is hydrogen storage in Hemmingstedt or so, which we attend and try via a community, the Grid SE. (IR_#8:195-199)

This report underlines, on the one hand, the requirement for invention and the development of storage capacities in order to enable the shutdown of other plants, and on the other hand, the need for governmental support in order to legally enable the local direct use of electricity. Locally, biogas plants are perceived as having much potential for securing the basic energy load and providing storage possibilities:

> I think it is a good approach for biogas plants, that they provide the base load and they become controllable, flexible. This I perceive for me like that, yes. Yes, it is not so easy with the storage, but....Our grids here in Germany, they are quite controllable. Also, you can transport it here and there. (IR_#13:118-121)

Related to the storage capacity, one person said, people 'dream all a bit, that [they] can perhaps use the [generated electricity] a little bit better for themselves, together with the biogas plants. That you can have an independent grid, that you can buy the electricity by yourself. That's a quick idea, but there are challenges that need to be overcome. We are ready that the transformer station is working, and that we can meet the politics, to stay up to date' (IR_#6:235-239). These remarks underline the vision people have of obtaining their electricity locally and regionally. However, future technological and political challenges need to be faced in order to create such energy-independent communities.

Secondly, the interviews revealed that people see opportunities for the **settlement of new companies** with a high energy demand. This settlement would bring energy generation and

energy demand closer together, and add values to the local municipalities. More recognition seems to be needed also by politicians:

> Dear politicians, please recognize that to preserve the landscape here, we have to bring added values to the companies here in the North. And there is no steel worker anymore and no aluminium workers, and it can be that Google – their servers consume [energy] without end – has a good location here. Perhaps, also, not too many people can work here, but due to that you settle new companies here, which can use the electricity. (IR_#15: 425-429)

This message emphasises the unused potential lying in the rural areas of North Frisia, and the need to advertise it to economic sectors with high energy demands.

Third, community renewables may provide the possibility of **long-term benefits for municipalities**. The interviews generally reiterated a long-term view on investments in renewables which secure livelihood and economic prosperity. People saw that income from community renewables could more be strongly intertwined with investments in coastal protection and protection of the hinterland: '[…] to generate value and that more money can stay in the municipality, to protect the land and municipality even better for any environmental influences. Because I think that's the point which would be important here. Because what do you want to do? If you want to reserve the region here, you have to think about the enhancement of the dike by five meters or something like that, if it's even enough. And of course, it is long-term thought you have to foster' (IR_#15:302-306). This assessment exhibits the potential to intertwine the revenues of renewables even more with environmental and coastal protection in order to develop climate resilient municipalities. Thus, community renewables are perceived to contribute to sustainable regional development for rural municipalities.

6.3   Discussion

6.3.1   Trade-off between benefits and challenges

This chapter has presented a detailed exploration of peoples' perceptions and assessments of community-based renewables and community transition in- and post-implementation in local North Frisian municipalities. The empirical findings sustain the idea that people perceive a transition induced by the introduction of renewable-energy technologies in their local places and communities. This community transition holds interwoven benefits and challenges, which could be categorised across five main analytical categories: (1) the perceived degree of

(re)shaping of the coastal landscape, and of contributions to mitigate climate change and to enhance the environment; (2) the assessed level of social support, cohesiveness and stability or social splitting; (3) perceived economic added values and the catalyst function of community renewables; (4) the perceived degree of political support; and (5) the assessment of community-renewables planning. These categories are characterised by linked sub-categories of benefits and challenges affecting attitudes towards to community renewables (Figure 6.4).
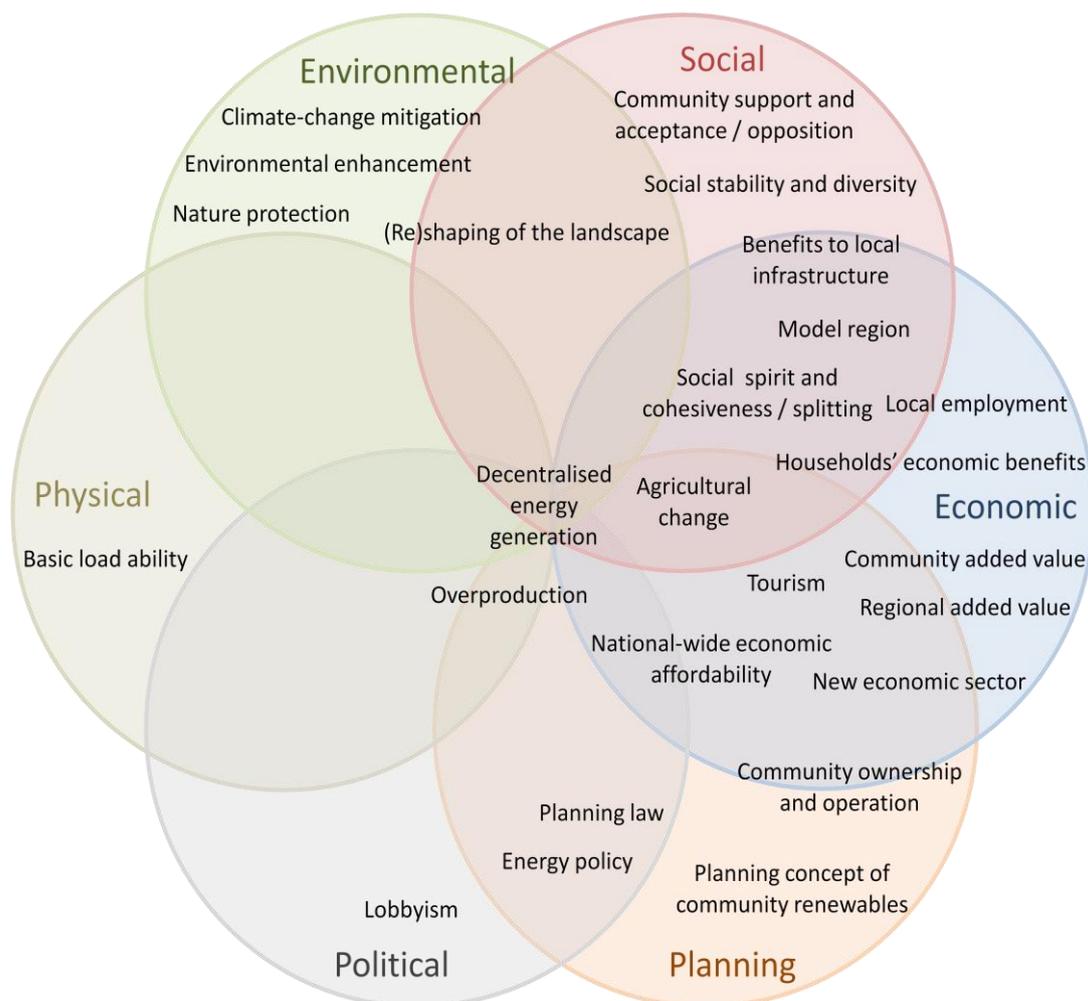
Figure 6.4 Community benefits and community challenges of renewables for North Frisian municipalities, based on the interviews and on the household survey

The empirical findings reveal that community renewables are perceived to cause visual and noise impacts and land-use change, as indicated by other studies (Rogers et al., 2008; Baxter et al.; 2013). In line with Baxter et al. (2013), the study found a generally high acceptance of such impacts, but, also indicated many differences between renewable-energy technologies. Solar panels on the roofs seem to impact the natural environment the least, whilst windmills were perceived to have a distant-perceivable visual impacts. Biogas has been assessed as having strong land-use impacts; therefore, the offsetting between environmental benefits

and harm has been questioned. Nevertheless, adding to previous research (Rogers et al., 2008; Cowell et al., 2011; Bristow et al., 2012), this study found that renewable energy has been generally assessed as the 'cleanest' alternative for energy production contributing to environmental enhancement and climate-change mitigation. Environmental, but also social and economic benefits, seem to outweigh the negative impacts, resulting in acceptance. In line with studies from Rogers et al. (2008) and Baxter et al. (2013), a high level of acceptance and local support for community renewables was found. Even more support could be found in a community where renewables have been already implemented (Baxter et al., 2013), which might be grounded in an *ex ante* social acceptance, as highlighted by Cowell et al. (2011). Here, the findings indicate a habituation towards renewables and a bonding based on planning and financial participation. An *ex ante* acceptance seems to be shown for people who are critically against landscape impacts, but who perceive clear social and collective economic benefits. However, based on the present research it must be noted that acceptance implies a continued acceptance process requiring local interaction with problems as they occur. Furthermore, active community involvement, going beyond purely financial incentives, was found to be important to spread information, and to create trust and acceptance (Aitken, 2010; Rogers et al. 2012). Nevertheless, previous studies (Rogers et al., 2008; Baxter et al., 2013) have indicated expected and perceived social impacts, between community enhancements and conflicts. This research revealed a high degree of relevance of community-based renewables and the diverse nature of social benefits, including community spirit and cohesiveness, and social stability and diversity, however also social challenges, including dealing with opposition and social splitting. The tax receipts of local municipalities were exhibited to be highly beneficial in providing a better financial situation and enabling spending for local families and infrastructure. This tax receipt is comparable with the community fund in the UK, which has been perceived as highly important to community benefits (Aitken, 2010). With regard to further factors, the research revealed tightly interwoven benefits for individual, community, regional, and super-regional levels. Although a generally fairly distributed benefit to the majority of the people was found to be perceived, substantial income differences could be identified between energy farmers and traditional farmers. Whilst local employment opportunities were found to be important, as indicated in previous literature (e.g., Rogers et al., 2008; Cass et al., 2010), this study could furthermore reveal that new economic sectors can contribute to the settlement of new companies and the mitigation of the departure of residents. Whilst this research reveals changes for and possible conflicts between different economic sectors, renewables may also provide new

opportunities, such as for tourism, which might be even used to enhance awareness of and opportunities for renewables. Furthermore, the results indicate that perceived community benefits are closely linked to community ownership. While in North Frisia, community ownership schemes have a long tradition and are assessed as highly important, in the UK literature, an increasing awareness for not only the importance of but also challenges of some form of shareholding was found (e.g., Cass et al., 2010; Aitken, 2010); Cowell et al., 2011). This study revealed an interesting concern regarding the moving away of shareholders: possible negative impacts on community benefits are expected if the profiteers do not live in the local communities anymore. However, not only financial but also the planning of participation and implementation of projects has been assessed as highly important for North Frisian municipalities, whilst people in the UK expect benefits from involvement in community energy projects weather it is community-led or by other organisations (Rogers et al., 2008). The findings here exhibit that the benefits of community control and participation have been considered highly valuable for community members. This impression contrasts with other studies (Walker & Cass, 2007; Rogers et al., 2008), which found a lack of recognition for the opportunities of public participation in energy projects. This lack of recognition might highlight the importance of first-hand experience with and learning from community renewable-energy projects. In line with the study from Rogers et al. (2008), where people expected the possibility to make the municipality an example, North Frisian municipalities perceived themselves as model communities, who could even advise others about the implementation of community-led projects. This self-conception may provide the opportunity for others to learn from the experiences and local empowerment of municipalities. The missing experience of community-led projects may also explain strong concerns related to project ownership and planning and outcome fairness (Aitken, 2010; Munday et al., 2011; Baxter et al., 2013). This study revealed the importance of a fair and municipality-driven siting process, which seems to outweigh expected concerns related to it (Baxter et al., 2013). The findings furthermore indicate that politics has been assessed as highly relevant for the successful implementation of renewables, especially in order to push new technologies. This relevance is in line with Rogers et al. (2012), who found that clear policy ambition is necessary for increasing project development. North Frisian inhabitants perceived decreasing support from local places and communities, while they see increasing support from big energy companies driving a concept complementary to the locally developed one of community renewables. Nevertheless, the findings of the study exhibit a strong visionary view of people related to encountering physical challenges associated with

direct usage of electricity, basic load capacity, storage and electricity grids. Overcoming these local challenges has been assessed as important to securing long-term economic benefits for local municipalities, which could be facilitated by the local settlement of energy-intensive companies.

Through empirically grounded research it became apparent that there are trade-offs between the diverse benefits and challenges. However, what does this outcome imply for the development of rural renewable-energy communities and regions? The findings indicate an overall positive assessment of community renewables because diverse environmental, social, economic, political and planning opportunities and benefits can be brought directly or indirectly to local municipalities. 'I am not a supplicant, but rather on the sunny side, on the windy side in the sense of the sunny side' (IN_#5:479-480), expressed one interviewee. This common sentiment indicates that community renewables provide the possibility to address and counteract linked local social challenges and problems such as demographic change, lack of job prospects, departure of the young people, and bad local infrastructure (Figure 3.2 in Chapter 3). In fact, people indicate that community renewables enable them to 'construct' the future of their local place and that they realise this possibility. Thus, the local benefits perceived and assessed seem to hold the potential to contribute to successful, long-term regional development in rural areas. These findings contrast with Munday et al. (2011) who question local economic development outcomes from wind generation projects, however, under another institutional and political framework. In order to catalyse regional development in renewables, it seems to be therefore required that collective benefits are distributed to the local population through open community ownership and regional planning, and that the local problems which occur are addressed and solved.

6.3.2 Conceptual implications of the empirical research

This chapter has aimed to reveal people's perceptions of the benefits and challenges of community renewables and assessed impacts on community transition. Common aspects emerged during the interviews and have implications for the environment, society, economy, policy and planning (Figure 6.4). Five main categories have been found and structured in sub-categories outlining the benefits of and challenges for community renewables (Table 6—1 and Table 6—2). These comprehensively and empirically grounded categories provide an important starting point for a conceptual framework of perceptions and assessments of community-based renewable-energy projects. Further empirical research must be conducted testing the applicability of the identified categories.

6.4   Interim conclusion

Overall, the research indicates that community renewables cause a transition to local peoples, local municipalities and rural regions holding environmental, social, economic, political and planning benefits and challenges. The analytical analysis of current approaches has revealed that there is no comprehensive conceptual framework for exploring the multiple facets of community transition associated with community renewables. Through the qualitative methodology, it was possible to get an in-depth understanding of the perceptions and assessments of different community renewables and their impacts on communal life. Based on the findings of one main case study, and expert interviews conducted in a further six municipalities of North Frisia, it was possible to identify general categories of community benefits and community challenges. Conceptually, the empirically grounded and analytically structured research conducted within this study reveals important impacts underlying community renewables, whose solidity should be assessed in other study regions. Moreover, the findings reveal the opportunities of community renewables, especially for rural municipalities and regions. Thus, future investigations should analyse the potential of community renewables for providing sustainable solutions for place-based regional development in rural areas. However, also local challenges must be addressed, such as social acceptance for the development and further expansion of projects.

Because community benefits are high on the political agenda but perceptions and assessments of community renewables remain less understood, the findings presented provide, furthermore, important implications to politicians and professionals. On the basis of the present findings, some planning and policy recommendations can be drawn for communicating, dealing with, and enhancing the benefits and challenges of community renewables: Community-led renewables are able to provide benefits to individuals, municipalities, and regions. Thus, local expectations of community renewables must be addressed before developing local projects in order to foster local participation and support for the project development and to address possible fears. Furthermore, local expertise and knowledge must be acknowledged, and planned projects must include and build on it. The power of community-owned and -led projects for creating environmental, social and economic values for places and communities deserves considerably increased attention in political decision making. The potential of such values must be considered specifically in relation to rural regional development strategies.

In conclusion, the study empirically reveals the importance of individual, municipal and regional benefits and local challenges, which need to be overcome to enable, facilitate and sustain community renewables. Therefore, this study's results lead to two important insights: First, community renewables can provide individual and collective benefits generated *in* and *for* local places and communities. Second, community renewables might cause local challenges and negative impacts, which must be addressed in local municipalities in order to provide long-term acceptance of and support for renewables. Community transition, thus, implies interwoven and offsetting beneficial and challenging aspects, especially a social and environmental (re)shaping of places which causes new structures and processes to arise in rural areas.

The conceptual and empirical investigations of the research have been presented over Chapters 3–6, and the next section will reflect on the research practice, the theoretical approaches applied and the methods used to explore the mitigation of climate change with community-based renewable energy.

7 Reflection on the research practice, methodology and theoretical approaches

Science is the captain, and practice the soldiers.

Leonardo da Vinci

Social research implies the exploration of social life, getting new insights into social life, learning from social life, but it also implies encountering challenges and dealing with obstacles emerging during the research process. The findings from the research extensively presented in the previous chapters provided an in-depth and multi-faceted perspective on the social and geographical aspects underlying local energy transition. This chapter reflects on the research practice, the methodology used and theoretical approaches applied by presenting strengths, challenges and limitations.

7.1 Reflection on the research practice

The interaction between theory, empirics and me as researcher represents one essential characteristic of this research. I was the engine of an interactive research process of collecting data, analysing data, interpreting data and reflecting on the data. In this research process, in-depth specific dimensions have been developed by making 'loops' to frame the emerging research themes and questions. I actively interpreted the data and decided based on that interpretation how the research was to continue and the point of time at which further 'looping' was stopped. This course of research over time is central to the idea of grounded theory (Charmaz, 2014; Corbin & Strauss, 2015).

Empirical research has been performed objectively in the case study of Reußenköge and other communities in North Frisia and in Kiel. Given the empirics conducted, it is prudent for me to reflect on my own position in the field. The region of North Frisia itself was new to me. This implies that I was a person from 'outside' coming into a research field. Not knowing about how much information my interviewees conducted about me beforehand, I, as a person, and my demeanour have certainly influenced the outcome of the field research. I did not experience strong scepticism about myself, though the interviewees reflected a general scepticism related to science. I found mostly an openness and interest for my research during the pre-meetings, interviews and group discussions. However, the pre-meetings aimed at

generating a certain degree of trust between the mayor and me. During the interviews, some people were a bit reserved, especially at the beginning of the interview. However, I tried my best to provide a socially warm interview atmosphere. In the course of the interviews, the group discussions and the survey, I may have heard and read stories they would not have told a person from the community or region. Albeit such stories were exclusive, some insights from the empirics served as important background information to understand people's perspectives on development in the communities. It is, however, also certainly the case that I could not apprehend all of the regionally and locally relevant aspects.

7.2   Reflection on theoretical concepts

Place is the transition point of social processes, and the present research investigated it as a spatial dimension for studying the locally embedded meanings of climate change and renewable-energy technologies. A place-based approach considers the research object based on a specific social and physical, local environment, individual and shared meanings and emotions associated with the place. As a consequence, the theoretical lens of place adds important aspects to the geographic environment and the social embeddedness of people. Place could be furthermore investigated as a source of knowledge, experiences, creativity, innovation and thus for the engagement with and development of collective actions. Using place as 'grounding' was beneficial for investigating 'emplaced' meanings of climate change. In the centre of this research were cognitive and behavioural dimensions, but exploring emotions could provide further insights. The concepts of *climate-change engagement* (Lorenzoni et al., 2007; Whitmarsh et al., 2011), *psychological distances* of climate change (Milfont, 2010; Spence et al., 2012) and *place attachment* (Manzo & Devine-Wright, 2014) have been introduced and their mutual interdependence explored (Figure 7.1). The empirical research in North Frisia demonstrated the relevance of social and geographical place-based aspects shaping, firstly, the local interaction with climate change and secondly places of a local energy transition.

The place-based approach applied devoted special attention to the local level, which enabled the study of details and small pieces of the investigated community. *Community* was defined as social system: a 'composition' of different individuals and groups and their interrelationships. To investigate the local place and the agent's behaviour in the community system at the same time, a place-based and an agent-based approach were merged. By applying an agent-based approach, agents, their non-linear relations and interactions and

their relevance for system dynamics and behavioural changes were explored. *Individual households* (agents) were assumed to be able to be part of the sub-system named *community renewables* (Figure 7.1). This sub-system is interwoven with the theoretical concept of *community renewable energy*, which refers to local renewable-energy generation with high degrees of project ownership and generated community benefits (Walker & Cass, 2007; Walker & Devine-Wright, 2008; Seyfang et al., 2014). Households' associations with community renewables were assumed to be dynamic. In community renewables, two main outcome levels can be generated: firstly, individual outcomes such as the adoption of solar or biogas plants which might be influenced by the social environment and, secondly, collective outcomes such as the adoption of wind farms or solar farms driven by individual households working together.
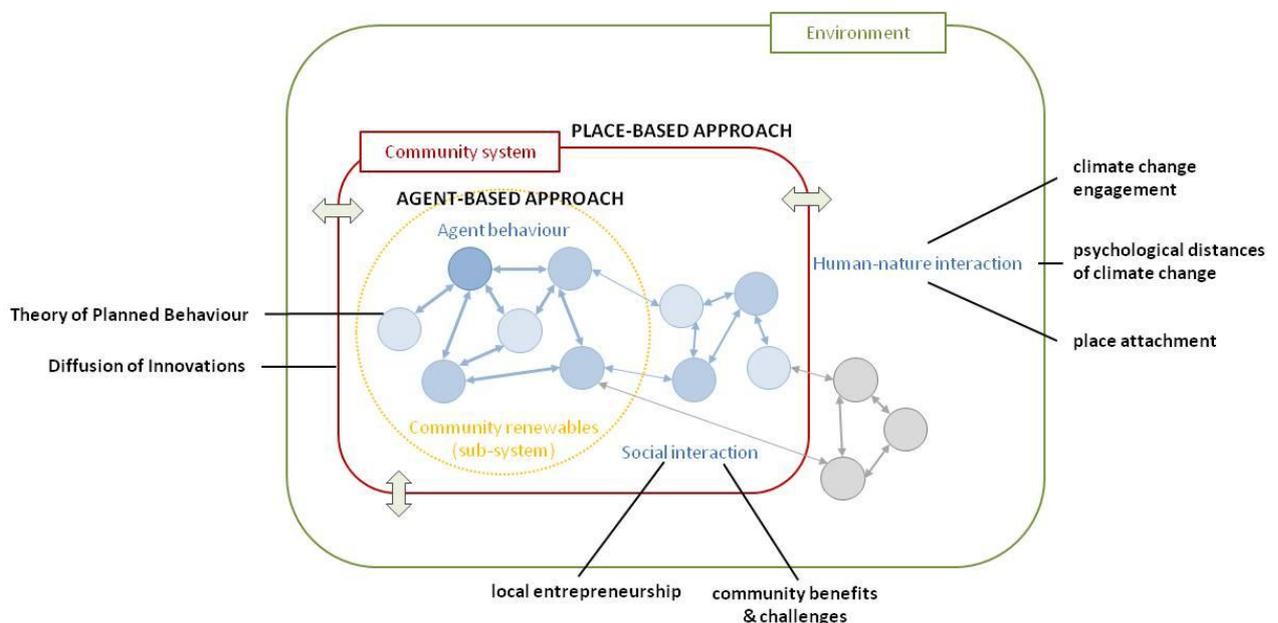
Figure 7.1: Analytical and theoretical concepts in the research framework, advanced Fig. 1.1

In comparison to a purely individualistic perspective, the community perspective allowed for the extension of perspective to the local area: the widening towards the level of some agreement among community members, the more holistic focus relating to neighbourhood, city or municipality as a whole place and, most importantly, the collective responses (Mihaylov & Perkins, 2014). Here, one community system, the municipality of Reußenköge, was of primary interest, while its environment and neighbouring municipalities in North Frisia were part of the broader case study area. *Place*, *place attachment* (Manzo & Devine-Wright, 2014) and *local entrepreneurship* (Feldman & Kogler, 2010; Audretsch et al., 2012) constituted beneficial concepts to study the pivotal role of individuals, and especially

entrepreneurs, and the importance of their local embeddedness for the process of community-based energy transition. Individual and collective adoption of renewables and their societal diffusion could be, furthermore, dynamically explored in an agent-based modelling framework. The theories of diffusion of innovations (Rogers, 2003) and of planned behaviour (Ajzen, 1991) have been introduced, here, and demonstrated suitable theories to study individual decision-making behaviour and the importance of social interaction for the diffusion of renewables (Figure 7.1).

The wide-ranging and complex analysis of local social and geographical aspects enabled an in-depth understanding of the social and complex nature of community renewables. The introduction of diverse theoretical concepts, however, holds also the challenge of integrating the different analytical concepts, which need to be tackled. Although this theoretical framework, based on different layers of analysis, may have tested the boundaries of the theoretical integration and of the research's cognitive capacity, it provided a pragmatic way for addressing the complex issues underlying and the social side of the research object. The in-depth analysis of local places and communities, however, lead to the result that less attention could be spent on the interactions between different levels – the regional, national and international levels. For example, the influence of governmental structures and national politics on local development could be only partially addressed. Although the aim was not to tackle the interaction between different levels, here, this grossly overlooked issue has been addressed and tried to diminish through the analytical framework applied in the study.

7.3   Reflection on the methods and results

The empirical research was investigated in one case study area: the district of North Frisia in general and the municipality of Reußenköge in particular. This focus implies that the findings are based on empirical research conducted once in specific time period, over two years. Starting with the research in Reußenköge and conducting further research in other municipalities provided, nevertheless, the opportunity to extend perspectives and to identify specialities and generalisations of specific aspects. Reußenköge had nuanced social and geographical place structure and independence; however, central dynamic themes which emerged are found to be relevant beyond Reußenköge. Insights from the case study have implications which can be transferred and need to be tested in other case studies.

The case study allowed me to apply a generally exploratory research design based on multiple methods in order to 'extend and magnify [my] view [on a climate-change–driven local energy

transition], and thus, to broaden and deepen what we [as a society] can learn of it and know about it' (Charmaz, 2006:14). Five different methods have been conceptually combined and integrated: The analysis of the literature, policy documents and online news functioned as a basis for the first round of semi-structured interviews and group discussions; the standardised household survey and the second phase of interviews were based on the first round of semi-structured interviews; and the interviews and the survey provided a data basis for the agent-based modelling. But why and with what result have the different methods been applied? Overall, the applied mixed-methods approach was essential for exploring the social and complex system nature of community renewable energy from different perspectives. Methods are reflected upon in more detail below, after a reflection specific to the role of models within the research.

Role of models

> Any function of the role and functions of models in the natural and social sciences invariably gets entangled in highly contentious philosophical debates about such matters as the status of language, reality, explanation, truth, data, understanding description, constructivism, theory, and so on. (Stehr, 2001:1)

Models are human constructs; in the framework of the present study, my constructs. Different models have been developed to address and skilfully and simply represent a complex reality (Döring et al., 2015). These models should not be, however, considered deterministic or functional, but rather explorative and 'focusing tools' (Stehr, 2001) to present aspects of the 'interpretation of empirical findings exhibiting the laws and axioms implicated in a theoretical framework' (Döring et al., 2015:91). Accordingly, the models have been constructed with specific purposes in mind (Stehr, 2001; Epstein, 2008). The building of the models followed a reductionist approach in order to differently represent or abstract the phenomena of local energy transition. During the analysis of the interviews, the categorisation of answers enabled an analytical structuring of the empirically observed reality. Functional relations have been created between identified categories, and key elements or fundamentals could be brought together into *conceptual models*. A simplification of one of the conceptual models and its translation into code is represented by the *computational model* and incorporated sub-models. The central feature of this study is the development of an agent-based model (ABM) that is informed by both theoretical concepts and empirical categories (see Chapter 5). The model of the phenomenon or post-computational conceptual model finally builds up the relation or distance between the model

and real world phenomenon (Stehr, 2001; Anzola, 2015). Using different styles of models in this research enabled varied thinking about and experimentation with the system elements, their characteristics, relationships and interactions, and social processes.

Scope of the methods applied

In the present research, 23 semi-structured interviews were conducted and analysed based on grounded theory (Charmaz, 2014; Corbin & Strauss, 2015), which enabled dynamic and explorative framework for 'working with' the data and the identification of specific, emerging and dynamic themes. This approach allowed for a structured analysis in terms of empirical categories and how these are reflected in and permeated by theoretical concepts. It must be reflected here that the interviews have been conducted in German. Consequently, the direct quotations presented in this study were translated from the German in the English language. Translations of phrases were discussed with several native speakers in order to guarantee for a translation as effectively as possible. These translations, nevertheless, are not able to quote word for word the original expressions and emotions given, but they are able to represent the general perspectives and opinions of the interviewees.

Before contacting the possible interview partners, two preparative meetings with the mayor and the local council of Reußenköge proved highly beneficial because they provided consent and support for the research to be undertaken in the municipality. Except one person, all requested interviewees agreed on an interview. The 15 interviews provided a rich and representative data set, although they cover only a small sample of the population. This saturation is justified with the well-conceived selection of interview partners according to their social function, profession and gender, to cover the social structure. Living in the municipality during the field research, furthermore, enabled me to react flexibly to interview requests. Therefore, a group discussion with the Country Youth in the municipality could be also realised, which revealed to be useful to represent also the voices and thoughts of the young people in this research. Although the discussion was based only on a small group (five people), the group atmosphere offered an open discussion about specific themes. Following the initial field research, a second phase of interviews proved important to get deeper insights into the local conditions and processes underlying local energy transition. Based on the knowledge of the first interview phase, it was beneficial to give specific focus to all of the experts interviewed, based on their expertise. This procedure was beneficial in two perspectives: firstly, it provided new perspectives beyond Reußenköge whereby the validity of findings could be increased; secondly, it enabled to focus and fine-tune my research.

The standardised household survey provided perspectives on regional climate change and a local energy transition from a larger sample size. With a response rate of about 46%, the survey considered successful. It became apparent that mainly people who are open to renewables participated and the voices of opponents were few. This low participation of opponents can be considered non-satisfying. Nevertheless, three factors might have positively contributed to the relatively high response rate: First; the distribution of the questionnaire was done in person. Therefore, some people could be reached at home and asked to take part, and people could have remembered seeing me cycling through the municipality. Secondly, people were given the possibility to return the questionnaire to the mayor, who expressed his support for the study. Moreover, the mayor was asked to distribute an email to the inhabitants about the survey and to ask them to participate. This support of the survey by the mayor was possible due to the cooperatively generated field access. Despite the positive conditions, feedback from the local people could also identify obstacles. The questionnaire itself included two possible obstacles: It was not clearly stated that the survey was voluntary and why the person having the next birthday should fill in the questionnaire. The questionnaire itself might have been too long, and people may thus have lost interest. These factors might have been responsible for the fact that some questionnaires were not answered completely. However, incomplete, illegible or incomprehensive questionnaires are a recognised problem of self-completion questionnaires in general (Simmons, 2008). Furthermore, one person expressed a refusal to take part because the questionnaire was not distributed personally, which seems to be because the person was not at home when I was distributing the questionnaire. It can be thus stated that distributing the questionnaire in person and having local support from the mayor and the local authority contributed positively to participation. The distribution time was well selected after the school holidays and a main harvesting time. Nevertheless, the time might have affected the response rate. In order to get even more attention for the survey, I wanted to have an article published in the local newspaper *Husumer Nachrichten*. Although my conversation with the newspaper's reporter took place during my interview period, the article was unfortunately published only after the survey's end date. Therefore, it seems to be recommendable to make early contact with the local newspaper to ensure that the article reaches the attention of the locals to the requested point of time. Nevertheless, the article proved valuable because two later expert interview partners became interested in my research and contacted me. Regarding the results of the survey, one main limitation could be identified. What became apparent in the survey process was the fact that although the surveyed people were asked

about their past decisions about the adoption or rejection of renewables, they gave answers based on their current attitudes and opinions. The next study should consider this fact and conduct the research in an area where the adoptions of renewables are currently under discussion, to collect pre-motivational factors.

Agent-based modelling provided an explorative and experimental approach and promising analytical tool to precisely thinking about and studying the importance of social interaction in the process of community renewables. The method is relatively new to social sciences but has great potential for application in the exploration of social life in a dynamic simulation by testing existing theoretical assumptions or empirical hypotheses. The development of the ABM draw me to systematically analyse the community system, because agents, their attributes and behavioural rules, relationships and interactions have been 'translated' in a conceptual and computational model. The community renewable energy transition (ComRET) model has been designed to simply represent the process of household adoption of solar panels and windmills within the community system under investigation. Hence, the model could be seen as an interpretation of the empirical findings incorporated in theoretical frameworks based on diffusion (Rogers, 2003) and social psychological theory (Ajzen, 1991). Although this translation process from the conceptual into the computational model implied simplification, it helped to identify agent types, to assign agent attributes, to define interaction types, to represent a decision-making process and to explore individual and collective behaviours and dynamics in the system. Difficulties appeared, however, in the calibration process because the empirically collected data did not provide an adequate and representative database for calibrating the agents' values. To cope with this problem, agents were equipped with estimated quantitative values. These values were adjusted 'inversely' until the model was able to reproduce empirical observations of the adoption process as well as possible (Railsback & Grimm, 2012). The decision process has been, furthermore, well thought through and informed by theories and empirical evidence. Hence, it incorporates conceptual and computational models, which can be further adapted, calibrated with new empirical data and applied to another research area. Because the simulation method allows running different experiments under what-if questions, different patterns of the adoption behaviour and the societal diffusion could be observed. This implies that simulation experiments allowed the study of the behavioural strategies of agents, interactions and their importance for the development of the community system.

Learning from the model started with the development of the model (Döring et al., 2015). Developing the ABM provided a new way of thinking about processes of the adoption of renewables, parameters relevant for households' decision making and the role of different interaction types. The model was not developed to predict the development of renewables but rather to increase the conceptual understanding of the importance of social interactions and collective action in the development process. The model can be used a tool for exploring the effects of the novel communication types which have been developed based on empirical evidence and theoretical assumptions. The developed ComRET model can be used as basis for more advanced future studies on decision making about renewables. Finally, it must be also noted that the method requires a sense of computer programming and the translation of ideas about social life into code. The programmable modelling environment named NetLogo (Wilensky, 2015) was new to me, but because of its comparably simple language, I was able to learn how to use it and to apply it to my research context.

Finally, it has to be noted that a mixed-methods approach is time consuming because the data analysis demands much time, and a number of skills are required in applying the methods. At the beginning of the research, I did not have the expertise in each method chosen. However, I am thankful that it was possible to draw on the methodological skills of team members at the Helmholtz-Zentrum Geesthacht, the Universität Hamburg and the University of Surrey. Overall, it was worth applying the mixed-methods approach.

7.4 Interim conclusion

Overall, the course of the research based on the interaction between theory, empirics and myself, as a researcher, proved highly beneficial for addressing emerging, multifaceted research themes and questions. Applying a combined place-based and agent-based approach is promising for conceptual study of social structures and processes underlying climate-change engagement, and community renewables in particular: it considers climate change and renewable-energy technologies in people's locality; it accounts for places as physical and social reservoirs affecting and informing innovative and entrepreneurial activities; it observes local agents and their dynamic and social interactions and behaviours; and it represents the local benefits and challenges of climate change and renewables related to social and geographic place characteristics. In interaction with the theory, different methods provided specific strength but also limitations for empirically studying structures and processes underlying community-based renewables. Thus, the study shows it to be useful to use a mixed-methods approach because complex issues require methodological creativity and

incremental innovation. The mixed-method approach generated 'grounded' and empirically saturated data providing important insights in social and geographical aspects — relevant in and beyond Reußenköge — enabling and sustaining a place-based renewable-energy generation. Using such different methods is, however, challenging in terms of knowledge and performance of the methods on time. However, tricky and challenging questions need interdisciplinary approaches. Despite the constraints, the present research provides a theoretical and methodological rich research framework for future investigations on climate-change engagement and community renewables.

8 Conclusions

It always seems impossible until it's done.

Nelson Mandela

Societies are the cause of and potentially the solution to climate change. To encounter climate change, low-carbon energy transition is pivotal and thus high on the political agenda. Because the social processes underlying a climate-change–driven energy transition are so far insufficiently studied, the present research aimed to contribute to an improved understanding of how a local energy transition is enabled, facilitated and sustained in communities and local places. The main research question for this research was:

> What place-based social and geographic aspects enable communities to become the places of a local energy transition?

In order to answer this question, people's place-based perspectives on mitigating climate change with renewable-energy technologies were theoretically, empirically and experimentally investigated. I have proposed a shift towards a 'yes, in my back yard' perspective, framing place as an important resource of experiences, knowledge and emotions initiating and supporting innovative and entrepreneurial activities and transition processes towards community renewables. Hence, special attention was devoted to local places and communities as spatial and analytical units. Considering communities as complex and dynamic systems enabled me to study people, their behaviour, relationships and interactions, and important aspects of their geographic environment and social embeddedness. To explore the social and complex nature of community renewable energy, a consecutive mixed-methods approach was applied combining and integrating complementary qualitative, quantitative and simulation methods. This approach proved manageable and a methodological strength for exploring the structure and dynamics of emerging themes through a grounded approach (Charmaz, 2014; Corbin & Strauss, 2015), and for experimentally studying system dynamics through simulation (Gilbert, 2008; Crooks & Heppenstall, 2012). Empirical data were gathered on the North Frisian mainland, a low-lying coastal region with both climate-change vulnerability and renewable-energy potential. Due to the current developments of renewable-energy projects such as community wind farms,

community solar farms, solar panels on roofs of houses and barns, and biogas plants on agricultural land, it was an in- and post-implementation study at the same time.

8.1   Key findings

The example of the district of North Frisia, and the study-site of Reußenköge, specifically, demonstrates community renewable energy as grassroots-based innovation. Most important for this conception of community renewable energy are local participation in and ownership of projects and the community benefits generated. This instantiation has been invented, collectively realised, implemented and sustained *in* local municipalities and *by* local people by providing opportunities *to* and benefits *for* people, communities, local places and regions beyond the local renewable-energy generation and supply. Thus, community-based renewables mobilise citizens from being pure energy consumers to become energy producers or even 'prosumers', holding the potential to create energy citizenship (Devine-Wright, 2007).

Although climate change might not be the main motivation driving the development of renewable-energy projects in North Frisia, the public debate and political relevance of climate change catalysed them. As stated in the introduction, 'climate change [can also be treated as the] unfolding story of an idea and how this idea is changing the way we think, feel and act' (Hulme, 2009:xxviii). Based on the analysis of people's understandings of climate change, this study concludes that people's embeddedness in local places and communities highly influences how they make sense of climate change. Peoples' understandings of climate change range from *local place* to *global wideness* permeated by social, geographical and temporal distances and proximities, which critically influence individual and collective engagement. People's experiences, memories and knowledge about past events and dealings with natural hazards substantially shape not only the physical but also the social place – the local individuals, their cohesion and interactions. Land reclamation and dike building historically and culturally frame people's individual and shared place-attachments, community cohesion and perceptions of place changes. In light of community-based renewables, people draw on their understandings, knowledge and innovativeness by using places as their reservoir to create and carry out new developments. Two important entry-points can be identified to provide the potential to increase the local relevance of and engagement with climate change: first, expected place-change caused by climate change must be locally thematised and; secondly, the opportunities and benefits of materialisation of climate change in community measures, such as the local development of renewable-energy technologies, must be addressed (Sub-question 1).

Based on the analysis of the places in transition, this investigation concludes that place-based resources and local entrepreneurship should be recognised and mobilised in order to enhance a successful and place-based emergence of community-based renewables. The development of such community-based projects must be understood and designed as an open and participatory process rather than a deterministic and functional one. Before developing strategies and measures inducing place changes, a 'grounded' understanding of people's place-based meanings and attachments related to the physical, social, genealogy (historical), contentedness, climate and innovation is essential because it indicates acceptance of or opposition to such changes. Furthermore, the presence and specific characteristics of people who plan to develop a project must be in-focus. Local innovators or entrepreneurs are characterised as locally embedded, collaborative, innovative, change-making, economic, communicative, networking and political. Local agents are the engine of the development, and their local knowledge and leaderships skills must be taken into consideration at the outset and used to mobilise renewable-energy projects to generate higher levels of acceptance and support. If such local innovators and leaders are absent, ideally regionally based companies or initiatives with existing concepts might be able and willing to support community renewables in other regions and to empower communities (Sub-question 2).

Due to the research undertaken here, I can conclude that attitudes, values and norms are of vital importance as well as direct participation and interaction for motivating and enhancing the household adoption and societal diffusion of wind turbines and solar panels. The development of the agent-based 'community renewable energy transition (ComRET) model' enabled the study of agents' decision-making and social interactions in a dynamic simulation. The agents' decision-making process has been computed based on theories applied to the specific context of community renewables. Based on the survey and theoretical understandings of ways in which households interact, it was furthermore possible to develop novel representations of interaction types, namely social norms, influential communication, advice-seeking, wind community meetings, and all three communication types combined. The statements which can be made with the model are explorative in nature because the parameter values were 'inversely' adjusted until they were able to reproduce empirical observations as well as possible. Based on model development and the results of the simulation runs, the study first concludes that the power of social norms and pressure must be recognised and diverse kinds of direct communication must be implemented. This

implementation would enable broader acceptance of renewables, would increase their adoption rate and would enhance the societal diffusion of renewables. Especially for the collective adoption of wind-energy, innovative agents and direct communication about opportunities of participation and actual participation in projects play a more significant role for their acceptance and adoption. Existing local innovators must be empowered because they function as essential leaders, communicators and convincers concerning renewables. Methodologically, agent-based modelling revealed to be a promising analytical tool for representing the complexities of decision about renewables, such as social interactions (Sub-question 3).

Based on the analysis of induced community transition, this research concludes that the positive and negative sides of community renewables must be acknowledged, communicated and negotiated within the affected local population. Community transition entails interwoven environmental, social, economic, political and planning benefits and challenges which, however, might offset each other, and are also differently assessed within the population. On the one hand, community renewables can provide individual and collective as well as direct and indirect benefits generated *in* and *for* local places and communities (e.g. community infrastructure and economic advantages). These benefits need to be more prominently acknowledged and implemented in public and politics. On the other hand, challenging aspects encompass a social and environmental (re)shaping of places and related fears and negative expectations. Social acceptance and its limits for the development and expansion of projects in local places must be discussed, such as regarding the density and height of wind turbines. These challenges must be addressed in order to enable and sustain community renewables, and to provide long-term acceptance and support for renewable-energy technologies. Therefore, assessments of renewables in local places should involve examination and investigation over longer time periods in order to better understand and address emerging problems (Sub-question 4).

8.2 Social relevance and policy implications

The present research documented the relevance of places as entry points for engaging individual households and communities in the climate-change debate and especially the energy transition. This finding holds implications for scientists, professionals, politicians and the public affected and involved in social processes underlying climate-change mitigation and adaptation.

People are contextualised and 'emplaced'. The present research exhibits that the ways people make sense of climate change, their adaptability towards local changes and their openness to actively (re)shape local places are 'sited', or socially and geographically embedded. In contrast, scientists, professionals, politicians are mostly not locally embedded but rather decontextualised. The experiences and findings of the research consequently reveal the imperative that people coming 'from outside' into a region must adopt the social and physical place in order to understand people's lived experiences and perspectives, and must integrate local people before developing decontextualised and displaced local strategies.

The findings of the present research, furthermore, provide relevant information to and implications for politics and professionals interested and working in the empowerment of communities and renewable-energy innovations, because they contribute to the understanding of people's perspectives on community renewables and the places of energy transition. On the basis of the conceptual and empirical investigation, I argue that *place matters* for enabling and supporting the diffusion of community-based renewable energy. Places must be recognised as a reservoir of experiences, local expertise, knowledge and innovation based on the interaction between a specific physicality of place and intangible social and historical circumstances inherent in them. This research suggests that local characteristics and resources must be valued and assessed before developing and negotiating implementation strategies, and planned projects should include or build on the outlined insights.

Professionals who plan to implement local projects should provide opportunities to the local population to participate in the planning process and to financially benefit on collective level. Local planning and financial participation are found to increase the acceptance of and support for project development and to encounter possible fears. Local expectations of community renewables and the community benefits generated should therefore be addressed before developing local projects. Furthermore, current exemplars of community renewables have generated local experiences and knowledge available for the benefit of place-based projects. Future project developers could learn from the process of current projects in two ways: first, they must build on the knowledge of local circumstances and requirements for successful development, and secondly, they must address the potential of community renewables by providing interesting and exciting new business models.

Energy governance should acknowledge and seriously take into account local agents and

communities and provide flexible, supportive funding schemes that empower community-based concepts and emplaced strategies. In consequence, structural and conceptual changes in funding policy are needed which tackle not only technological and economic feasibility but social feasibility and acceptability. Even more, politics should learn from the regional and local impacts of and experiences with a rather decontextualised national energy policy and should support communities and local places rather than single big companies. The power of grassroots innovations, local entrepreneurship and community benefits for creating environmental, social, economic, planning and political values for places and communities deserve considerably increased attention in political decision-making. Place-based opportunities, challenges and strategies should be discussed with local people and seriously considered when it comes to political decision-making. Related to this point, the potential of community-owned and -led projects for overcoming social problems and enhancing sustainable development, especially in rural areas, should be put into sharper focus by governments. Furthermore, the findings highlight the relevance of a place-based, bottom-up approach and the potential of integrating a stronger focus on community-based concepts and actions such as community renewable energy in future strategies and policies. Politics should, thus, build on existing developed policies in the EU, highlighting place-based strategies (Barca, 2009). However, community actions also have limitations and thus require support by regional and national governments in order to foster long-term adaptation to and mitigation of climate change.

Finally, my research had an actual impact on the places in which the study was carried out, and beyond, it provides a strong message for the public. In fact, local people were informed about the research via a newspaper article during the study (Appendix B). They also indicated their interest in results during the interviews and the survey, wherefore a report of the research (in German) is planned to be published locally. Interview partners, including local entrepreneurs and politicians, have already signalled their interest in the research results, which will be provided via free distribution of the dissertation. Besides the mentioned impacts related to the dissertation, the show-case examples should impressively present that not a single individual but collective efforts and actions enable and facilitate a community-based energy transition. The core of the grassroots-based innovation of community-renewables is the social. The broader public should attend to the message that 'people power' makes a real difference and change happen.

8.3 Outlook

The present research results also give rise to further research questions and themes in the field of climate change and renewable energy in local communities and places. The dissertation revealed the importance of people's local embeddedness for individual and collective forms of engagement with climate change and community renewable-energy based on one case study. However, social, cultural and geographic circumstances differ between communities. Although the research enabled the identification of the general characteristics or tendencies of the process of community-based energy transition, the relevance of these characteristics should be assessed in other study areas. Further empirical research should be thus conducted applying a place-based approach and the concept of community renewables in regions with different social and geographical circumstances. The potential of community concepts and actions should also be further theoretically and empirically explored in the context of community-based adaptation. Recent research has paved the way by investigating the role of social capital for collective action on small islands (e.g., Petzold & Ratter 2015; Petzold, 2016), even though it is still an open question how coastal sites differ from inland areas.

Furthermore, the research performed here confirmed the suitability and imperative of a mixed-methods approach for studying the social and complex issue of community renewables. It required methodological creativity and incremental innovation to address the multifaceted structures and processes underlying current and future local energy transition. However, it also revealed the limitations of conducting research at a single point in time and not on a longer time-scale. It seems to be promising to apply more creative and innovative participatory research along the whole development process. However, this participatory research should critically consider how we — as scientists — can be integrated in the social process and what we can learn from it. Questions are: What social challenges emerge at different stages of the development process and what is the general structure informing these development processes? How can such challenges be encountered? To address these questions, further empirical research should be conducted pre-, in- and post-implementation of community-based renewables. Such an approach would be also valuable for improving the developed agent-based ComRET model with empirically saturated data. Future work could use the presented ComRET model and the social psychological framework (Ajzen, 1991) and diffusion framework (Rogers, 2003) by building a more applied model of local renewable-energy adoption. Recent research documented that findings from interviews with politician's

and professionals can underpin the construction and use of an ABM as an 'interested amateur' and can serve as an interaction and discussion tool (Johnson, 2015).

The research focused on local communities and places as analytical units which are, however, not independent from their broader environment. Considering the region of North Frisia, one challenge which became apparent in the interviews was the local overproduction of electricity. Therefore, further research must be performed considering not only single municipalities but rather the supply-demand relationships and related synchronisation of technology implementation and energy need. Related to that aspect, it could also be interesting to explore the interactions between rural places and cities or rural places and close-by companies with high energy demands. To draw on the broadening of the perspective, future research should elaborate on the potential of community renewable energy for facing social problems and facilitating sustainable regional development, especially in rural areas. Can community-based renewable energy provide solutions for sustainable regional development? Based on the characteristics of a locally induced community transition identified in this research, a comprehensive conceptual framework should be developed in future investigation. This framework should draw on recent research of a complex evolutionary perceptive on regional development highlighting the importance of non-linear relationships and interactions between heterogeneous agents, learning processes and active behaviour as an engine of regional development (Weig, 2016). Complexity theory indicates the provision of a valuable theoretical foundation here by emphasising specific local elements and their non-linear interactions, causing specific structures and developments of regional systems (Sobiech, 2013; Weig, 2016).

Overall, the present research provides a conceptually and methodologically rich research framework, which should be deepened and applied in future research to further enhance the understanding of people's meanings of and relations to climate change and place-based aspects empowering local places and communities.

Closing this dissertation, I would like to refer to its title, 'People-powered local energy transition'. My research provides multifaceted perspectives on how individual households and communities behave as local engines of the global energy (r)evolution by harvesting not only renewable energy but also by seeding their own future. Local ideas and actions pave an important path towards a global energy transition, albeit *it always seems impossible until it's done.*

Signal to the World Climate Conference in Durban 2010: Renewable Energy is stronger than fossils. Renewables are infinitely available, conserve the climate and the environment.
Photo: © Shayne Robinson / Greenpeace

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Appendix

Appendix A

Example of an interview guideline:

_____

Interview Gemeinde Reußenköge

NAME: _____

Datum: _____

Hintergrund
- seit Dez. 2012 Doktorarbeit zu regionalen Klimaveränderungen und lokalen Anpassungsstrategien im Küstenbereich
- REKLIM - Forschungsprojektes zu regionalen Klimaveränderungen
- Wissenschaftliche Forschung kann nicht ohne Menschen vonstattengehen. Sie findet im besten Fall nicht im luftleeren Raum statt, sondern mit den Menschen und für die Menschen.

Ich interviewe Sie als **Privatperson**, auch wenn ich mir bewusst bin, dass es mit Sicherheit einige fließende Übergänge zu Ihrer beruflichen Tätigkeit gibt. Ich möchte Sie bitten auf meine Fragen frei heraus und ehrlich zu antworten; es gibt keine richtigen oder falschen Antworten, sondern es geht mir um persönliche Wahrnehmungen und Einstellungen.

Interview – 5 thematische Schwerpunkte
- 1. Soziale und emotionale Bindung zur Gemeinde
- 2. Wahrnehmung und individuelle Bewertung von Klimawandel
- 3. Information und Kommunikation von Klimawandel
- 4. Klimabezogene Maßnahmen
- 5. Ortgebundene Klimavisionen

Ich möchte das **Interview sehr gern aufnehmen**, damit ich während des Gesprächs wirklich bei Ihnen sein kann und ich mir keine ausführlichen Notizen machen muss. Die Daten aus den Interviews werden streng vertraulich behandelt. Das heißt, dass die Interviews anonymisiert werden und ich nur die transkribierten Daten nutze. **Wären Sie mit der Aufnahme unseres Gesprächs einverstanden?**

Es ist für mich selbstverständlich, die **Ergebnisse meiner Studie** im Rahmen einer Versammlung vorzustellen. Sofern Ihrerseits Interesse besteht, sind Sie natürlich auch herzlich dazu eingeladen.
Noch Fragen?

1 HINTERGUND ZUR PERSON, UND SOZIALE UND EMOTIONALE BINDUNG ZUR GEMEINDE		
Zum Einstieg möchte ich gern mehr über Sie Person und die Gemeinde Reußenköge erfahren.		
	Inwiefern fühlen Sie sich mit Nordfriesland und Ihrer Gemeinde im speziellen verbunden?	
	Wie sieht das soziale Zusammenleben in der Gemeinde aus?	
		Wo trifft man sich, wo tauscht man sich aus? Soziale Aktivitäten? Vereine oder Clubs?
Wenn Sie jetzt einmal über das soziale Zusammenleben in der Gemeinde hinausdenken und ihre Umwelt im Ganzen betrachten.		
	Was sehen Sie als Bedrohung/Problem für Ihre Gemeinde und wie stark schätzen Sie diese ein?	
		Sehen Sie das Thema Klimawandel auch als Problem an?
2 WAHRNEHMUNG UND INDIVIDUELLE BEWERTUNG VON KLIMAWANDEL		
Bleiben wir bei der Thematik des Klimawandels. Das Thema Klimawandel ist hoch aktuell. Es wird in der Öffentlichkeit viel diskutiert und in der Wissenschaft vielfältig erforscht.		
	Vor diesem Hintergrund, habe ich erst einmal eine generelle Frage: Was bedeutet Klimawandel für Sie?	
		Wie wirkt sich der Klimawandel für Sie persönlich aus?
	Ist die Thematik des Klimawandels auch relevant für Reußenköge? Wenn ja, warum?	
		Nehmen Sie Klimaveränderungen in Ihrer Region wahr? Und wenn ja, wie?
	In wie weit sehen Sie sich persönlich durch (physische, soziale, ökonomische, etc.) Risiken betroffen??	
		Haben Sie persönlich Erfahrungen gemacht?
3 INFORMATIONEN ZUM UND KOMMUNIKATION VON KLIMAWANDEL		
Sie haben mir gerade erzählt, dass… Die Bereitstellung und Vermittlung von Information über die Auswirkungen des Klimawandels und Anpassungsmaßnahmen ist ein wesentliches Ziel des Aktionsplans Anpassung in Deutschland.		
	Daher meine Frage, fühlen Sie sich gut über Klimaveränderungen in Ihrer Region informiert, und über Maßnahmen zum Klimaschutz und Klimafolgenanpassung?	
	Woher haben Sie Informationen zum Klimawandel und damit verbundene Maßnahmen erhalten? Was sind für Sie die wichtigsten Informationsquellen?	
4 KLIMABEZOGENE MASSNAHMEN		
Um vor derzeitigen und zukünftigen Klimaveränderungen geschützt zu sein, ist die Umsetzung von konkreten Maßnahmen von entscheidender Bedeutung.		
	Was könnten konkrete Vorsorgemaßnahmen sein, um sich vor derzeitigen und zukünftigen Klimaveränderungen zu schützen? *Notiz Maßnahme:*	
	Als Maßnahmen haben Sie mir eben *XY* genannt. Wer (Person/Institution) ist Ihrer Ansicht nach für die Umsetzung dieser Maßnahme/n zuständig?	
	Wissen Sie was die Gemeinde Reußenköge tut um dem Klimawandel zu begegnen? Wie bewerten Sie dies?	
		Wer hat Ihrer Meinung nach entscheidend zu den Entwicklungen beigetragen?

		Gibt es Maßnahmen, die Sie persönlich ergriffen haben, die zur **Eindämmung des Klimawandels**, häufig auch **Klimaschutz** genannt, beitragen?
		Wenn *nein*, warum? - Notwendigkeit - Informationen - Möglichkeit der Umsetzung - Effektivität des Schutzes - Kosten-Nutzen - Unsichere/r Klimawandel/Risiken
		Wenn *ja*, welche, wann und warum? - Erneuerbare Energie - Energieeffizienz - Wärmedämmung - Beteiligung an Planungsprozessen - Notwendigkeit - Informationen - Möglichkeit der Umsetzung - Effektivität des Schutzes - Kosten-Nutzen - Unsichere/r Klimawandel/Risiken
		Neben der Eindämmung des Klimawandels spielt die Klimafolgenanpassung eine Rolle. Haben Sie spezielle private Maßnahmen ergriffen, um sich an klimatische Veränderungen in der Region **anzupassen** bzw. sich vor diesen zu schützen?
		Wenn *nein*, warum? - Notwendigkeit - Informationen - Möglichkeit der Umsetzung - Effektivität des Schutzes - Kosten-Nutzen - Unsichere/r Klimawandel/Risiken
		Wenn ja, welche, wann und warum? - Versicherung - Informationshefte - Hochwasserschutzplan - Evakuierungsplan - Teilnahme an Informationsveranstaltungen - Maßnahmen am Haus - Beteiligung an Planungsprozessen - Notwendigkeit - Informationen - Möglichkeit der Umsetzung - Effektivität des Schutzes - Kosten-Nutzen - Unsichere/r Klimawandel/Risiken

5 ORTSGEBUNDENE KLIMAVISIONEN	
Nun würde ich sehr gern mit Ihnen gemeinsam in die Zukunft schauen. Fragen des Klimaschutzes und der Klimafolgenanpassung beziehen Erwartungen über zukünftige Entwicklungen und Vorhaben maßgeblich mit ein.	
	Erwarten Sie, dass Sie in Zukunft mehr von klimatischen Veränderungen betroffen sein werden? Und wenn ja, wie könnten diese aussehen?
	Was wünschen Sie sich, was die Politik in Bezug zu Klimawandelbegrenzung und Klimafolgenanpassung unternehmen sollte?
	Welche Maßnahmen zur Klimafolgenanpassung sollten Ihrer Meinung unverzüglich angegangen werden, welche später, welche nie? Warum?
	Was für Maßnahmen haben Sie vor zukünftig selbst zu ergreifen? Wann und warum wollen Sie diese ergreifen?
	Zum Schluss möchte ich Sie Fragen: Habe ich etwas vergessen, was Sie noch als wichtig erachten?

Statistische Daten
Wie lange wohnen Sie schon hier?
Wie viele Personen wohnen in Ihrem Haushalt?
In welchem Jahr sind Sie geboren?

Appendix B

Article in the newspaper *Husumer Nachrichten*, 16.09.2014:

Experience report: The North Frisian and climate change

Husumer Nachrichten

ERFAHRUNGSBERICHTE

Die Nordfriesen und der Klimawandel

vom 16. September 2014   Aus der Redaktion der Husumer Nachrichten

Die junge Wissenschaftlerin Diana Süsser hat für ihre Doktorarbeit mehr als 100 Bewohner der Reußenköge befragt. Auch die lokale Energiewende wurde thematisiert

Diana Süsser war in Sachen Klimaschutz in Nordfriesland unterwegs. Die junge Wissenschaftlerin lernte dabei auch der steifen Brise mitsamt Regenschauern zu trotzen. Über das raue Nordseeklima kann sie nun mitreden. Die Hamburgerin hatte mit dem Fahrrad die Reußenköge durchquert, um Fragebogen an alle Haushalte zu verteilen. Diana Süsser ist in der Abteilung für Sozioökonomie des Küstenraumes am Helmholtz-Zentrum in Geesthacht beschäftigt und schreibt an ihrer Doktorarbeit. Dafür benötigt sie Informationen rund um das Thema „Regionaler Klimawandel und Entwicklung der erneuerbaren Energien".

Die Reußenköge mit ihren rund 300 Einwohnern hatte die Doktorandin aus einem ganz bestimmten Grund für ihre Studien ausgesucht: „Ich interessiere mich schon lange für Nordfriesland, da die Region direkt an der Küste liegt, und die historische Entwicklung sehr spannend ist. Für die Einwohnerbefragung habe ich mir dann eine überschaubare Gemeinde gesucht und wurde hier fündig." Grünes Licht für ihre Befragung hatte sie zuvor noch bei der Gemeindevertretung eingeholt.

Für ein paar Wochen wohnte Diana Süsser in den Reußenkögen, wobei sie kein Neuland betrat, denn die Doktorandin war für Interviews bereits Ende Februar vor Ort gewesen. 15 Einwohner kamen damals zu Wort – zum Klimawandel, Küstenschutz und zu erneuerbaren Energien. Bei ihrem zweiten Besuch hatte die Forscherin dann 120 Fragebogen im Gepäck. „Was bedeutet für Sie Klimawandel?", „Haben Sie ihre Meinung zur Solarenergie in den letzten Jahren verändert?" und „Warum haben Sie sich dafür entschieden, eine Windenergieanlage zu bauen, beziehungsweise sich an einem Bürgerwindpark zu beteiligen?" – dies war nur einiges, was sie genau wissen wollte. Dazu kamen Fragen zum Leben im Koog, dem Zusammenhalt sowie den Problemen und der Bewertung der lokalen Energiewende.

Im Helmholtz-Zentrum befasst sie sich nun mit den Antworten der Nordfriesen aus dem Koog – Diskretion ist zugesichert. Diana Süsser möchte herausfinden, wie der Klimawandel von den Bewohnern wahrgenommen wird. „Wichtig sind mir die Wahrnehmungen der Menschen vor Ort. Es geht nicht darum, die Antworten persönlich zu bewerten", versichert sie. Falls Interesse an dem Ergebnis ihrer Studie besteht, würde Diana Süsser diese gern im Rahmen einer Bürgerversammlung vorstellen. „Das kann allerdings noch etwas dauern."

Photo © Mommsen: Windkraft und die Reußenköge gehören zusammen: Diana Süsser in ihrem „Forschungsgebiet" (engl.: Wind energy and the Reußenköge belong together: Diana Süsser in here „research area")

Online: http://www.shz.de/lokales/husumer-nachrichten/die-nordfriesen-und-der-klimawandel-id7691146.html

Einwohnerbefragung
zum regionalen Klimawandel und
der Entwicklung der erneuerbaren Energien
in der Gemeinde Reußenköge

Helmholtz-Zentrum Geesthacht

Zentrum für Material- und Küstenforschung

Institut für Küstenforschung

Sozioökonomie des Küstenraumes

Max-Planck-Straße 1

21502 Geesthacht

Bitte füllen Sie diesen Fragenbogen bis **zum 27. August** aus. Es gibt 3 Möglichkeiten diesen zurückzugeben:

1. Sie können den Fragebogen am 27. August unter Ihrer Fußmatte oder in einer Plastiktüte an Ihrer Eingangstür hinterlegen.

2. Sie können den Fragebogen verschlossen im Umschlag bis zum 27. August beim Bürgermeister Herr Albrecht, im Desmerciereskoog 8, in den Briefkasten einwerfen.

3. Sie können Ihn mir per Post an uns zurück senden, an folgende Anschrift:
    Helmholtz-Zentrum Geesthacht, KSO, z. H. Frau Süsser
    Max-Planck-Straße 1, 21502 Geesthacht
    Der Umschlag kann als Rücksendeumschlag verwendet werden.

Vielen Dank für Ihre Mitarbeit!

Sehr geehrte Einwohnerinnen und Einwohner der Gemeinde Reußenköge,

vielleicht sind Sie schon durch eine Ankündigung per E-Mail, die Husumer Nachrichten, Nachbarn oder mich persönlich auf unsere Befragung aufmerksam geworden. Wir führen derzeit in der Gemeinde Reußenköge eine Befragung zum Thema regionaler Klimawandel und Entwicklung der erneuerbaren Energien durch. Hierbei interessiert uns, wie Sie persönlich die Klimaveränderungen wahrnehmen und erneuerbare Energien wie zum Beispiel Wind- und Solaranlagen in Reußenköge bewerten. Die Befragung wird im Rahmen einer Doktorarbeit durchgeführt, die am Helmholtz-Zentrum Geesthacht (HZG) in Kooperation mit der Universität Hamburg entsteht.

Die Beantwortung der Fragen dauert etwa 30 Minuten und sollte wenn möglich durch die **Person Ihres Haushaltes** erfolgen, die **mindestens 16 Jahre** alt ist und – von heute an gesehen – **als nächstes Geburtstag hat.**

Das Ausfüllen des Fragebogens ist ganz einfach, da es weder richtige noch falsche Antworten gibt. Am besten, Sie füllen den Fragebogen spontan und in der vorgegebenen Reihenfolge aus. Hierzu ist es lediglich notwendig, die für Sie zutreffenden Kästchen anzukreuzen, Ziffer auszuwählen oder mit eigenen Worten Ihre Meinung darzulegen. Sollte hinter der für Sie zutreffenden Antwort ein Pfeil, z.B. Bitte weiter mit Frage 3, stehen, können Sie auch eine oder mehrere Fragen überspringen. Bitte beantworten Sie möglichst alle für Sie zutreffenden Fragen.

Das Helmholtz-Zentrum Geesthacht (HZG) arbeitet nach den gesetzlichen Bestimmungen für den Datenschutz. Die Ergebnisse der Befragung werden ausschließlich in anonymisierter Form dargestellt. Das bedeutet: Niemand kann aus den Ergebnissen erkennen, von welcher Person welche Aussagen stammen. Wir garantieren Ihnen, dass Ihre Angaben vertraulich behandelt und ausschließlich für Forschungszwecke verwendet werden.

Vielen Dank, dass Sie sich die Zeit nehmen den Fragebogen auszufüllen.

Wenn Sie Fragen haben, können Sie uns gerne unter den unten angegebenen E-Mail Adressen oder Telefonnummern kontaktieren:

Diana Süsser, M.Sc.   diana.suesser@hzg.de   Telefon: 0152 - 53704780

Prof. Dr. Beate M.W. Ratter beate.ratter@hzg.de   Telefon: 040 - 42838 5225

Diana Süsser, M.Sc.   Prof. Dr. Beate M.W. Ratter
Wissenschaftliche Mitarbeiterin   Abteilungsleiterin
Sozioökonomie des Küstenraumes   Sozioökonomie des Küstenraumes
Helmholtz-Zentrum Geesthacht (HZG)   Helmholtz-Zentrum Geesthacht (HZG)
                                                        Universität Hamburg, Institut für Geografie

Zu Beginn möchten wir Ihnen einige Fragen zu Ihrem Wohnort - der Gemeinde Reußenköge - stellen.

1.   Seit wann wohnen Sie in der Gemeinde Reußenköge?

Seit meiner Geburt   ☐

Seit dem Jahr ……………… → Bitte weiter mit Frage **3.**

2.   Haben Sie zwischenzeitlich wo anders gelebt?

Ja ☐   Nein ☐

Wenn ja, aus welchem Grund/aus welchen Gründen?

Berufliche Gründe   ☐

Familiäre Gründe   ☐

Andere Gründe,
nämlich……………………………………………………………

→ Bitte weiter mit Frage **4.**

3.   Wo haben Sie zuvor gewohnt und warum haben Sie dort gewohnt?

……………………………………………………………………………………

4.   Inwiefern fühlen Sie sich mit Nordfriesland und der Gemeinde Reußenköge verbunden?

a) Mit <u>Nordfriesland</u> fühle ich mich … verbunden.

sehr stark ☐   eher stark ☐   teils/teils ☐   eher wenig ☐   gar nicht ☐

b) Mit <u>Reußenköge</u> fühle ich mich … verbunden.

sehr stark ☐   eher stark ☐   teils/teils ☐   eher wenig ☐   gar nicht ☐

Bitte begründen Sie kurz Ihre Antwort.
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………

5.   Würden Sie die Gemeinde Reußenköge als Ihre Heimat bezeichnen?

Ja ☐   Nein ☐

Bitte begründen Sie kurz Ihre Antwort. …………………………………………
……………………………………………………………………………………
……………………………………………………………………………………

6. **Wie würden Sie den sozialen Zusammenhalt in Reußenköge bewerten?**

sehr stark □   eher stark □   teils/teils □ eher gering □   gar keiner □

Bitte begründen Sie kurz Ihre Antwort, oder haben Sie ein konkretes Beispiel?

……………………………………………………………………………….…

……………………………………………………………………………….…

7a. **Was glauben Sie, inwiefern ist Reußenköge von den folgenden Problemen betroffen?**

	sehr stark betroffen	eher betroffen	teils/teils	eher nicht betroffen	gar nicht betroffen
Demographischer Wandel	□	□	□	□	□
Wohnraummangel	□	□	□	□	□
Schlechte Verkehrsinfrastruktur	□	□	□	□	□
Abwanderung der Bevölkerung	□	□	□	□	□
Erhaltung der Gemeindeunabhängigkeit	□	□	□	□	□
Arbeitsplatzmangel	□	□	□	□	□
Umweltprobleme allgemein	□	□	□	□	□
Klimawandel	□	□	□	□	□
Perspektivlosigkeit auf dem Arbeitsmarkt	□	□	□	□	□
Konflikte mit dem Naturschutz	□	□	□	□	□
Sturmfluten	□	□	□	□	□

Andere Probleme, nämlich:

……………………………	□	□	□	□	□
……………………………	□	□	□	□	□

7b. **Sind Sie persönlich oder Ihr Haushalt von diesen Problemen betroffen?**

Ja □   Nein □

Bitte begründen Sie kurz Ihre Antwort. …………………………………………..

....

....

Als nächstes möchten wir Ihnen einige Fragen zu Ihren persönlichen Werten stellen.

8.   Bitte lesen Sie die einzelnen Beschreibungen sorgsam durch. Überlegen Sie, inwiefern die Beschreibung für Sie zutrifft und tragen Sie dann rechts eine der folgenden Ziffern ein:

trifft vollständig auf mich zu	trifft auf mich zu	trifft etwas auf mich zu	trifft eher nicht auf mich zu	trifft gar nicht auf mich zu
1	2	3	4	5

Es ist mir wichtig, Menschen um mich herum zu helfen. Ich möchte, dass es meinen Mitmenschen gut geht.	
Ich bin davon überzeugt, dass Menschen die Natur erhalten sollten. Umweltschutz ist wichtig für mich.	
Es ist mir wichtig, neue Ideen zu haben und kreativ zu sein. Ich mag es, Dinge auf meine eigene Weise anzugehen.	
Es ist mir wichtig, Entscheidungen zusammen mit Vertrauenspersonen zu treffen. Ich mag es, Dinge gemeinsam anzugehen.	
Ich suche nach Herausforderungen und nehme Risiken auf mich. Es ist mir wichtig, verschiedene Dinge im Leben auszuprobieren.	
Ich nutze jede Gelegenheit, um Spaß zu haben. Es ist mir wichtig, das Leben in vollen Zügen zu genießen.	
Es ist wichtig für mich, erfolgreich zu sein. Ich möchte, im Leben etwas erreichen.	
Es ist mir wichtig, respektiert zu werden. Ich möchte, dass meine Mitmenschen meine Meinung ernst nehmen.	
Es ist mir wichtig, Sicherheit im Leben zu haben. Ich vermeide alles, was meine Sicherheit gefährden könnte.	
Es ist mir wichtig, sich ordnungsgemäß zu Verhalten. Ich vermeide Dinge zu tun, die andere Menschen falsch finden könnten.	
Tradition ist wichtig für mich. Ich versuche die Bräuche meiner Familie und/oder meiner Religion zu pflegen.	

Die nächsten Fragen befassen sich speziell mit der Thematik des Klimawandels.

9. **Was bedeutet für Sie Klimawandel?**

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

10. **Wo sehen Sie den Klimawandel in Ihrem direktem Lebensumfeld?**

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

11. **Inwiefern sehen Sie sich selbst vom Klimawandel betroffen?**

sehr stark □   eher stark □   teils/teils □   eher wenig □ gar nicht□

Bitte begründen Sie kurz Ihre Antwort. …………………………………………..

……………………………………………………………………………………

……………………………………………………………………………………

12. **Wir nennen Ihnen einige Aussagen zum Thema Klimawandel weltweit. Sagen Sie uns bitte, ob Sie den Aussagen eher zustimmen oder eher nicht zustimmen.**

Klimawandel…..	stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
…findet statt.	□	□	□	□	□
…ist nicht relevant	□	□	□	□	□
…hat es schon immer gegeben.	□	□	□	□	□
…ist zum größten Teil vom Menschen verursacht.	□	□	□	□	□
…ist ein ernstzunehmendes Problem unserer Gesellschaft.	□	□	□	□	□
…müssen wir durch Maßnahmen entgegen wirken.	□	□	□	□	□

Die Auswirkungen .... sind mit hohen Unsicherheiten verbunden.	☐	☐	☐	☐	☐

13. **Wir nennen Ihnen nun einige Aussagen zum Thema <u>Küstenschutz</u>. Sagen Sie uns bitte, inwiefern Sie den Aussagen zustimmen.**

Ich denke, dass der bestehende Küstenschutz in Reußenköge <u>derzeit</u> ausreichend Sicherheit vor Sturmfluten bietet.

stimme voll zu   stimme eher zu   stimme teilweise zu   stimme eher nicht zu   stimme gar nicht zu
     ☐   ☐   ☐   ☐   ☐

Ich denke, dass der bestehende Küstenschutz in Reußenköge <u>für die kommenden Jahrzehnte</u> ausreichend Sicherheit vor einem steigenden Meeresspiegel und Sturmfluten bietet.

stimme voll zu   stimme eher zu   stimme teilweise zu   stimme eher nicht zu   stimme gar nicht zu
     ☐   ☐   ☐   ☐   ☐

Ich denke, für den Schutz vor dem Meeresspiegelanstieg und Sturmfluten sind <u>zusätzliche Maßnahmen</u> zum Außendeich notwendig.

stimme voll zu   stimme eher zu   stimme teilweise zu   stimme eher nicht zu   stimme gar nicht zu
     ☐   ☐   ☐   ☐   ☐

Ich denke, dass die Gemeinde Reußenköge noch mehr in den Küstenschutz eingebunden werden sollte.

Ja ☐   Nein ☐

Bitte begründen Sie kurz Ihre Antwort.   ……………………………………………
………………………………………………………………………………………….…
………………………………………………………………………………………….…

Würden Sie persönlich gern mehr in den Küstenschutz eingebunden werden?

Ja ☐   Nein ☐

14. **Wir nennen Ihnen nun einige Aussagen zum Thema <u>Entwässerung.</u> Sagen Sie uns bitte, inwiefern Sie den Aussagen eher zustimmen.**

Ich denke, dass das bestehende Entwässerungssystem in der Gemeinde <u>derzeit</u> ausreichend Sicherheit vor starken und/oder langanhaltenden Niederschlägen bietet.

stimme voll zu   stimme eher zu   stimme teilweise zu   stimme eher nicht zu   stimme gar nicht zu
     ☐   ☐   ☐   ☐   ☐

Ich denke, dass das bestehende Entwässerungssystem in der Gemeinde <u>für die kommenden Jahrzehnte</u> ausreichend Sicherheit vor starken und/oder langanhaltenden Niederschlägen bietet.

stimme voll zu   stimme eher zu   stimme teilweise zu   stimme eher nicht zu   stimme gar nicht zu
     ☐   ☐   ☐   ☐   ☐

Ich denke, für den Schutz vor starken und/oder langanhaltenden Niederschlägen sind <u>zusätzliche Maßnahmen</u> zur Entwässerung notwendig.

stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
☐	☐	☐	☐	☐

15. Wir nennen Ihnen nachfolgend einige Maßnahmen, die im Bezug zu Ihrem Haushalt oder täglichen Leben stehen. Sagen Sie uns bitte durch entsprechendes Markieren, ob Sie die Maßnahmen selbst ergriffen haben, oder ob Sie planen diese zukünftig umzusetzen.

	ja	teilweise	nein	wenn **nein:** geplant	nicht geplant
Ich besitze energieeffiziente Haushaltsgeräte.	ja	teilweise	nein	geplant	nicht geplant
Geräte (wie TV) stehen nicht auf Stand-by.	ja	teilweise	nein		
Ich besitze eine energieeffiziente Beleuchtung, z. B. LED.	ja	teilweise	nein	geplant	nicht geplant
Ich schalte das Licht beim Verlassen des Raumes aus.	ja	teilweise	nein		
Das Haus in dem ich wohne, besitzt ein energieeffizientes Heizsystem.	ja		nein	geplant	nicht geplant
Das Haus in dem ich wohne, besitzt eine energieeffiziente Wärmedämmung.	ja	teilweise	nein	geplant	nicht geplant
Ich fahre ein energieeffizientes Auto.	ja		nein	geplant	nicht geplant
Ich nutze öffentliche Verkehrsmittel.	ja	teilweise	nein		
Ich laufe oder fahre Rad bei kurzen Strecken (bis zu 5 km).	ja	teilweise	nein		
Ich beziehe Ökostrom*. *Strom aus 100 % Erneuerbaren Energien	ja		nein	geplant	nicht geplant

Andere Maßnahmen, die geplant oder umgesetzt sind, ämlich……………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

16. **Wir nennen Ihnen nachfolgend einige Maßnahmen, die im Bezug zu Ihrem Haushalt oder täglichen Leben stehen. Sagen Sie uns bitte durch entsprechendes Markieren, ob Sie die Maßnahmen selbst ergriffen haben, oder ob Sie planen diese zukünftig umzusetzen.**

	ja	teilweise	nein	wenn **nein**:	
				geplant	nicht geplant
Ich habe eine Versicherung für Sturmschäden und/oder Überschwemmungen.	ja		nein	geplant	nicht geplant
Ich habe Informationsveranstaltungen zu dem Thema Klimawandel und Anpassung besucht.	ja		nein	geplant	nicht geplant
Ich achte auf Flutwarnungen.	ja		nein		
Ich habe Barrieren für Türen und/oder Fenster installiert.	ja	teilweise	nein	geplant	nicht geplant
Mein Strom- und/oder Heizsystem ist Flutsicher.	ja	teilweise	nein	geplant	nicht geplant
Im Falle einer Überflutung kenne ich Nachbarn, die helfen.	ja		nein		
Ich enagiere mich aktiv in einem Deich- und/oder Sielverband.	ja		nein	geplant	nicht geplant
Ich engagiere mich aktiv bei der Freiwilligen Feuerwehr.	ja		nein	geplant	nicht geplant

Andere Maßnahmen, die geplant oder umgesetzt sind, nämlich…………………

………………………………………………………………………………………

………………………………………………………………………………………

Die nächsten Fragen befassen sich speziell mit der Thematik der erneuerbaren Energien.

17.   **Wir nennen Ihnen im Folgenden einige Aussagen zum Thema erneuerbare Energien. Sagen Sie uns bitte, inwiefern Sie den Aussagen zustimmen.**

Erneuerbare Energien....	stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
...leisten einen Beitrag zum Klimaschutz.	☐	☐	☐	☐	☐
...tragen zur Reduzierung der Kohlendioxid (CO_2) Emissionen bei.	☐	☐	☐	☐	☐
...sind wichtig für die Energiewende*. *Wende zu einer Energieversorgung aus 100 % Erneuerbaren Energien.	☐	☐	☐	☐	☐
...sind für Haushalte eine finanzielle Mehrbelastung.	☐	☐	☐	☐	☐
...sind gesellschaftlich akzeptabel.	☐	☐	☐	☐	☐
Stromtrassen für ... sind gesellschaftlich akzeptabel.	☐	☐	☐	☐	☐

18.   **Wir nennen Ihnen im Folgenden einige Aussagen speziell zum <u>Thema Solarenergie</u>. Bitte lesen Sie die Aussagen sorgsam durch und tragen Sie rechts eine der folgenden Ziffern ein, die für Sie zutrifft.**

stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
1	**2**	**3**	**4**	**5**

Ich denke, dass die Nutzung von Solarenergie einen Beitrag zum Klimaschutz leistet.	
Ich denke, dass die Entwicklungen der Solarenergie in meinem Umfeld akzeptabel sind.	
Ich fühle mich gut, wenn ich durch die Investition in Solarenergie etwas Gutes für die Umwelt tue.	
Ich denke, wir haben eine moralische Verantwortung in Solarenergie zu investieren.	
Ich denke, dass jeder Mensch durch die Investition in Solarenergie einen Beitrag zum Klimaschutz leisten kann.	

Wenn ich andere Gemeindebewohner sehe, wie sie in Solaranlagen investieren, denke ich, dass ich das auch tun sollte.					

Ich denke, dass die Nutzung von Solarenergie einen Beitrag zur Energieunabhängigkeit / Energieautarkie leistet.	
Ich denke, dass Solaranlagen auf Dächern das Landschaftsbild zerstören.	
Ich denke, dass in der Landschaft stehende Solaranlagen (Solarparks) das Landschaftsbild zerstören.	
Ich denke, dass sich die Investition in eine Solaranlage privat finanziell lohnt.	
Ich denke, dass die Solarenergie ein wichtiges Standbein des privaten Einkommens sein kann.	
Ich denke, dass finanzielle Anreize durch das Erneuerbare-Energien-Gesetz (EEG) private Investitionen in Solaranlagen fördern.	
Ich denke, dass die Investition in Solarenergie, neben dem privaten Nutzen, auch einen wichtigen Nutzen für die Gemeinde schafft, wie z. B. Arbeitsplätze.	

Damit sich eine Solaranlage finanziell lohnt, ist eine Förderung durch das Erneuerbare-Energien-Gesetz (EEG)...

sehr wichtig	eher wichtig	teilweise wichtig	eher nicht wichtig	gar nicht wichtig
☐	☐	☐	☐	☐

Die Unterstützung durch die Gemeinde (Bürgermeister, Gemeinderat, etc.) ist für die private Entscheidung in eine Solaranlage zu investieren...

sehr wichtig	eher wichtig	teilweise wichtig	eher nicht wichtig	gar nicht wichtig
☐	☐	☐	☐	☐

Dass Bürgerinnen und Bürger aus der Gemeinde Solaranlagen planen, und nicht jemand von außerhalb, ist...

sehr wichtig	eher wichtig	teilweise wichtig	eher nicht wichtig	gar nicht wichtig
☐	☐	☐	☐	☐

19. **Haben Sie Ihre Meinung zu Solarenergie in den letzten Jahren geändert?**

Ja   ☐   Nein   ☐

Bitte begründen Sie kurz Ihre Antwort. …………………………………………
…………………………………………………………………………………………
…………………………………………………………………………………………

20. **Haben Sie selbst eine Solaranlage auf Ihrem Haus und/oder Ihrer Scheune installiert?**

Ja, im Jahr/in den Jahren …………………………………………………

Nein ☐ → Bitte weiter mit Frage 22.

21. **Warum haben Sie sich für eine Solaranlage auf Ihrem Haus und/oder Ihrer Scheune entschieden?**

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

22. **Wir nennen Ihnen folgend einige Aussagen zur Investition in eine private Solaranlage. Bitte reflektieren Sie Ihre Entscheidung für eine Solaranlage und tragen Sie rechts eine der folgenden Ziffern ein, die für Sie zutrifft.**

stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
1	**2**	**3**	**4**	**5**

Ich sah mich in der Lage, eine kompetente Entscheidung über die Investition in eine Solaranlage treffen zu können.	
Ich war finanziell in der Lage, in eine Solaranlage zu investieren.	
Da andere Gemeindebewohner in Solaranlagen investierten, dachte ich, dass ich dies auch tun kann.	
Erfahrungen durch die Nutzung anderer erneuerbaren Energien auf meinem Hof oder in der Gemeinde, haben mir die Entscheidung erleichtert.	
Ich ging davon aus, dass die Investition in eine Solaranlage einfach sei.	
Ich erwartete eine Vereinbarkeit der Solaranlage mit meinen täglichen Gewohnheiten und Routinen.	
Ich ging davon aus, dass jeder die gleiche Möglichkeit hat, sich eine Solaranlage zu installieren.	
Da eine Renovierung des Gebäudes anstand, dachte ich, es wäre eine gute Gelegenheit eine Solaranlage zu installieren.	

23. **Wir präsentieren Ihnen nachfolgend einige Aussagen zur Bewertung der Investition in eine private Solaranlage. Sagen Sie uns bitte, inwiefern Sie diesen eher zustimmen oder eher nicht zustimmen.**

Ich bin froh über die Entscheidung, mir eine Solaranlage auf meinem Dach installiert zu haben.

stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
☐	☐	☐	☐	☐

Ich würde wieder eine Solaranlage auf meinem Dach installieren.

stimme voll zu stimme eher zu stimme teilweise zu   stimme eher nicht zu stimme gar nicht zu

☐   ☐   ☐   ☐   ☐

Ich habe <u>in der Vergangenheit</u> anderen Gemeindemitbewohnern geraten sich eine Solaranlage auf seinem Dach zu installieren.

Ja   ☐   Nein   ☐

Ich würde <u>zukünftig</u> anderen Gemeindebewohnern raten, sich eine Solaranlage auf dem Dach zu installieren.

Ja   ☐   Nein   ☐   Eventuell   ☐

→ Bitte weiter mit Frage **26**.

24. **Warum haben Sie sich (bisher) nicht für eine Solaranlage auf Ihrem Haus und/oder Ihrer Scheune entschieden?**

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

25. **Wir nennen Ihnen im Folgenden einige Aussagen zur Investition in eine private Solaranlage. Bitte reflektieren Sie Ihre Entscheidung (bisher) nicht in eine Solaranlage zu investieren und tragen Sie rechts eine der folgenden Ziffern ein, die für Sie zutrifft.**

stimme voll zu stimme eher zu stimme teilweise zu   stimme eher nicht zu stimme gar nicht zu
1   **2**   **3**   **4**   **5**

Ich sah mich nicht in der Lage, eine kompetente Entscheidung über die Investition in eine Solaranlage treffen zu können.	
Ich war finanziell nicht in der Lage, in eine Solaranlage zu investieren.	
Obwohl andere Gemeindebewohner in Solaranlagen investierten, dachte ich nicht, dass ich dies tun kann.	
Erfahrungen durch die Nutzung der erneuerbaren Energien auf meinem Hof oder in der Gemeinde, haben zu meiner Entscheidung beigetragen.	
Ich ging davon aus, dass die Investition in eine Solaranlage schwierig sei.	
Ich erwartete, dass eine Solaranlagen auf meinem Dach nicht vereinbar ist mit meinen täglichen Gewohnheiten und Routinen.	
Ich ging davon aus, dass nicht jeder die gleiche Möglichkeit hat, sich eine Solaranlage auf dem Dach zu installieren.	
Da ich zuvor erst eine Renovierung des Gebäudes vornahm, dachte ich, es wäre kein guter Zeitpunkt, um nachträglich eine Solaranlage zu installieren.	

26. **Wir nennen Ihnen nachfolgend einige Quellen über die Sie möglicherweise Informationen zu Solaranlagen erhalten haben. Sagen Sie uns bitte, inwiefern Sie folgende Informationsquellen für sich selbst als wichtig einschätzen.**

	sehr wichtig	eher wichtig	teilweise wichtig	eher nicht wichtig	gar nicht wichtig
Familie, im Haushalt lebend	☐	☐	☐	☐	☐
Familie, in Reußenköge lebend	☐	☐	☐	☐	☐
Familie, ausserhalb von Reußenköge lebend	☐	☐	☐	☐	☐
Fernsehen	☐	☐	☐	☐	☐
Internet	☐	☐	☐	☐	☐
Fachzeitschriften	☐	☐	☐	☐	☐
Energieversorger	☐	☐	☐	☐	☐
Informationsveranstaltungen in der Gemeinde	☐	☐	☐	☐	☐
Persönliche Gespräche mit Gemeindemitbewohnern	☐	☐	☐	☐	☐
Beobachtung von Entwicklungen in der Gemeinde	☐	☐	☐	☐	☐
Verein/Organisation	☐	☐	☐	☐	☐

wenn wichtig, welche(r) …………………………………………………………………………

Andere Informationsquelle(n), nämlich:

……………………………	☐	☐	☐	☐	☐
……………………………	☐	☐	☐	☐	☐

27. **Wir nennen Ihnen nachfolgend einige Aussagen speziell zum <u>Thema Windenergie</u>. Bitte lesen Sie die Aussagen sorgsam durch und tragen Sie rechts eine der folgenden Ziffern ein, die für Sie zutrifft.**

stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
1	**2**	**3**	**4**	**5**

Ich denke, dass die Nutzung von Windenergie einen Beitrag zum Klimaschutz leistet.	

Ich denke, dass die Entwicklungen der Windenergie in meinem Umfeld akzeptabel sind.	
Ich fühle mich gut, wenn ich durch die Investition in Windenergie etwas Gutes für die Umwelt tue.	
Ich denke, wir haben eine moralische Verantwortung in Windenergie zu investieren.	
Ich denke, dass jeder Mensch durch die Investition in Windenergie einen Beitrag zum Klimaschutz leisten kann.	
Wenn ich andere Gemeindebewohner sehe, wie sie in Windanlagen investieren, denke ich, dass ich das auch tun sollte.	
Ich denke, dass die Nutzung von Windenergie einen Beitrag zur Energieunabhängigkeit / Energieautarkie leistet.	
Ich denke, dass Windanlagen auf dem Land (Onshore) das Landschaftsbild zerstören.	
Ich denke, dass Windanlagen im Meer (Offshore) das Meeresbild zerstören.	
Ich denke, dass sich die Investition in eine Windanlage privat finanziell lohnt.	
Ich denke, dass die Windenergie ein wichtiges Standbein des privaten Einkommens sein kann.	
Ich denke, dass finanzielle Anreize durch das Erneuerbare-Energien-Gesetz (EEG) private Investitionen in Windanlagen fördern.	
Ich denke, dass die Investition in Windenergie, neben dem privaten Nutzen, auch einen Nutzen für die Gemeinde schafft, wie z. B. Arbeitsplätze.	

Damit sich eine Windanlage finanziell lohnt, ist eine Förderung durch das Erneuerbare-Energien-Gesetz (EEG)...

sehr wichtig	eher wichtig	teilweise wichtig	eher nicht wichtig	gar nicht wichtig
☐	☐	☐	☐	☐

Die Unterstützung durch die Gemeinde (Bürgermeister, Gemeinderat, etc.) ist für die Entscheidung in eine Windanlage zu investieren...

sehr wichtig	eher wichtig	teilweise wichtig	eher nicht wichtig	gar nicht wichtig
☐	☐	☐	☐	☐

Das Vertrauen in die beteiligten Bürgerwindparkseigner ist...

sehr wichtig	eher wichtig	teilweise wichtig	eher nicht wichtig	gar nicht wichtig
☐	☐	☐	☐	☐

28. **Haben Sie Ihre Meinung zur Windenergie in den letzten Jahren geändert?**

Ja ☐ Nein ☐

Bitte begründen Sie kurz Ihre Antwort.………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

29. **Haben Sie eine Windanlage gebaut und/oder sich an einem Bürgerwindpark beteiligt?**

Ja, Windanlage(n) im Jahr/in den Jahren ……………………………………

…………………………………………… → Bitte weiter mit Frage **30a**.

Ja, Bürgerwindpark 1 ☐   Bürgerwindpark 5 ☐

   Bürgerwindpark 2 ☐   Bürgerwindpark 6 ☐

   Bürgerwindpark 3 ☐   Bürgerwindpark 7 ☐

   Bürgerwindpark 4 ☐   weiß nicht ☐

   (Mehrere Antworten sind möglich.)   → Bitte weiter mit Frage **30b**.

Nein ☐   → Bitte weiter mit Frage **33**.

30. **Warum haben Sie sich dafür entschieden...**

a) eine Windanlage zu bauen?

………………………………………………………………………………………

………………………………………………………………………………………

b) sich an einen Bürgerwindpark zu beteiligen?

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

…….

31. **Wir nennen Ihnen nachfolgend einige Aussagen zur Beteiligung an einem Bürgerwindpark. Bitte reflektieren Sie Ihre Entscheidung für die Investition in eine Windanlage und tragen Sie rechts eine der folgenden Ziffern ein, die für Sie zutrifft.**

stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
1	2	3	4	5

Ich sah mich in der Lage eine kompetente Entscheidung über die Investion in eine Windanlage treffen zu können.	

Ich war finanziell in der Lage mich an einer Windanlage zu beteiligen.	
Da andere Gemeindebewohner in Windanlagen investierten, dachte ich, dass ich dies auch tun kann.	
Erfahrungen durch die Nutzung anderer erneuerbaren Energien auf meinem Hof oder in der Gemeinde, haben mir die Entscheidung erleichtert.	
Ich ging davon aus, dass die Beteiligung an einer Windanlage einfach sei.	
Ich erwartete eine Vereinbarkeit der Windanlagen in der Gemeinde mit meinen täglichen Gewohnheiten und Routinen.	
Ich ging davon aus, dass jeder die gleiche Möglichkeit hat, sich an einer Windanlage zu beteiligen.	

32. **Wir präsentieren Ihnen nachfolgend einige Aussagen zur Bewertung der Beteiligung an einem Bürgerwindpark. Sagen Sie uns bitte, inwiefern Sie diesen zustimmen.**

Ich bin froh über die Entscheidung, mich an einem Bürgerwindpark beteiligt zu haben.

stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
☐	☐	☐	☐	☐

Ich würde mich wieder an einem Bürgerwindpark beteiligen.

stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
☐	☐	☐	☐	☐

Ich habe <u>in der Vergangenheit</u> jemanden aus der Gemeinde geraten sich an einem Bürgerwindpark zu beteiligen.

Ja ☐   Nein ☐

Ich würde <u>zukünftig</u> anderen Gemeindebewohnern raten, sich an einem Bürgerwindpark zu beteiligen.

Ja ☐   Nein ☐   Eventuell ☐

→ Bitte weiter mit Frage **35**.

33. **Warum haben Sie sich (bisher) nicht an einem Bürgerwindpark beteiligt?**

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

34. **Wir nennen Ihnen nachfolgend einige Aussagen zur Beteiligung an einem Bürgerwindpark. Bitte reflektieren Sie Ihre Entscheidung (noch) nicht in eine Windanlage investiert zu haben und tragen Sie rechts eine der folgenden Ziffern ein, die für Sie zutrifft.**

stimme voll zu	stimme eher zu	stimme teilweise zu	stimme eher nicht zu	stimme gar nicht zu
1	**2**	**3**	**4**	**5**

Aussage	
Ich sah mich nicht in der Lage, eine kompetente Entscheidung über die Investion in eine Windanlage treffen zu können.	
Ich war finanziell nicht in der Lage, mich an einer Windanlage zu beteiligen.	
Obwohl andere Gemeindebewohner in Windanlagen investierten, dachte ich nicht, dass ich dies tun kann.	
Erfahrungen durch die Nutzung anderer erneuerbaren Energien auf meinem Hof oder in der Gemeinde, haben mir die Entscheidung erleichtert.	
Ich ging davon aus, dass die Beteidigung an einer Windanlage schwierig sei.	
Ich erwartete, dass die Windanlagen in der Gemeinde nicht vereinbar wären mit meinen täglichen Gewohnheiten und Routinen.	
Ich ging davon aus, dass nicht jeder die gleiche Möglichkeit hatte, sich an einer Windanlage zu beteiligen.	

35. **Haben Sie Ihr Land für einen Bürgerwindpark zur Verfügung gestellt?**

Ja für, Bürgerwindpark 1 ☐   Bürgerwindpark 5   ☐

Bürgerwindpark 2 ☐   Bürgerwindpark 6   ☐

Bürgerwindpark 3 ☐   Bürgerwindpark 7   ☐

Bürgerwindpark 4 ☐   weiß nicht   ☐

Ja, für andere Windanlage(n) im Jahr

……………………………………………

Nein   ☐

36. **Wir nennen Ihnen nachfolgend einige Quellen über die Sie möglicherweise Informationen zu Windanlagen erhalten haben. Sagen Sie uns bitte, inwiefern Sie folgende Informationsquellen für sich selbst als wichtig einschätzen.**

	sehr wichtig	eher wichtig	teilweise wichtig	eher nicht wichtig	gar nicht wichtig
Familie, im Haushalt lebend	☐	☐	☐	☐	☐
Familie, in Reußenköge lebend	☐	☐	☐	☐	☐
Familie, ausserhalb von Reußenköge lebend	☐	☐	☐	☐	☐
Fernsehen	☐	☐	☐	☐	☐
Internet	☐	☐	☐	☐	☐
Fachzeitschriften	☐	☐	☐	☐	☐
Energieversorger	☐	☐	☐	☐	☐
Informationsveranstaltungen in der Gemeinde	☐	☐	☐	☐	☐
Persönliche Gespräche mit Gemeindemitbewohnern	☐	☐	☐	☐	☐
Beobachtung von Entwicklungen in der Gemeinde	☐	☐	☐	☐	☐
Verein/Organisation	☐	☐	☐	☐	☐

wenn wichtig, welche(r) ………………………………………………………………………

Andere Informationsquelle(n), nämlich:

	sehr wichtig	eher wichtig	teilweise wichtig	eher nicht wichtig	gar nicht wichtig
……………………………	☐	☐	☐	☐	☐
……………………………	☐	☐	☐	☐	☐

37. **Haben Sie <u>weitere Investitionen</u> in erneuerbare Energien getätigt?**

Nein   ☐

Ja, in eine **Biogasanlage** im Jahr …………………

Begründen Sie bitte kurz warum.………………………………………………………

…………………………………………………………………………………………

Ja, in **Geothermie** im Jahr …………………

Begründen Sie bitte kurz warum. …………………………………………………...

………………………………………………………………………………………….

………………………………………………………………………………………..

Ja, in …………………………… im Jahr …………………

Begründen Sie bitte kurz warum. …………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

38. **Sofern Sie in verschiedene erneuerbare Energien Technologien investiert haben, sagen Sie uns bitte, ob sich Ihre Investitionen in erneuerbaren Energien gegenseitig beeinflusst haben?**

Ja   ☐   Nein   ☐

Bitte begründen Sie kurz Ihre Antwort. …………………………………………

…………………………………………………………………………………….

…………………………………………………………………………………….

…………………………………………………………………………………….

39. **Inwiefern haben die erneuerbaren Energien das soziale Zusammenleben in der Gemeinde verändert?**

sehr stark ☐   eher stark ☐   teils/teils ☐   eher wenig ☐   gar

nicht ☐

Bitte begründen Sie kurz Ihre Antwort. …………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

Abschließend haben wir noch ein paar Fragen zu Ihrer Person und zu Ihrem Haushalt.
Diese Angaben dienen ausschließlich dazu, die Befragten in statistische Gruppen Einteilen zu können, was unsere Analysearbeit hilft. Daher bitten wir Sie, auch diese Fragen möglichst vollständig zu beantworten.

In welchem Jahr sind Sie geboren? …………………

Sie sind....

weiblich ☐

männlich ☐

Sind Sie Mitglied in einem Verein oder einer Organisation?

Ja, bei(m) Verein(en) / Organisation(en) …………………………………...

………………………………………………………………………………

Nein ☐

Ist Ihr Wohnort in Reußenköge Ihr Erstwohnsitz oder Ihr Zweitwohnsitz?

Erstwohnsitz ☐

Zweitwohnsitz/Nebenwohnsitz ☐

Die Wohnung/das Haus, in der/in dem Sie in Reußenköge leben, ist:

Mein Eigentum/Teileigentum/Familieneigentum ☐

Gemietet ☐

Anderes, nämlich …………………………………

Besitzen Sie (weiteres) Eigentum in Reußenköge? (Mehrere Antworten sind möglich.)

Ja, Wohnung/Wohnungen bzw. Haus/Häuser,

in denen ich aber nicht lebe ☐

Ja, landwirtschaftliche Flächen bzw. Gärten ☐

Ja, anderes, nämlich……………………………

Nein ☐

Wie viele Personen, Sie eingeschlossen, leben in Ihrem Haushalt?

……… Person(en)

Haben Sie Kinder und leben diese in Ihrem Haushalt?

Keine Kinder ☐

………… (Anzahl) Kind/Kinder

Ja, leben noch im Haushalt ☐

Nein, leben nicht mehr im Haushalt ☐

Wie hoch schätzen Sie das Nettoeinkommen ein, das Ihr Haushalt monatlich zur Verfügung hat? Denken Sie dabei an das Nettoeinkommen aller Haushaltsmitglieder, Kindergeld, Renten, Arbeitslosengeld, etc.

unter 899 €	☐	2.000 – 2.599 €	☐
900 – 1.299 €	☐	2.600 – 3.199 €	☐
1.300 – 1.699 €	☐	3.200 – 3.999 €	☐
1.700 – 1.999 €	☐	4.000 € und mehr	☐

Was ist Ihr höchster schulischer Ausbildungsabschluss?

Volksschul-/Hauptschulabschluss ☐

Realschulabschluss/Mittlere Reife ☐

Hoch-/Fachhochschulreife (Abitur/Fachabitur) ☐

Noch in der schulischen Ausbildung ☐

Ohne Abschluss/vor der 8. Klasse abgegangen ☐

In welchem Beruf sind Sie tätig bzw. waren Sie zuletzt tätig?

………………………………………………………………………………………………

Vielen Dank für Ihre Teilnahme an der Befragung.
Sie haben uns mit Ihren Antworten sehr geholfen.

Abschließend noch zwei kurze Fragen:

Haben Sie Interesse von den Ergebnissen dieser Befragung zu erfahren, zum Beispiel durch
die Vorstellung der Forschungsergebnisse auf einer Bürgerversammlung?

Ja ☐

Nein ☐

Haben wir in unserem Fragebogen noch etwas Wichtiges vergessen?
Oder ist Ihrer Meinung nach irgendetwas zu kurz gekommen?
Ihre Anmerkungen können Sie uns hier gern mitteilen.

………
………
………
………
………

Related publications

Elements from this manuscript are about to appear in the following publications:

Süsser, D., M. Döring, B. M.W. Ratter (under review). Harvesting energy: Place and local entrepreneurship in community-based renewable energy transition, *Energy Policy.*

Süsser, D. (under review). Coastal dwellers-power against climate change: A place-based perspective on individual and collective engagement in North Frisia. *Journal of Coastal Conservation.*

Süsser, D., A. Kannen (submitted). 'Renewables? Yes, please!' – Perceptions and assessment of community transition induced by renewable energy projects in North Frisia, *Journal of Environmental Science and Policy.*

de Guttry, C., **D. Süsser**, M. Döring (under review). Untying the climate knot: An analysis of psychological distances and proximities permeating climate change meanings in North Frisia. *Global Environmental Change*.

The model is available on the Modelling Commons website:
http://www.modelingcommons.org/browse/one_model/4765

Sunset in the Desmerciereskoog, Reußenköge (*Sonnenuntergang im Desmerciereskoog*)
Painting by the regional artist Gesche Nordmann, 2010[2]