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Factors influencing citizens' acceptance of wind energy in Germany

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Abstract

With wind energy expanding rapidly in Germany and abroad and with an increasing number of communities confronted with wind power developments nearby, there is an urgent need to empirically investigate citizens' concerns about wind energy. These concerns can be affected by various factors, which may be placed in the following categories: personal characteristics, perceived side effects, technical and geographical issues, and process-related variables. The impacts of these factors on the three different groups with varying levels of acceptance of wind energy, namely "active non-acceptance", "ambivalence" or "active acceptance" had not previously been investigated thoroughly. Data was collected for the present study through two focus groups, nine expert interviews and an online survey involving 1,363 citizens in Germany. The conclusions of the study are drawn from a content analysis, choice-based multivariate analysis and multinomial logistic regression analysis. These analyses are very consistent in showing that participation in the form of information gathering impacts positively on the acceptance of wind energy. In addition, the results show that this information form of participation is more important to citizens than financial participation in wind energy projects. The sound level at the place of residence impacts upon citizens' acceptance of the turbines. The findings regarding the perception of infrasound generated by wind turbines were consistent in all of the analyses. Specifically, infrasound negatively influences citizens' acceptance. This thesis contributes to the understanding of citizens' acceptance of wind energy and thus supports the transition towards renewable energies. The findings are relevant for academia, wind energy developers and policy-makers alike, and they highlight the need for further understanding of the interplay between the motives, beliefs and preferences of citizens on the acceptance of wind energy.

Zusammenfassung

Mit dem zunehmenden Ausbau der Windenergie im In- und Ausland steigt die Zahl der Gemeinden, in deren unmittelbarer Nähe neue Windkraftanlagen entstehen. Damit betroffene Bürgerinnen und Bürger geplante Windprojekte nicht ablehnen, ist es notwendig, die Einflussfaktoren für deren Akzeptanz empirisch zu erforschen. Ablehnung von Windenergie kann durch verschiedene Faktoren verursacht werden, die sich in vier Kategorien einordnen lassen: persönliche Eigenschaften, technische und geografische Belange, wahrgenommene Nebenwirkungen, prozessbezogene Variablen. Die Auswirkungen dieser Faktoren auf die Akzeptanz von Windenergieanlagen, die sich grob in die Kategorien aktive Nichtakzeptanz, Ambivalenz und aktive Akzeptanz einordnen lassen, wurden bisher nicht ausreichend untersucht. Im Rahmen der vorliegenden Dissertation wurden Daten aus zwei Fokusgruppen, neun Experteninterviews und einer online-Umfrage mit 1.363 Teilnehmern in Deutschland gesammelt. Die Daten der Studie wurden mittels einer qualitativen Inhaltsanalyse, dem hierarchischen Bayes-Schätzalgorithmus und einer multinomialen logistischen Regressionsanalyse ausgewertet. Die verschiedenen Analysen zeigen einheitlich den positiven Zusammenhang zwischen einem höheren Partizipationslevel und Akzeptanz. Darüber hinaus wird deutlich, dass Informationen für die Bürger wichtiger sind als die Möglichkeit zu einer finanziellen Beteiligung. Der wahrgenommene Schallpegel am Wohnort wirkt sich stark auf die Akzeptanz der Bürger aus. Die Erkenntnisse in Bezug auf die Wahrnehmung von Infraschall einer Windkraftanlage sind innerhalb der verschiedenen Analysen konsistent. Die zumeist negative Wahrnehmung von Infraschall, die von Windenergieanlagen ausgeht, hat einen negativen Einfluss auf die Akzeptanz bei Windenergie. Die Ergebnisse dieser Dissertation tragen zum Verständnis der Akzeptanz von Bürgern in Bezug auf die Windenergie bei und unterstützen damit den Übergang zu erneuerbaren Energien. Die Erkenntnisse sind für akademische Zwecke, Windenergie-Projektierer sowie im politischen Bereich gleichermaßen relevant. Zusätzlich zeigen sie die Notwendigkeit, das Zusammenspiel von Motiven, Überzeugungen und Präferenzen der Bürger in Bezug auf die Akzeptanz von Windenergie besser zu verstehen.

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List of abbreviations

ACBC	Adaptive choice based conjoint
BauGB	Baugesetzbuch (Town and County Planning Code)
BImSchG	Bundesimmissionsschutzgesetz (Federal Immission Control Act)
EEG	Erneuerbare Energien Gesetz (German Renewable Energy Act)
FFH	Flora-Fauna-Habitat
kWh	kilowatt hour
MW	Megawatt
MaxQDA	Max Qualitative Data Analysis
NIMBY	Not in my backyard
TAM	Technology Acceptance Model

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1 Introduction

1.1 Background

The expansion of renewable energies is a key issue worldwide in the transition towards greater environmental sustainability and lowering the carbon footprint (Agnew and Dargusch 2015; de Sisternes et al. 2016; Intergovernmental Panel on Climate Change 2014). Germany, the European Union and many other countries have set targets for the expansion of renewable energies with differing levels of ambition (IEA 2016; Yildiz et al. 2015; Araújo 2014). Depending on the energy policy context and natural conditions, countries have set different priorities for the expansion of renewable energies. Renewable energies enjoy very strong support in European countries (Agentur für Erneuerbare Energien 2016), which is based on the positive environmental impacts and the perceived future viability of renewable energy by citizens. In a cross-national European comparison, Germany was recorded as having the highest level of acceptance, with about 93% of citizens approving the further expansion of renewable energies (Agentur für Erneuerbare Energien 2016).

Germany has set ambitious renewable energy targets for 2035 and has been witnessing a rapid development in the renewable energies sector over the past years, mainly due to political support in the form of a feed-in tariff. In Germany, electricity produced from renewable energy sources amounted to 31.6 percent of the gross electricity consumption in 2015 (Federal Ministry for Economic Affairs and Energy 2016b). Of this, wind energy accounted for the largest share of the renewable energy sources. Electricity supplied from German wind farms almost doubled from 48.3 billion kWh in 2011 to 79.8 billion kWh by 2016. Currently, 28,217 wind turbines provide 12.3 percent of Germany's gross electricity production (Strom-Report 2017). The further expansion of wind energy is expected, with an additional 2,800 MW of new wind generation per annum by 2017 being planned in order to meet the target set by the German government of 55 to 60 percent renewable electricity by 2035 (Federal Ministry for Economic Affairs and Energy 2016b). Figure 1 shows the regional distribution of wind energy in Megawatts (MW) per federal state. The northern part of Germany has much more wind energy than the southern part, which can be explained by the higher wind velocities in northern Germany.

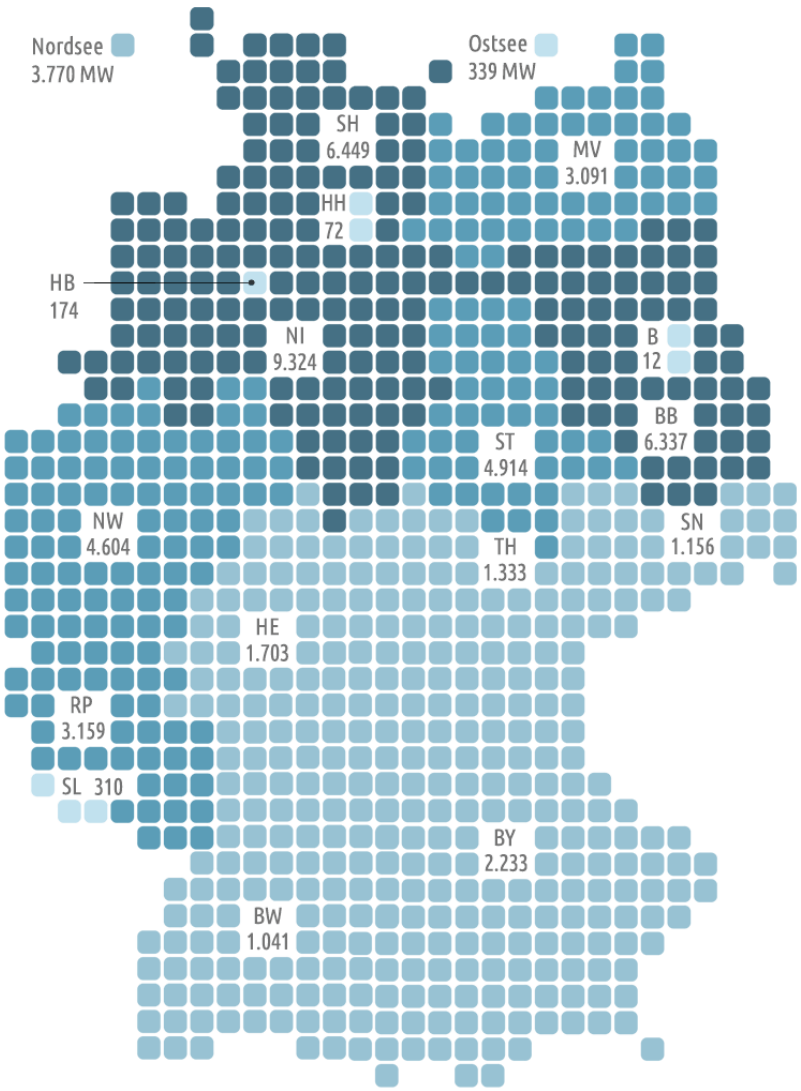

Figure 1: Regional distribution of wind energy in Germany per federal state in MW

Source: Strom-Report 2016

Acceptance of renewable energies is generally regarded as an important prerequisite for the further expansion of wind energy. Although there is widespread public support for wind energy, individual wind farm projects have faced significant resistance from locals (Wüstenhagen et al. 2007). Perceived negative impacts of wind farms include, amongst others, noise pollution (Jensen et al. 2014), visual appearance and landscape intrusion (Ladenburg 2014; Firestone et al. 2012), wind shadow (Pohl et al. 2000), navigation lights (Hübner and Löffler 2013) and fear of decline in residential property values (Jensen et al. 2014). Some of these perceived negative impacts might be related to the distance of wind turbines from the place of residence. Previous studies have argued that the Not-in-my-backyard (NIMBY) syndrome is one of the factors with the most impact on opinions towards wind energy (Devine-Wright 2007; Geissmann and Hubert 2011). However, more recent

studies indicate the NIMBY syndrome is too simplistic (Brennan and Van Rensburg 2016) or cannot even be found to exist in some cases (Salm et al. 2016). Other studies suggest that acceptance of wind energy is affected by citizen involvement in wind energy projects in the form of deliberative planning approaches (Wolsink 2007), early and increased community consultation (Ek and Persson 2014), and by providing employment opportunities and local ownership (Maruyama et al. 2007; Álvarez-Farizo and Hanley 2002). Further studies have focused on citizens' acceptance of wind energy with respect to energy security (Eltham et al. 2008), the level of experience with wind farms (Eltham et al. 2008; Kaldellis et al. 2013), physical externalities such as turbine height (Dimitropoulos and Kontoleon 2009), and demographic factors such as income (Ladenburg and Dubgaard 2007) or gender (Ek and Persson 2014). Process-related variables can also affect acceptance of wind energy. However, the nature of wind farm developments is often unclear to local communities (Cowell et al. 2011), as wind energy development is a highly speculative and competitive sector. The planning and construction of a wind farm takes a long time and is subject to changing legal and policy conditions (Bell et al. 2013).

1.2 Research framework

Energy development has to be considered in the context of the policy and regulatory framework which guides the expansion of renewable energy technologies. Generally, the introduction of subsidies and taxes can help to stimulate the development of renewable energy technologies. The German Renewable Energy Act (EEG) surcharge is used to support renewable energy technologies (Agora Energiewende 2015). It covers the difference between the cost of generating one unit of renewable electricity (in form of the feed-in-tariff paid to the generators) and the revenues from selling that unit on the wholesale market. Energy-intensive industrial sectors enjoy an exemption on taxes and levies in order to preserve the competitiveness of those industries in international markets (Agora Energiewende 2015). The EEG surcharge is predicted to increase up until the early 2020s to 7.7 cents per kilowatt hour (Agora Energiewende 2016). Due to falling feed-in tariffs and the termination of the funding period for old plants, the EEG surcharge will decrease in the long run and projections suggest that it will settle around 4.5 cents per kilowatt hour by 2035 (Agora Energiewende 2015, 2016).

The regulatory framework for renewable energy technologies has changed several times over the years. These changes were intended to foster innovation, speed up technological expansion and support market integration of renewable energy sources. A fixed feed-in tariff was introduced through EEG 2000 and a modified market-premium was introduced by the EEG 2012. The latest financing system established by the EEG 2017 consists of auctions for renewable energy technologies (Agora Energiewende 2016). The pre-existing policy incentives facilitated both the fast expansion of renewable energy and raised the total

annual remuneration costs for renewable energy (Agora Energiewende 2016). The auction system was introduced to counteract this effect and to control the added capacity of wind energy in the coming years. This system restricts and coordinates the yearly added capacity of wind energy turbines. For onshore wind power, the EEG 2017 stipulates an increase by 2,800 megawatts per year starting in 2017 (Agora Energiewende 2016). It is predicted that the auction system will reduce the costs of electricity from renewable energies (Agora Energiewende 2017). The auction system is based on the pay-as-bid principle, meaning that the bidder with the lowest bid wins the auction and receives the submitted bid as a subsidy for the electricity produced (Agora Energiewende 2016). The introduction of the auction system presents potential risks and structural disadvantages, particularly for energy cooperatives rather than for institutional investors. These challenges include the lower predictability of the future earnings from wind energy projects, long waiting times during the planning phase with substantial costs, and in the case of energy cooperatives, there are no possibilities to lower the risk through diversification (Bundesverband WindEnergie e.V. 2015; Leuphana Universität and Nestle 2014). These challenges for energy cooperatives may result in less involvement by citizens in wind energy development, which could also simultaneously have consequences for the acceptance of this technology (Leuphana Universität and Nestle 2014).

To foster the ambitious renewable energy targets, an amendment has been made to the 1997 Town and County Planning Code (BauGB) (ARL 2013). §35 (3) BauGB provides that wind turbines are permissible in the undeveloped outskirt areas of settlements. Planning approval is mandatory for the installation of wind turbines higher than 50 meters (Ministerium für Wirtschaft, Klimaschutz, Energie und Landesplanung 2013; Agatz 2014). The development of a wind farm includes both site assessment and the acquisition of the land. The site assessment includes consideration of whether a wind energy installation can be approved according to the relevant land use or development plans and issues concerning nature conservation are also reviewed (NABU and BUND 2014). This process is followed by the development approval process under the Federal Immission Control Act (BImSchG) (Hessisches Ministerium für Umwelt, Klimaschutz, Landwirtschaft und Verbraucherschutz 2014; Agatz 2014). The BImSchG has both a simplified and a formal approval procedure. The formal approval procedure differs from the simplified approval procedure, particularly in terms of public participation, which is obligatory under the formal approval procedure (Ministerium für Wirtschaft, Klimaschutz, Energie und Landesplanung 2013). Studies (Brennan and Van Rensburg 2016; Hammami et al. 2016; Howard 2015) discuss the positive influence of including the public in decision-making processes about wind energy projects. The integration of participation models into wind energy projects can increase trust between citizens and wind energy developers and potentially prevent conflicts. The procedure to be

followed when approving wind turbines depends on the number of installations to be approved and whether an environmental impact assessment must be carried out. For more than 20 wind turbines, it is obligatory to carry out an environmental impact assessment. In the case of 6 to 19 wind turbines, a preliminary assessment of the individual case has to be carried out. In the case of 3 to 5 turbines, a site-specific preliminary assessment of the individual case is conducted (Ministerium für Wirtschaft, Klimaschutz, Energie und Landesplanung 2013; Energieagentur NRW 2016; Agatz 2014). If the preliminary examination or the site-specific preliminary assessment leads to the conclusion that substantial adverse effects could arise from the turbines, an environmental impact assessment must also be carried out, meaning that the formal approval procedure must be followed and public participation is obligatory. In the formal approval procedure, the proposed development will be publicly announced and the development application documents are displayed publicly for one month (Ministerium für Wirtschaft, Klimaschutz, Energie und Landesplanung 2013; Energieagentur NRW 2016; Agatz 2014; Fachagentur Windenergie an Land 2017). Any suggestions and concerns of the public can be discussed at a discussion meeting. Subsequently, the approval authority decides to approve or reject the project.

Public participation in wind energy projects can take other even more intensive forms, e.g. financial participation. A number of studies (Walker et al. 2014; Zoellner et al. 2008; Dimitropoulos and Kontoleon 2009; Musall and Kuik 2011) have shown a positive relationship between financial participation in wind energy projects and their acceptance by citizens. According to Walter (2014), communal funds result in higher acceptance of wind energy compared to individual financial participation. This implies that equality, meaning that all persons involved get an equal share of the outcome, is more important to citizens than individual financial participation. The different forms of participation in wind energy projects can influence the acceptance of citizens in this technology.

1.3 Research aim

This thesis aims to explore the acceptance of wind energy by citizens in Germany, and in particular, their preferences towards the participation design. Understanding how acceptance is formed is necessary for designing ways to implement wind farm projects which enjoy a high level of acceptance. Therefore, analysing the preferences of citizens is not only relevant for consumer research, but also for the realisation of these projects.

The present thesis addresses these issues by investigating the following research questions:

I. Which factors have an influence on the acceptance of wind energy?
II. Which factors in the four identified categories (personal characteristics, perceived side effects, technical and geographical issues and process-related variables) have a

significant impact on the different acceptance groups (active non-acceptance, ambivalence and active acceptance groups)?

III. Which kind of participation do citizens prefer with respect to wind energy projects?

The scientific literature provides a basis for understanding potential acceptance drivers and resistance patterns with respect to wind energy. However, these approaches fail to provide ideas about how to put the results of acceptance research into practice. Also, a conceptual analysis of the factors which help to reduce conflicts in wind energy planning are still missing. Furthermore, relatively little research has specifically focused on the role of participation opportunities and acceptance. This thesis focuses on the yet relatively unexplored interplay of these factors. The study approach allows conclusions to be made about factors that are related to the acceptance of wind energy. Such knowledge should be useful, especially for policy-makers at different levels, for facilitating effective expansion of wind energy in future. This thesis also contributes to a better understanding of the energy transition in Germany, with a special focus on wind energy. A high level of acceptance of wind energy by society accelerates the development of wind farms, which could help to accomplish the German renewable energy targets. The results of this thesis might assist policy makers and persons in charge to implement a wind farm with a high acceptance level from the citizens' point of view.

This thesis only considers the electricity sector when analysing citizens' preferences for participation in wind energy projects and acceptance of wind energy. The analysis centres on individual citizens in Germany, which makes an interesting subject of study as the energy transformation in this country could be regarded as pioneering the way on how to adapt and transform highly industrialised nations towards a more sustainable energy system.

The papers of this thesis are focused on acceptance levels. The level of acceptance depends on influencing factors, which are analysed first in a general way (paper I), then specifically with respect to participation mode (paper II), and third on the separation of the factors according to the different acceptance groups, i.e. active non-acceptance, ambivalence and active acceptance (paper III).

First, the thesis aims to give insights on how citizens' acceptance of wind energy is impacted by a variety of factors. A holistic understanding of these factors is still lacking. The analysis provides insights on technical process-related and personal factors, as well as perceived side-effects, and how these factors should be addressed in order to have a high acceptance level. It is meaningful to study the factors likely to foster acceptance or lead to non-acceptance of wind energy projects, if wind energy developments are to continue or even increase. By identifying the factors affecting acceptance of wind energy, this thesis aims to advance understanding and implementation of these factors.

Second, as previous studies (Walker et al. 2014; Dimitropoulos and Kontoleon 2009; Musall and Kuik 2011) have shown, the involvement of citizens in wind energy projects plays a crucial role. To the knowledge of the author, the study of different participation modes in the context of wind energy projects is a novel exercise. A special focus of this thesis is, therefore, whether different types of participation influence the level of acceptance of wind energy by citizens. The research presented here seeks to better understand the role of participation in changing these acceptance levels. Based on the theoretical foundations of participation theory, the relationship between five different participation levels and acceptance is tested. By generating information about the relationship between acceptance and participation modes, the government and/or wind project developers can adopt planning approaches that counteract potential resistance in the community to wind energy projects.

Third, the combination and interplay of various factors influencing the acceptance of wind energy are examined. Past research has analysed various factors that influence the acceptance of wind energy. However, a conceptual analysis of factors on different acceptance levels is still unexplored and there is a lack of knowledge about these relationships. Therefore, this thesis investigates how the analysed factors and different levels of these factors influence the degree of citizen acceptance. The aim is to predict the probability of factors affecting the citizen's acceptance level. Furthermore, the analysis enables evaluation of a number of potential independent variables by ascertaining which of the independent variables explain a significant amount of the variance in the dependent variable. This provides understanding of citizens and their preferences in a changing energy system and can be used to support the development of wind energy farms.

1.4 Structure of the thesis

The structure of this thesis is as follows: Chapter 2 discusses the key terms and theoretical concepts, followed by the methods in chapter 3. Chapter 4 consists of a summary of the theoretical considerations and a summary of the three publications. Paper I analyses the main influencing factors with respect to wind energy acceptance in Bavaria through a qualitative study. Paper II focuses on participation and its impact on citizen preferences towards wind energy projects using an adaptive choice-based conjoint analysis. Paper III studies the impact of the influencing factors in the categories "process-related variables", "personal characteristics", "perceived side effects" and "technical and geographical issues" on the active acceptance, ambivalence and active non-acceptance groups by applying a multinomial regression analysis. Chapter 5 discusses the key findings. Finally, chapter 6 concludes with the implications of this thesis and an outlook for future research.

2 Theoretical framework

This chapter outlines the theoretical basis of the thesis. Section 2.1 presents an overview about acceptance theory, including a general description of acceptance theories and a focus on acceptance research in the field of energy technologies. Section 2.2 provides an overview of participation theory.

2.1 Acceptance theory

Acceptance research combines a variety of approaches and a variety of different acceptance objects in different fields such as, e.g. technology, political decisions, protected areas or energy systems. The approaches differ in many aspects. For this thesis, focus has been placed on four general theories of acceptance and three specific theories relating to renewable energies in order to demonstrate the diversity of the concept of acceptance in the various disciplines. The additional models, which have been illustrated in this thesis, provide an overview of the different approaches and points of views within acceptance research. However, the theories presented in this thesis are not complete. Only scientific research on selected approaches, theories or models that have influenced the development of acceptance research has been included. The selected studies have been addressed chronologically so that their respective effects on the scientific community and developments in acceptance research in the field of renewable energies can be illustrated. In addition, emphasis is placed on models explaining the impact of knowledge because of the relevance to the results of this thesis.

2.1.1 General overview

Lucke (1995) discusses the concept of acceptance from a social point of view in a fundamental and comprehensive way. As she provides a good overview about the complexity of the concept, her work will be briefly explained here. In addition, her work forms the basis of the theory subsequently developed by Hofinger. Lucke describes acceptance as a mixture of the two verbs to adopt and to adapt. Subjects adopt and adapt something into existing systems with as minor changes as possible. In this sense, “to accept” something includes active change of both the thing that is adopted as well as the adaptive structures. Lucke (1995) characterizes the concept of acceptance using the following ten points:

1. Acceptance involves an object, subject and context (see Figure 2). The acceptance framework is designed as a triangle, where there is a relationship between all three components. The acceptance context is influenced by both the acceptance object and the acceptance subject.

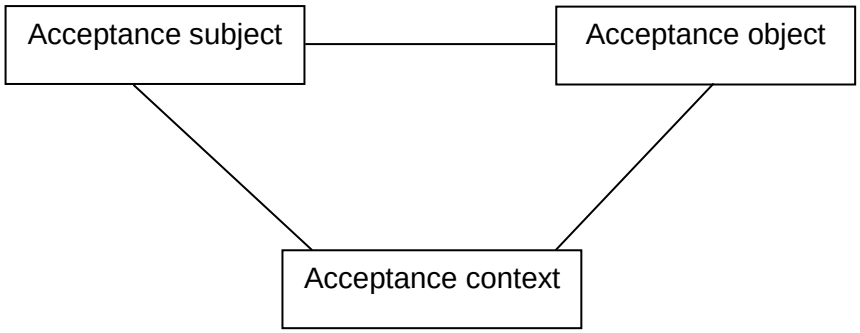

Figure 2: “Acceptance” in relation to acceptance subject, acceptance object and acceptance context

Source: Own elaboration based on Lucke (1995)

2. Acceptance does not describe a property but the result of a reciprocal process. Acceptance is the result of previous social definitions and interpretations as well as the results of proposals.
3. Acceptance is a counterpart to indignation and the subjective reverse of legitimation.
4. Acceptance is a value-conservative term.
5. There is no surface phenomenon behind the term acceptance.
6. Acceptance relates not only to passive characteristics but also includes active components.
7. Acceptance is the result of an act of rational insight and inner conviction.
8. Acceptance is not only a term for a mental phenomenon or the expression of the will of self-sufficient individuals.
9. Acceptance does not imply a norm but contains normative elements.
10. Acceptance is a term for a highly differential and multivariate phenomenon.

According to Lucke (1995), this characterization describes the concept of acceptance in a general and basic way. Furthermore, she developed twelve different acceptance types in order to classify and analyse various acceptance phenomena. These twelve acceptance types are:

1. The enlightened, authentic acceptance of the informed agreement (“informed consent”).
2. The committed-critical or sympathetic (non-) acceptance without actual self-concern as the "demonstrative ignoramus" of consciously denied or granted consent.
3. The routine acceptance and formalized consent (“sans acception de personne”).
4. The conditional acceptance situated between “private acceptance” and “public compliance”.

5. The intellectual rational acceptance without a content-normative clarification or active engagement.
6. The situational acceptance without insight, previous clarification and subsequent agreement.
7. The alibi acceptance without intention to perform real acceptance.
8. The derived acceptance without its own authority or other legitimation.
9. The purely reactive acceptance of the approval and confirmation.
10. Acceptance in absence of knowledge.
11. Acceptance due to embarrassment because of assumed or actual lack of alternatives.
12. Acceptance ("forced compliance") which is carried out against will and against better knowledge.

Lucke (1995) notes, however, that these twelve acceptance types are subject to an empirical examination in terms of appropriateness, usability, applicability, etc. in order to be further developed or modified on the basis of specific examples. Hofinger (2001a) attempts to do this by analysing the term acceptance in the context of a biosphere reserve. The biosphere reserve "Schorfheide-Chorin" serves as the acceptance object and the residents as the acceptance subjects. In her research, acceptance involves a combination of the three components of thinking (assessments or cognitive components), feeling (emotional relation or affective component) and acting (action tendency or conative component). According to Hofinger (2001a, 2001b), people have opinions about things but these opinions do not float freely in space. They are linked to thinking, feeling and acting. This definition shows that acceptance is expressed through the combination of three components based on the "three-component theory of attitudes" (Foscht et al. 2015) which is presented in Figure 3 and involves the following three components:

1. Affective component: emotional and motivational elements
2. Cognitive component: individual knowledge and experience
3. Conative (intentional) component: behavioural tendency of the individual

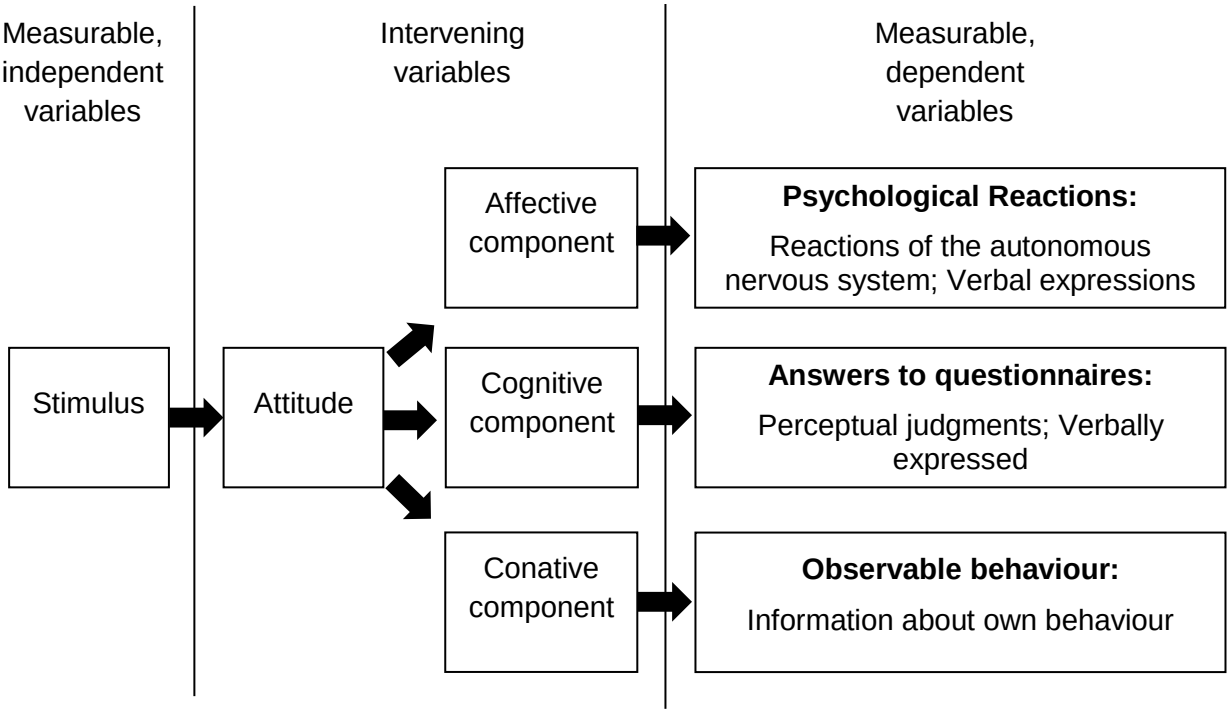

Figure 3: Three-component theory of attitudes

Source: Own elaboration based on Foscht et al. (2015)

Based on the three-component theory of the attitudes and the results of the interviews carried out by Hofinger, she developed seven acceptance levels (from acceptance to non-acceptance), which are shown in Table 1. With the formation of these acceptance levels, Hofinger achieves what Lucke (1995) demands for her twelve formulated acceptance types with respect to feasibility and usability. The seven acceptance levels described by Hofinger (2001a) are shown in Table 1.

Table 1: Acceptance levels based on Hofinger

	Affective component	Cognitive component	Conative component
Active opponents	Strongly negative	Strongly disapproving Own objectives contradict the objectives of the Biosphere Reserve	High Active doing, opinion maker
Rejection	Slightly negative No emotion recognizable	Strongly disapproving Own objectives are contrary to the aims of the biosphere reserve but not currently threatened	Low to medium Express opinions but do not become active themselves
Undecided	Slightly negative Skeptical, waiting,	Slightly rejecting No benefit to self but also	Currently low

	possibly slightly annoyed or slightly positive	little threat to own goals or alternatively slightly advocating Current low-level use of the biosphere reserve	
Indifferent	Low Indifferent, distant	No interest Own goals relating to the biosphere reserve not affected; Mostly little knowledge, no contact; no definite opinion (possibly socially desirable consent)	None
Tolerant	Changing, possibly quite strong Anger, disappointment vs. expectations, hope	Conflictual Own important goals are hindered and others are encouraged by biosphere reserve; Intensive debate, usually well informed	Currently low as "paralyzed" but latently high, if one of the goals becomes more important
Approval	Positive but not necessarily strong	Positive evaluation Biosphere reserve useful for important own goals or region	Low to medium Information search, participation in events
Enthusiastically engaged	Strongly positive	Strongly positive Own goals supported by the biosphere reserve, biosphere reserve required for region; Participation in the biosphere reserve is the goal	Medium to high Participation in actions

Source: Own elaboration based on Hofinger (2001a)

Hofinger (2001a, 2001b) notes that the "undecided" and "approval" forms of acceptance do not differ a lot in terms of the level of action. However, it is essential to understand the differences between them in order to predict community positions. Both levels have the potential to change the acceptance level. However, the “undecided” level is based on rather negatively-coloured conclusions, while the “approval" level, on the other hand, is based on a rather positive conclusion. Therefore, the "undecided" acceptance level is much more vulnerable to change to another level than the approval level.

In 2005, the Federal Agency for Nature Conservation published a report on improving the acceptance of flora-fauna-habitat (FFH) areas. In this study, Sauer et al. (2005) also assume that acceptance is the result of interactions between the subject of acceptance (the person who can accept something) and the object of acceptance (the object which can be accepted

or rejected). The subject and object of acceptance are both determined in an acceptance context, which encompasses the social framework in which the acceptance system moves. Based on Hofinger's assumption, Sauer et al. (2005) notes that the acceptance process is made up of several steps. First, the acceptance object (for instance a wind turbine) must be consciously perceived (cognitive level). Second, the acceptance subject (for instance a neighbour living close by) has to evaluate the object positively or negatively (affective level). After these two steps, the acceptance subject decides to or not to actively take part for the acceptance object (conative level). This acceptance process displays the instability of the concept of acceptance. The development of several levels results in a long acceptance process which is prone to changes. Acceptance levels can easily change through changes to the affective component assessment, different framework conditions, or modified definitions of the acceptance object (Sauer et al. 2005). For their analysis, Sauer et al. (2005) used the seven acceptance levels proposed by Hofinger but expanded them by one additional level called "conditional acceptance". According to Sauer et al. (2005), "conditional acceptance" is a low level of acceptance based on rational considerations and linked to conditions such as compensatory payments. However, "conditional acceptance" is unstable because it is dependent upon financial advantages, which must be permanently maintained, and not the intrinsic convictions of a person. In other words, financial incentives do not generate genuine acceptance but rather an unstable acceptance dependent upon certain conditions.

2.1.2 Acceptance theory in the field of renewable energy

With the development and spread of renewable energies, acceptance research in this field has also started to expand, largely due to the number of protests which have occurred. Some studies have focused on the influence of certain factors on acceptance. The first model which will be introduced in this chapter focuses on the interplay between the perception and behaviour of people towards an object.

The Technology Acceptance Model (TAM) developed by Davis et al. (1998) aims to analyse factors which influence acceptance of new information technologies. The model aims to predict and to explain behaviour, namely why certain computer systems are rejected or accepted. In particular, the "perceived ease of use" and the "perceived usefulness" of the new technology have a major initial role in the attitude towards the new system and behavioural intention (see Figure 4).

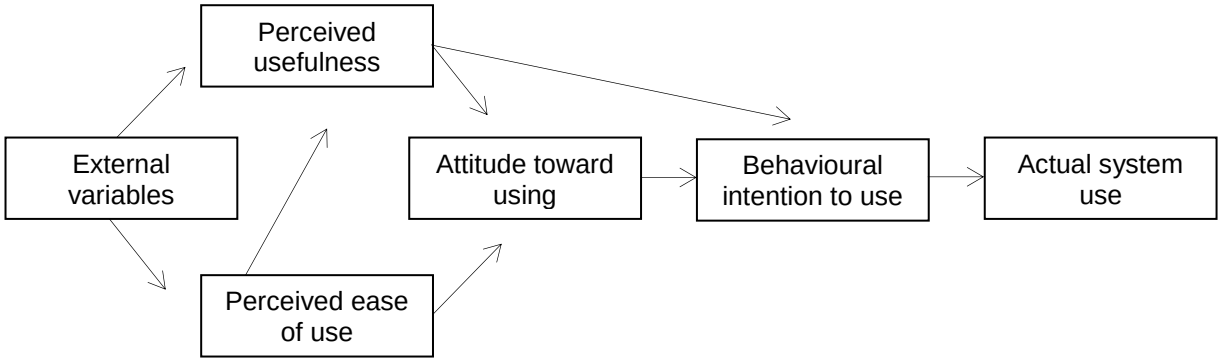

Figure 4: Technology Acceptance Model (TAM)

Source: Own elaboration based on Davis et al. (1998)

In the case of wind turbines, there is no actual user acceptance by citizens. Citizens can only accept wind energy in their role as a citizen and not as a user of wind turbines directly. Therefore, the model cannot be applied directly for wind energy. However, it has some similarities with the work of Foscht et al. (2015), both using cognitive and affective determinants in their the models. According to Stiehler (2015), Devlin (2005) used an approach based on the Technology Acceptance Model to investigate the factors affecting public acceptance of wind turbines in Sweden. In particular, the argumentation of Devlin (2005) that "perceived need increases willingness, which in turn dampens opposition and allows for a fuller development of wind power" reminds due to the similar use of the term "perceived need" on the TAM. Although Devlin (2005) does not refer explicitly to the TAM, she may have been inspired by it. This illustrates the evolution of acceptance research in the area of renewable energies, which began with rather simplistic models but has become more complex over time.

Wüstenhagen et al. (2007) published an introductory article in Energy Policy for the special issue on "Social acceptance of renewable energy innovation". The article presents a basic acceptance model (the triangle of social acceptance), in which they define three interpretation forms (dimensions) of social acceptance. Here, the term "social" refers to society as a whole as well as to individual groups such as municipalities, cultural or political groups. The term "acceptance" refers to a small or large degree of approval or opposition to renewable energy projects based on the interaction of different values (beliefs, knowledge, opinions and motivations) of either individuals or groups.

The division of the term acceptance into three dimensions is intended to give the concept of acceptance a more concrete form. The three dimensions in which acceptance can be divided

in the context of energy technologies are socio-political acceptance, community acceptance and market acceptance (see Figure 5).

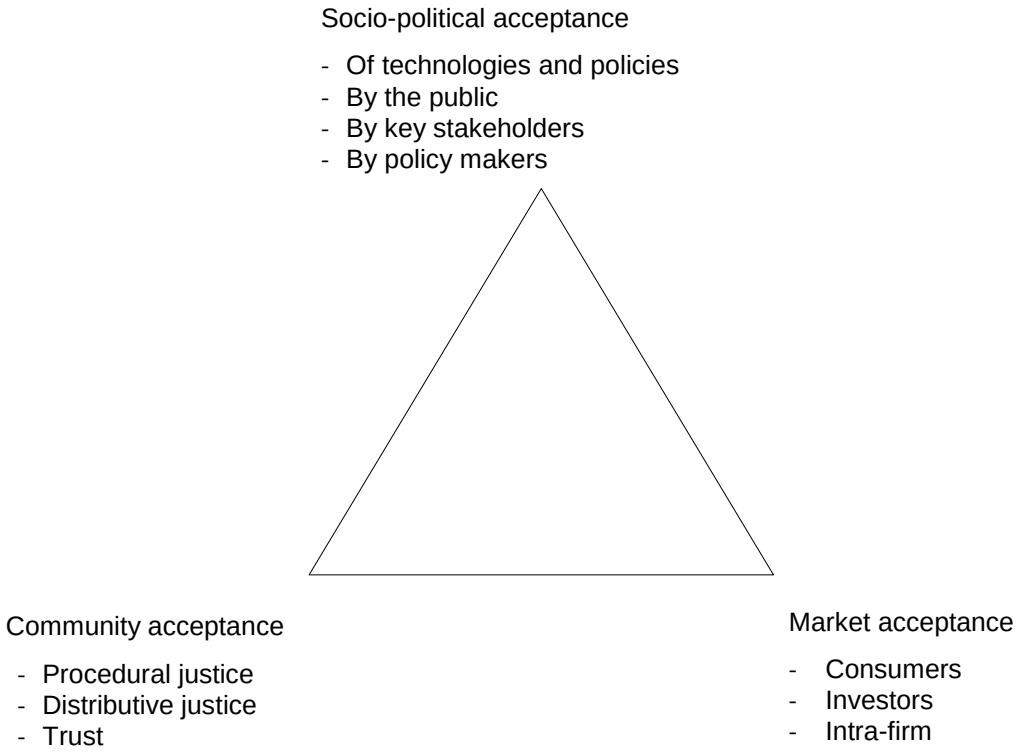

Figure 5: The triangle of social acceptance of renewable energy innovation

Source: Own elaboration based on Wüstenhagen et al. (2007)

Socio-political acceptance: This dimension comprises social acceptance at the widest level. The acceptance object of this dimension can be a renewable energy technology as well as political decisions in the field of renewable energies. Acceptance subjects can be the public, key stakeholders or political decision-makers. This type of acceptance related to renewable energies is relatively high in many countries.

Community acceptance: This dimension, also referred to as “social acceptance”, refers to the acceptance of a specific site (acceptance object) by local actors such as residents or local authorities (acceptance subject). The temporal dimension plays a crucial role in this context (Devine-Wright 2005; Wolsink 2007). The “community acceptance” dimension follows a typical pattern, which can be classified into three phases involved in project planning: no plan, planned project and built turbines. Figure 6 depicts a U-shaped development of the general attitude in the three phases, beginning with a high acceptance in phase 1 (no plan), a much lower acceptance in phase 2 (planned project) and a return to a higher level in phase 3 (built turbines), i.e. when the project is completed and the plant is running. A decisive factor

for this dimension is distributional justice, procedural justice and trust (Wüstenhagen et al. 2007).

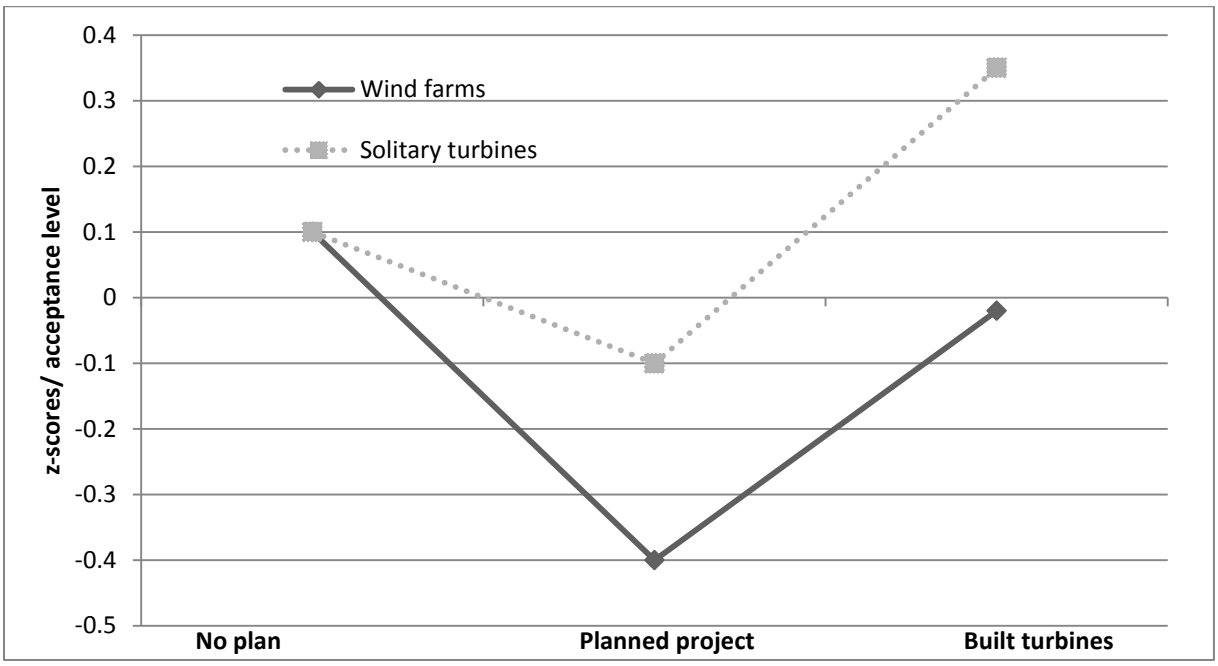

Figure 6: Development of public attitudes towards wind power

Source: Own elaboration based on Wolsink (2007) and Devine-Wright (2005)

Market acceptance: This dimension refers to the "process of market adoption of an innovation" (Wüstenhagen et al. 2007) and is based on the theory of "innovation-decision process" (Rogers 2005). Figure 7 depicts this process, starting from the point when initial knowledge about an innovation is gained, to the making of a decision, implementation of the new idea and confirmation of the decision. According to this theory, the process by which individuals decide for or against an innovation involves five different phases:

I. Knowledge (experience from innovation): retrieval of information, comprehension of information
II. Persuasion (positive or negative attitude towards innovation): affinity for the innovation, discussion of new behaviour with others, reception of information on innovation, creation of a positive image of innovation
III. Decision (decision for or against innovation): intention to seek further information about innovation and the intention to try out innovation
IV. Implementation (application of innovation): acquisition of additional information of the innovation, regular use of innovation
V. Confirmation (confirmation of the innovation decision in positive or negative sense): awareness of the benefits arising from the use of innovation, integration of innovation into the everyday routine, promotion of innovation

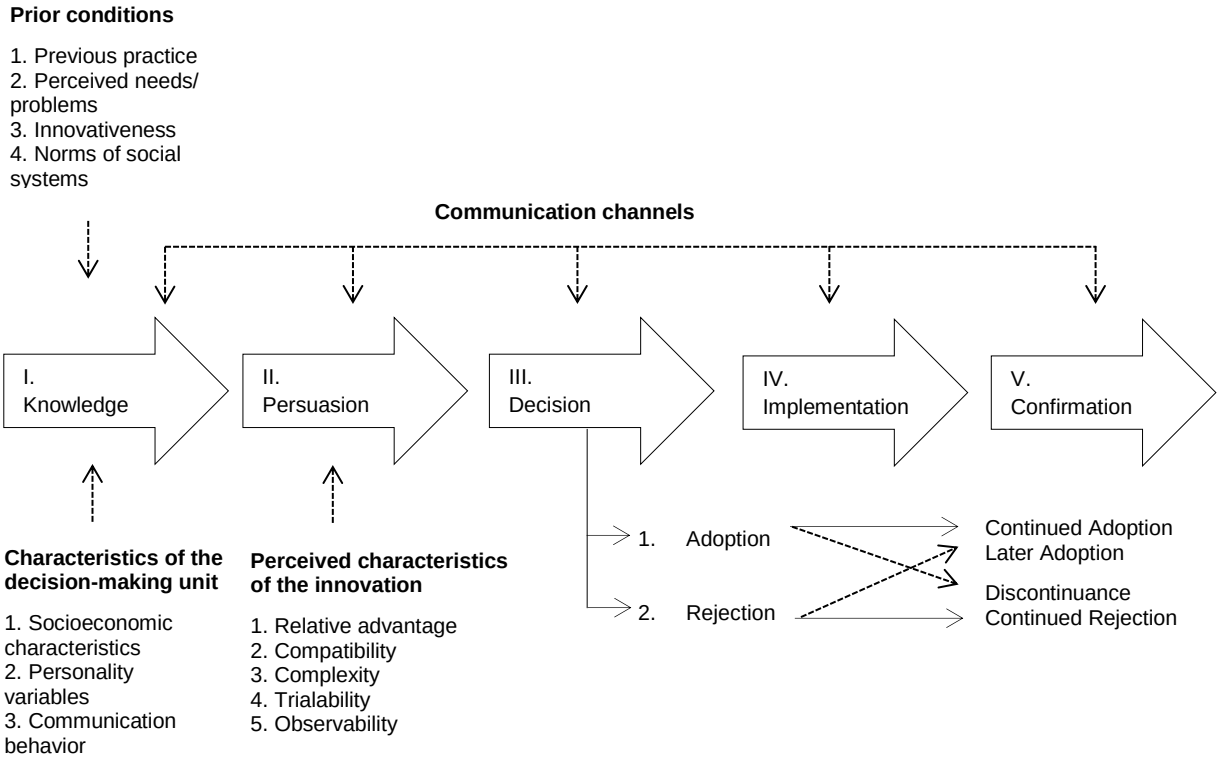

Figure 7: Model of Five Stages in the Innovation-Decision Process

Source: Own elaboration based on Rogers (2005)

In addition, Rogers (2005) identifies five user categories: Innovators, Early Adopters, Early Majority, Late Majority and Laggards. Thus, “market acceptance” can be described as a communication process between individual adopters and their environment. According to Rogers' (2005) model, earlier knowers do not necessarily adopt new ideas earlier. People know about many innovations that they have not adopted. Some people may know about an innovation but they have not adopted it, as it is not regarded as being relevant for their situation. Therefore, attitudes towards an innovation intervene between the knowledge and decision functions in the innovation-decision process. According to Rogers (2005), “consideration of a new idea does not go beyond the knowledge function if an individual does not define the information as relevant to his or her situation, or if sufficient knowledge is not obtained to become adequately informed, so that persuasion can then take place”.

Mallett (2007) evaluated Rogers' (2005) model in the field of social acceptance of renewable energy innovations in Mexico. According to her work, a lack of awareness during the knowledge phase plays a crucial role in the adoption of the technology. Other studies also suggest that a lack of knowledge explains a negative attitude towards wind energy (Rand and Hoen 2017; Bush and Hoagland 2016). Bidwell (2016) discovered a relationship between informational interventions and increased support for a wind energy project. The results of his study suggest that (1) attending information events can strengthen attitudes

and (2) participation in an information event can influence the attitude toward wind energy. However, other studies have refuted the finding that information deficits impact upon acceptance levels. According to Fast (2015), people with a negative attitude towards wind energy are not ignorant of the facts about wind energy. Baxter et al. (2013) also show that high knowledge levels do not necessarily correlate with positive attitudes towards wind energy.

In his dissertation, Hertel (2014) modified and further developed Rogers' model on a theoretical basis (see Figure 8). He assumed that the first phase is about awareness/ involvement and concludes that it is not knowledge about a technology that comes first but rather interest in the technology, which can be regarded as awareness/ involvement. Factors impacting on this phase are the existing technologies, competition and norms of the social system. In addition, he claims that innovativeness and absorptive capacity impact on the knowledge, persuasion, decision and implementation phases. In comparison to the original model, his theoretical assumptions show that these characteristics can influence the first five phases of the model and not only the knowledge and persuasion phase as implied by Rogers (2005). In addition, he distinguishes between perceived characteristics relating to innovation, which impact on the persuasion phase, and perceived restrictions on adoption, which influence the decision phase.

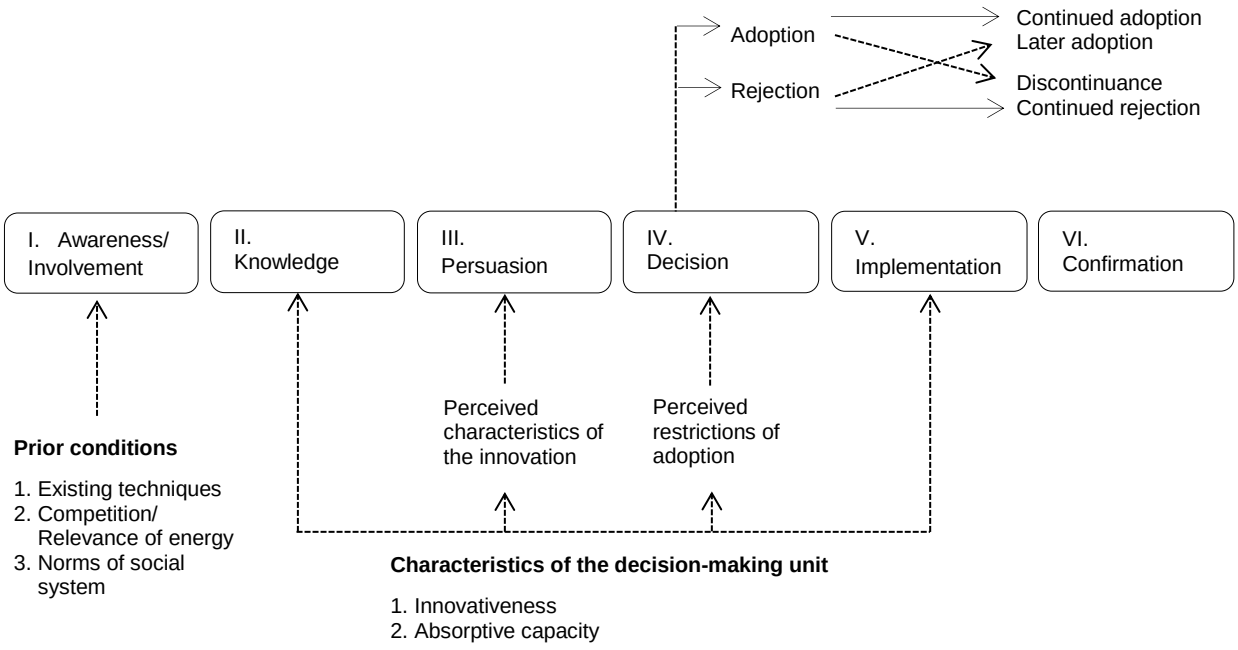

Figure 8: Modified model of Five Stages in the Innovation-Decision Process

Source: Own elaboration based on Rogers (2005) and Hertel (2014)

Wüstenhagen et al. (2007) provide a model which can be used specifically in the field of wind energy. Moreover, by distinguishing the three dimensions, they provide three different views on the topic of wind energy, namely a political, community and market approach. This distinction allows the separation of different fields of action and analysis of a certain group of subjects.

2.2 Participation theory

One crucial factor, which influences the acceptance of wind energy, is the mode of participation. The aim of involving the public at different stages in wind energy projects is to generate a more effective way of informing citizens and letting them have a certain amount of influence on the decision (Gustafsson et al. 2014). Governmental institutions try to increase acceptance through public participation.

The impact of different participation modes has been discussed throughout conventional and renewable energy fields (Aegerter and Bucher 1993; Gangale et al. 2013). In general, participation includes the involvement of the public in project planning and project realization. This process can be conducted by means of information distribution, public meetings, dialogue, consultation, or mediations etc. (Beierle 1998). Not only the type of participation has influence on acceptance but also who is involved, the timing and the frequency of participation (Mah and Hills 2014).

Public participation can be described as the involvement of citizens in decision-making with the purpose of influencing the choices being made (Renn and Webler 1992). Table 2 shows a comparison of three important participation theories developed in the last century and how they relate to each other. According to Arnstein (1969), a pioneer in the field of participation research, participation can be divided into eight different levels. These include manipulation, therapy, informing, consultation, placation, partnership, delegated power and citizen control. These levels can be categorized in three broad types of participation, including non-participation (manipulation etc.), tokenism (placation etc.) and citizen power (partnership etc). The ladder of participation is to be understood as more of a continuum than separate steps, as each level depicts a very broad group. Wilcox (1994) further developed the ladder of participation and modified it into five interconnected levels of participation: information, consultation, deciding together, acting together and supporting independent community interests. Ziekow et al. (2013) reduced the participation ladder to four levels including decision with binding agreements, cooperation, consultation and information.

Table 2: Ladder of participation

Type of participation	**Level of participation according to**		
	Arnstein (1969)	**Wilcox (1994)**	**Ziekow et al. (2013)**
Degrees of citizen power	Citizen control	Supporting independent community interest	Decision with binding agreements
	Delegated power	Acting together	Cooperation
	Partnership		
Degrees of tokenism	Placation	Deciding together	
	Consultation	Consultation	Consultation
	Informing	Information	Information
Non participation	Therapy	-	-
	Manipulation	-	-

Source: Own elaboration based on Arnstein (1969); Wilcox (1994); Ziekow et al. (2013)

3 Material, methods and research design

This section describes the methodology used for this thesis. Data was collected in two different ways, with qualitative data being used for paper I and quantitative data being used for papers II and paper III. The data collected in the qualitative step was used to develop the theoretical basis for the data collection in the quantitative step. Figure 9 provides an overview of the structure of the whole research project, including information about the data collection, data sources, data analyses and results for all three steps.

	First step	**Second step**	**Third step**
DATA COLLECTION	Literature review	Interviews and focus groups	Online survey
DATA SOURCE	Printed and electronic resources	9 semi structured expert interviews + 2 focus groups	Online-Survey with 1.356 respondents
DATA ANALYSIS	Interpretative techniques	Interpretative techniques and coding	SSI Web and SPSS
DATA RESULTS	Identification of influencing factors	Identification of main influencing factors	Relevance of main influencing factors

Figure 9: Structure of the research project

Source: Own elaboration (2016)

3.1 Literature review (First step)

The first step included a qualitative study in the form of an extensive literature review in which peer-reviewed studies dealing with the acceptance of wind energy were reviewed. The relevant studies were identified and collected via searches in Web of Science™ and ScienceDirect® as these databases incorporate social science studies and engineering literature. In addition, the review also included studies published by the Bavarian government, which provided in-depth insight into Bavarian wind energy policy. Several synonyms of wind energy such as wind power, wind turbines and wind farms were used for the database searches. In order to find the widest possible range of relevant literature, these synonyms were combined with various keywords such as acceptance, attitudes, public opinion, preferences, public perception. The combinations of the synonyms and the different keywords were applied during the search in the literature databases. This search approach to identify the relevant literature is illustrated in Figure 10.

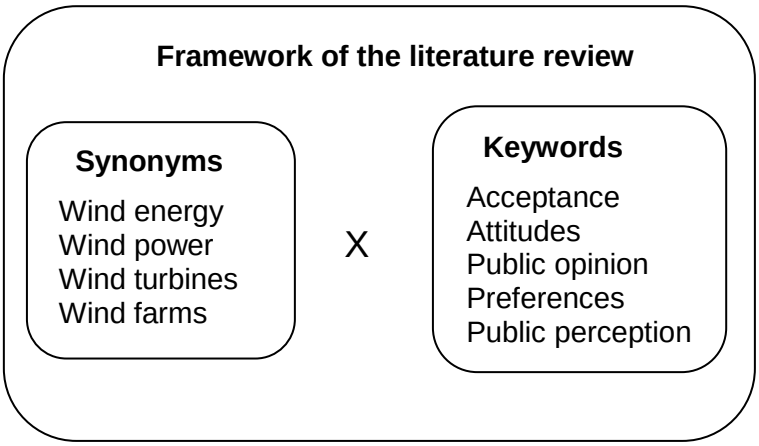

Figure 10: Identification of literature for review article

Source: Own elaboration (2016)

The peer-reviewed studies were subsequently examined to identify relevant factors which impact upon the acceptance of wind energy. This approach allowed the identification of factors, which can be grouped into four categories, namely process-related variables, personal characteristics, perceived side effects and technical and geographical issues. The classification of these four categories was necessary in order to conduct an in depth analysis of the factors during the second step of the data collection.

3.2 Interviews and focus groups (Second step)

The second step included data collection through semi-structured expert interviews and focus groups. By applying these qualitative methods, authentic information about the factors which influence acceptance of wind energy could be identified and afterwards analysed in depth in the third step of the data collection process. A guideline was used to predefine the topics of the expert interviews. Open-ended questions were used to let the interviewees elaborate on their experience in the field of wind energy. The interview guideline was comprised of five sections (see Appendix 1). The first part started with the background of the interviewee. Then the interview focused on technical issues, while the third part concentrated on the personal characteristics of wind energy opponents. The fourth part centred on questions relating to participation modes. The final part included questions about the information opportunities between citizens and other actors involved. The expert interviews were conducted from February to April 2015. The experts were identified using the snowball technique of screening web pages directly from organizations and professional social networks. The nine interviewees included representatives of wind energy supporters and opponents in Bavaria, such as project developers, governmental representatives, members of citizens' initiatives, wind company representatives, local planning officials and non-governmental organizations. The inclusion of experts from different domains provided a

holistic overview of the relevant factors and participation levels influencing the acceptance of wind energy.

The expert interviews were supplemented with focus groups, which were intended to maximise the quantity of information received from different stakeholders. Due to the open character of the focus groups, they generate diverse and authentic reactions to the topic. Participants of focus groups act more spontaneously to certain points of view and the casual atmosphere leads to honest answers and reveals true feelings, fears or frustrations (Buber 2009). Moreover, working with heterogeneous groups encourages in-depth discussions so that it is likely that new and undiscovered ideas and insights can be drawn out, which have not yet been considered by the researcher (Lamnek 2010). The guideline developed for the focus groups included seven sections. The first part dealt with organizational issues, followed by the perceived side effects of wind energy. The third section dealt with the personal characteristics of the opponents and supporters of wind energy. The next part was about the placement of wind turbines and this was followed by questions about how citizens should be informed about wind energy projects. The sixth part involved issues on participation models. In the last part, the participants could state their final comments. Two focus groups were conducted in the lower and upper-Palatinate regions of Bavaria, which have a low and very high number of wind turbines respectively. Participants were recruited through a press release, which announced a work shop around wind energy. The two groups consisted of six and eight participants respectively.

3.2.1 Analysis of qualitative data

The expert interviews and focus groups were tape-recorded, except for one interview where the interviewee did not provide permission for the interviewee to be recorded. They were protocolled and subsequently transcribed, in order to enhance reliability. The transcripts were then imported into the Computer Assisted Qualitative Data Analysis Software MaxQDA (Kuckartz 2012). This program systematizes, organises and clarifies the analysis by providing themes and comparison of the interviews. The qualitative data was analysed by using content analysis. Content analysis is an empirical data procedure with a focus on the analysis of texts (Atteslander 2008). A deductive-inductive core system was applied. Based on the literature review, a coding system was developed before the interviews and focus groups were conducted (Gläser and Laudel 2010). Throughout the content analysis, new subcategories were inductively developed, which permitted a natural illustration of the data without distortion from any preconceptions the researcher may have (Kuckartz 2012; Früh 2011; Diekmann 2010).

The qualitative data was quantified through category counts. Afterwards, a comparison of the frequency of categories functioned as an orientation for the importance of the factors

(Mayring 2015). Factors with a high frequency in the expert interviews and focus groups were assumed to be relevant for the study. In addition, the texts were assessed by the context and the intensity of the statements. The statements were analysed for commonalities and differences. Common factors among the different text were supposed to be crucial. This process enables the evaluation and interpretation of the statements of the expert interviews and focus groups. According to Hopf and Schmidt (1993), consensual coding improves the quality and reliability of coding, by coding the text independently by several scientists. Therefore, all texts were coded independently by both the author of this thesis and a research assistant.

3.3 Survey (Third step)

The third step included quantitative research in the form of an online-survey. Data for the quantitative study was collected through an online questionnaire, including a computer-based adaptive choice based conjoint (ACBC) experiment designed with Sawtooth Software (Orme 2014). This study used an online survey due to the reduced costs, higher flexibility and faster data collection than traditional mail surveys. Respondents were recruited by a subcontracted market research company. Respondents were invited to participate in several rounds until the desired number of participants in a group (see Table 3) was reached. To encourage participation, a fixed compensation was offered by the market research company.

The survey was completed by German respondents aged 18 years or above. Participants with different degrees of experience with wind energy were included in order to get a holistic view of citizens' assessment of wind energy in Germany. Therefore, the survey included five different groups of respondents with differing "participatory experience" in wind energy projects (see chapter 2.2): no participation, information, consultation, cooperation, and financial participation (Table 3). The alibi participation group was not included in the sampling procedure as it was expected that not enough participants would be recruited to this group. Respondents had to indicate their degree of experience according to these five participation levels. In December 2015, a total number of 1,363 respondents qualified for participation in the survey and completed the questionnaire.

Table 3: Sampling frame

Group	Description	Involvement of citizen participation	Number of respondents in sample
No participation	People with no experience with wind energy	No involvement	274
Information	People with experience with wind energy through television, web pages, information	Passive involvement	292
Consultation	People with experience with wind energy through dialogue events, internet forums	Active involvement by obtaining personal opinion	282
Cooperation	People with experience with wind energy through active events in which recommendations are made such as round table discussions, planning workshops, demonstrations, public forums	Active involvement by co-decision of citizens	267
Financial participation	People with experience with wind energy through active participation with mandatory negotiations, such as financial contribution, cooperatives, associations	Independent and responsible action of citizen	248
Total	Total sample number of respondents	-	1,363

Source: Own elaboration (2016)

The questionnaire had a brief introductory text. Then there were several questions about their current situation with respect to the distance of the turbines from their place of residence, the number of turbines and the extent of their involvement with these turbines. Next, respondents were asked to evaluate a number of statements regarding the factors which influence the acceptance of wind energy. The respondents then participated in a choice experiment in which the main influencing factors were the attributes. The last part of the questionnaire asked for socio-demographic information.

The choice experiment was intended to identify how participants evaluated different types of wind energy projects. Therefore, participants had to choose between seven different attributes each with different levels relating to the acceptance of wind energy. Table 4 shows the seven different attributes with their respective levels.

Table 4: Attributes and attribute level in the ACBC experiment

Attribute	Description	Levels	Source
Participation	Citizen participation in wind energy projects	No participation	Schweizer-Ries (2010)
		Alibi participation	
		Information	
		Consultation	
		Cooperation	
		Financial participation	
Political and regulatory framework	Includes policies, regulations and governance of wind energy issues	Reliable	Sagebiel et al. (2014)
		Not reliable	
Distance to place of residence	Distance of wind turbine in km to place of residence	0 – 0,5 km	Maruyama et al. (2007)
		0,51 – 1,0 km	
		1,01 – 2,0 km	
		2,01 – 10,0 km	
		>10,01 km	
Hub height	The distance from the turbine platform to the rotor of an installed wind turbine	60 – 94 m	Bundesverband WindEnergie e.V. (2013)
		95 – 140 m	
		>140 m	
Number of wind turbines	The number of wind turbines installed at a wind farm	1 – 2	Federal Ministry for Economic Affairs and Energy (2014)
		3 – 5	
		6 – 10	
		>10	
Visual appearance at place of residence	Visibility of the turbines at the place of residence in km	Visible up to 1 km away	Álvarez-Farizo and Hanley (2002)
		Visible up to 10 km away	
		Visible up to 20 km away	
		Not visible	
Sound level at place of residence	The sound generated by a wind turbine which is audible at the place of residence	Not audible	LUBW Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg (2016)
		Whisper	
		Common domestic noise background (e.g. refrigerator)	
		Conversation	

Source: Own elaboration (2016)

3.3.1 Analysis of quantitative data

The measurement of consumer attitudes, choices and preferences can be realised in many ways (Phillips et al. 2002; Louviere et al. 2008). Paper II applied an adaptive choice-based conjoint analysis, while paper III used multinomial logistic regression.

The aim of conjoint analysis is to determine utility values for individual attributes of a product through consumer preferences (Albers 2009; Green and Srinivasan 1978). Choice-based conjoint analysis analyses decisions by participants regarding the same products but with variable attributes. Based on random use theory and discrete choice analysis, it is assumed that the participants behave in a way that maximizes their profit, meaning that conclusions can be drawn from their decisions about the utility values of the attributes and levels (Albers 2009). Participants are assumed to choose the alternative which has the highest utility for them. The respondent implicitly makes trade-offs between the attributes associated with each alternative by choosing the preferred project. By changing the level of the attributes of these projects, the impact of each attribute on the project choice can be calculated.

Using regression analysis, it is possible to determine the probability of certain events occurring and the dependence of certain variables. Regression analysis takes into account a dependent variable and several independent variables. There are a number of different statistical methods which can be used, such as linear regression analysis, multiple regression analysis, binary or multinomial logistic regression, and ordinal regression. The dependent variables are important for the choice between different types of regression analysis. In paper III, the dependent variable had more than two acceptance levels and nominal values. Therefore, a multinomial logistic regression analysis was conducted in paper III. Three groups of the dependent variable (active non-acceptance, ambivalence or active acceptance group) were compared with each other in order to identify those influencing factors which separate these groups (Albers 2009). Prior to the interpretation of the regression model, it is necessary to take into consideration the validity of the model. Examining the "total fit" of a multinomial logistic regression requires analysis of how the independent variables contribute to the separation of the dependent variable. In particular, the following quality criteria were taken into account: First, as a measure of reliability, a likelihood-ratio test was conducted. Second, to gauge whether the observed cell counts differ significantly from the calculated result of the model expected frequencies, Pearson’s chi-squared test was performed. Third, the Pseudo-R-square includes the measurements of Cox and Snell, Nagelkerke and McFadden. To interpret the influence of the factors, each category of the dependent variable was assigned to a parameter estimator. The estimated regression coefficients B allowed the direction of the relationship to be determined. Positive coefficients in paper III indicated that a respondent belonged to the reference group (e.g. active acceptance, ambivalence or active non-acceptance). This enables interpretation if the

factor influence the likelihood of being in the active “non-acceptance”, “ambivalence” or “active acceptance” group. The strength of the relationships are indicated by the odds (Exp(B)). Positive regression coefficients receive odds >1 and negative regression coefficients receive odds <1 (Hinton et al. 2014; Hilbe 2009; Hosmer et al. 2013; Backhaus 2016).

4 Results

In this chapter, the results of the theoretical considerations about the concepts of acceptance and participation are presented together with a summary of paper I, paper II and paper III, each of which addressed specific research questions. The main findings and contributions of each paper are summarised. Further details can be found in the full papers, which are included in the appendix.

4.1 Results of the theoretical framework

This thesis is based on the acceptance framework of Hofinger (2001a) and Sauer et al. (2005), which has eight concrete levels and thus allows explicit and accurate groups to be developed. Table 5 displays the scale of acceptance classification based on Hofinger (2001a) and Sauer et al. (2005). This classification relates to the actual behaviour of the respondents and allows an approximate quantitative assessment to be made of the population's acceptance levels. The scale represents a static view of the situation as the term acceptance does not have an absolute value. Different people can have different forms of acceptance levels. The active opponents and rejection level can be classified as a form of “non-acceptance”. The “ambivalence” group captures a transition group between the non-acceptance and acceptance groups. This intermediate group consists of the levels undecided, indifferent, tolerant and conditional acceptance. The levels approval and enthusiastically engaged can be classified as “acceptance”.

Table 5: Acceptance scale

Acceptance group	**Acceptance level**	**Description according to Hofinger (2001a) and Sauer et al. (2005)**
Non-acceptance	Active opponents	The person is clearly opposed to wind energy. Through the development of the wind turbines, the persons’ own goals or the welfare of the region are threatened. Their attitude is strongly negative and emotional and the person has a high level of willingness to act against the wind energy project.
	Rejection	The person has a strongly negative opinion, but their own goals are not regarded as being threatened. The person is not very emotionally opposed to wind energy and their readiness to act is low to medium.
Ambivalence	Undecided	The person cannot make a clear assessment of the conflict between criticism and consent. The person is intensively involved with wind energy and his or her emotional attitude is ambivalent and changing. The willingness to act is currently low due to the person’s own inner conflict.
	Indifferent	The person has nothing to do with wind energy and their aims are not affected. Their level of knowledge is very low, the emotional attitude is indifferent and distant, and the person has no willingness to act against the wind energy project.

	Tolerant	The person sees little benefit in wind energy but also little threat to their own goals. The emotional attitude is sceptical and the willingness to act is very low.
	Conditional acceptance	Acceptance which is based on rational considerations and is coupled with conditions.
Acceptance	Approval	The person evaluates wind energy positively. It is considered as useful for his or her own goals or for the region. The emotional attitude is positive but not particularly intense.
	Enthusiastically engaged	The person values wind energy very positively. The emotional connection is strong and positive. The readiness to act in support of the wind energy project is high.

Source: Own elaboration based on (Hofinger 2001a; Sauer et al. 2005)

With respect to the participation model, an adaption of the three participation theories of Arnstein (1969), Wilcox (1994) and Ziekow et al. (2013) was used in this thesis. Table 6 shows the six relevant participation levels based on these three theories: no participation, alibi participation, information, consultation, cooperation and financial participation. These different levels illustrate a continuum from passive to active participation modes. Participation levels depend on different actions, contexts and settings. The higher the level of participation, according to Table 6, the higher the influence on citizens. The lowest level, which is “no participation”, implies that citizens had no contact with wind energy before the study took place. “Alibi participation” refers to citizens who would like to participate but there is no real decision-making power and therefore, their participation does not have any consequences (Schweizer-Ries 2010). The next level, which is “information”, is described as passive participation, which involves visiting webpages, reading materials about wind energy, watching television programs about wind energy etc. (Bundesverband WindEnergie e.V. 2013). The next level is “consultation”, which refers to active participation, where the personal opinion is stated through dialogue events, discussions in internet forums, hearings or surveys (Brian and Weber 2014). The level “cooperation” implies active participation though the making of joint decisions on wind energy plans through round tables or working groups (Brian and Weber 2014). The last level, which is “financial participation”, refers to active participation evidenced by financial investment in wind energy projects (Brian and Weber 2014).

Table 6: Modified participation levels

Type of participation	Definition	Source
Financial participation	Active participation through financial investment in wind energy projects.	Brian and Weber (2014)
Cooperation	Active participation through joint decision-making on wind energy plans through round table discussions, or working groups.	Brian and Weber (2014)
Consultation	Active participation by expressing the personal opinion during dialogue events, in discussions in internet forums, at hearings or in surveys.	Brian and Weber (2014)
Information	Passive participation in the form of visiting webpages, reading materials about wind energy, watching television programs with information about wind energy etc.	Bundesverband WindEnergie e.V. (2013)
Alibi participation	Individuals who want to get involved but their participation has no consequences and the results will not be considered further.	Schweizer-Ries (2010)
No participation	Individuals who have no participation experience with wind energy at all.	-

Source: Own elaboration (2016)

4.2 A qualitative analysis to understand the acceptance of wind energy in Bavaria (Paper I)

The paper “A qualitative analysis to understand the acceptance of wind energy in Bavaria” was published by Katharina Langer, Thomas Decker, Jutta Roosen and Klaus Menrad in the Journal *Renewable and Sustainable Energy Reviews*. The doctoral candidate was the primary author of the paper and was responsible for the data collection, data analysis and writing the manuscript in agreement with the co-authors.

Langer, Katharina; Decker, Thomas; Roosen, Jutta; Menrad, Klaus (2016): A qualitative analysis to understand the acceptance of wind energy in Bavaria. In: Renewable and Sustainable Energy Reviews 64, S. 248–259. DOI: 10.1016/j.rser.2016.05.084.

Changes to energy production are necessary for the energy transition in Germany. In particular, the federal state of Bavaria, which currently generates the most electricity from nuclear power in Germany, has set ambitious renewable energy targets, which are outlined in the Bavarian Energy Concept (Bavarian State Ministry of the Environment and Consumer Protection 2013). In terms of wind energy, Bavaria aims to increase electricity production from wind energy by 6 to 10% by 2025 (Bavarian Ministry of Economic Affairs and Media, Energy and Technology 2013). In addition to a range of other considerations, the acceptance of wind energy by citizens is crucial to the successful construction and operation of the wind energy farms, which are needed in order to reach this target. Acceptance is affected by a number of factors. One factor is the distance of the wind turbines to the place of residence. The government of Bavaria has enacted the so called 10H regulation, which is intended to keep acceptance of wind energy high (German Wind Energy Association 2015). Against this background, this paper aims to identify the multiplicity of factors that influence acceptance of wind energy systems and to categorize the most important influencing factors in the federal state of Bavaria.

Using a qualitative approach involving an extensive literature review and expert interviews with leaders from groups of wind energy supporters and opponents in Bavaria, the results indicated that the influencing factors can be classified into four broad categories: personal characteristics, perceived side effects, technical and geographical issues, and process-related variables. The category “personal characteristics” include factors related to the individual’s distinctive character. “Perceived side effects” refer to the external impacts of wind energy technologies on an individual. “Technical and geographical issues” refer to technical properties and the geographical location of the wind turbines. And the fourth category, “process-related variables”, includes political and operational issues during the planning and development of wind farms.

In total, 10 influencing factors were selected as the main factors for wind energy acceptance in the federal state of Bavaria. Figure 11 gives an overview of these factors.

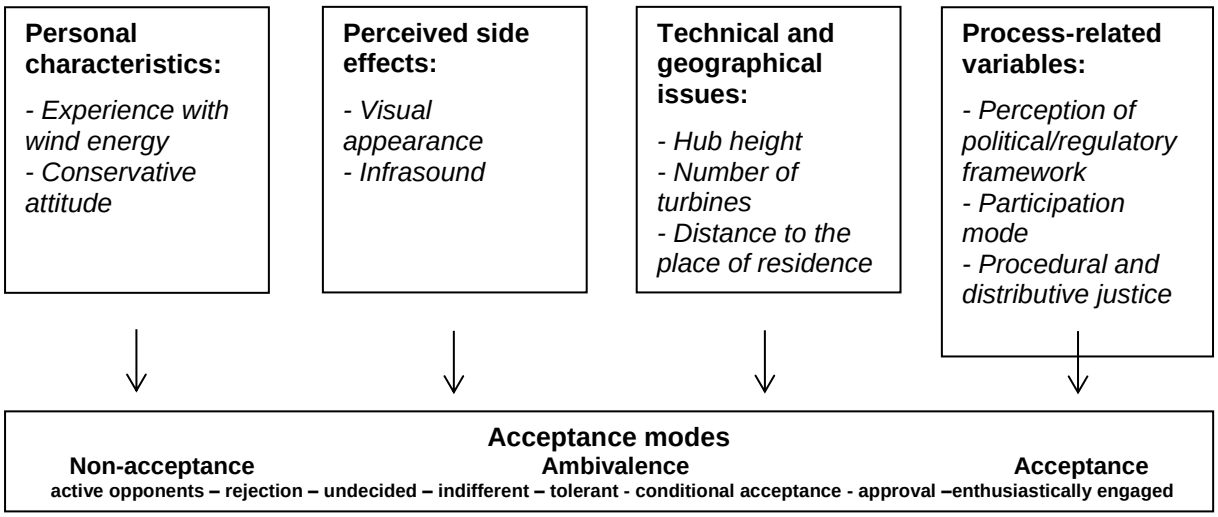

Figure 11: Theoretical influencing factors on the acceptance of wind energy

Source: Own elaboration, 2016

The results of this paper emphasise that there is no agreement in the literature with respect to the distance of the turbines to the place of residence. According to Jones and Eiser (2010) and Devine-Wright (2007), visual impacts from wind turbines caused by short distances to the place of residence reduce the acceptance of wind energy. On the other hand, Warren et al. (2005) and Braunholtz (2003) suggest that acceptance increases when wind turbines are built close to the place of residence. Our results showed that the mode of participation plays an important role in the acceptance of wind energy. In particular, the so-called 'alibi participation', defined as participation with no real consequences, is a factor with enormous influence. Positive effects on acceptance were also found through forms of participation which allow people to contribute to wind energy projects through either consultation or financially (Mallett 2007; Walker and Devine-Wright 2008; Schweizer-Ries et al. 2011.) Being kept informed about wind energy projects in a transparent manner is also relevant. Transparent policy-making with respect to wind energy also enhances trust in the community and acceptance of wind energy by citizens (Gross 2007; Wolsink 2007). The enactment of the 10H regulation has resulted in some confusion about wind energy in Bavaria. In line with Gross (2007), our results show that distributive justice is an important factor for acceptance of wind energy. This can be observed at both neighbourhood and regional level. The neighbourhood level incorporates feelings if envy arising due to unequitable financial distribution at the neighbourhood level, while the regional level refers to the lack of comprehension amongst citizens regarding regional differences in the distribution of wind turbines in the various federal states of Germany, which can be seen in Figure 1.

4.3 Public participation in wind energy projects located in Germany: which form of participation is the key to acceptance? (Paper II)

This section summarises the paper “Public participation in wind energy projects located in Germany: which form of participation is the key to acceptance?” published by Katharina Langer, Thomas Decker and Klaus Menrad in the Journal *Renewable Energy*. The doctoral candidate was the primary author of the paper and was responsible for the data collection, data analysis and editing the paper in agreement with the co-authors.

Langer, Katharina; Decker, Thomas; Menrad, Klaus (2017): Public participation in wind energy projects located in Germany: Which form of participation is the key to acceptance? In: Renewable Energy 112, S. 63–73. DOI: 10.1016/j.renene.2017.05.021.

Citizen participation in wind energy projects contributes to their acceptance of the project (see Paper I). Participation modes range from “no participation”, “alibi participation”, “information”, “consultation”, “cooperation” and “financial participation” (Wilcox 1994; Arnstein 1969). This paper focuses on the different modes of participation and their influence on acceptance of wind energy. In addition, the relevance between the six participation modes and the factors perception of infrasound, knowledge and experience of wind energy is assessed.

In an adaptive choice based conjoint analysis, people had to choose between different hypothetical wind energy projects, which were described by a number of attributes. These seven attributes included: participation (Schweizer-Ries 2010), political framework for wind energy (Sagebiel et al. 2014), distance to the place of residence (Maruyama et al. 2007), hub height (Bundesverband WindEnergie e.V. 2013), number of wind turbines (Federal Ministry for Economic Affairs and Energy 2014), visibility from the place of residence (Álvarez-Farizo and Hanley 2002), and sound level at the place of residence (LUBW Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg 2016). The results show that participation is one of the most important factors influencing acceptance of wind energy projects. With respect to the participation mode, the participation forms “information”, “cooperation” and “consultation” were more positively evaluated than “financial participation”. This result suggests that citizens should be involved in informative and deliberative participation processes. The positive effect of these participation forms on the acceptance of wind energy is in line with existing literature (Corscadden et al. 2012; Geißler et al. 2013). As expected, the participation form “no participation” and “alibi participation” were negatively evaluated.

The variables “knowledge about wind energy”, “experience with wind energy” and “perception of infrasound” were included in the choice experiment in order to test their

relevance for the acceptance of wind energy. In line with previous studies (Corscadden et al. 2012), the results show that wind energy projects are more attractive for people who have more knowledge about wind energy. The results also show a positive relationship between “financial participation” and experience with wind energy, which is in line with the findings of Kaldellis et al. (2013). Wind energy projects are more negatively evaluated when there is an increasingly negative perception of infrasound.

4.4 Factors influencing citizens' acceptance and non-acceptance of wind energy in Germany (Paper III)

This chapter summarises the paper "Factors influencing citizens' acceptance and non-acceptance of wind energy in Germany" published by Katharina Langer, Thomas Decker, Jutta Roosen and Klaus Menrad to the Journal of Cleaner Production. The doctoral candidate was the primary author of the paper and was responsible for the data collection, data analysis and editing the paper in agreement with the co-authors.

Langer, Katharina; Decker, Thomas; Roosen, Jutta; Menrad, Klaus (2018): Factors influencing citizens' acceptance and non-acceptance of wind energy in Germany. In: Journal of Cleaner Production 175, S.133 – 144. DOI: 10.1016/j.jclepro.2017.11.221.

Due to ambitious aims of the German government with respect to renewable energy (Federal Ministry for Economic Affairs and Energy 2016a), there will be a large increase in wind energy in Germany in the coming years (Federal Ministry for Economic Affairs and Energy 2016b). A crucial issue in this context will be the acceptance of wind energy by citizens. However, the scientific community it is not yet clear as to which factors will increase or reduce the acceptance of wind energy. This paper analyses whether certain factors positively or negatively influence acceptance. These factors can be divided into four categories, including "process-related variables", "personal characteristics", "perceived side effects" and "technical and geographical issues". This paper also addresses the belonging and the impact of the factors within the three different acceptance groups: "active non-acceptance", "ambivalence" and "active acceptance".

Based on a multinomial logistic regression analysis, the results show that factors in all four categories impact on all three acceptance groups. Fear of infrasound, the participation mode and the distance to the place of residence play a special role in differentiating between these groups.

It was revealed that the factor "procedural and distributive justice" significantly increases the probability of being in the "active acceptance" group. This positive effect on acceptance is in line with former studies (Bronfman et al. 2012; Ottinger et al. 2014). In addition, the results emphasise that different participation modes influence acceptance (Paper II). The participation levels "information", "consultation", "cooperation" and "financial participation" have a positive influence on acceptance, a finding which is supported by the studies of Ek and Persson (2014) and Ciupuliga and Cuppen (2013). The levels "no participation" and "alibi participation" have a significantly negative influence on acceptance. These results highlight that deliberative and active participation forms contribute positively towards the acceptance of wind energy. In line with a study by Enevoldsen and Sovacool (2015), the

results also show that there is a positive influence on citizens who have experience with wind energy, which implies that people who have already had experience wind energy are more tolerant of and open towards this form of renewable energy.

Different factors significantly contribute to the acceptance level in the “ambivalence”, depending upon which group is taken for comparison. Compared to the “acceptance” group, infrasound, no participation, alibi participation and financial income have an influence on the “ambivalence” group. When compared to the “non-acceptance” group, only consultation and procedural and distributive justice were positively correlated with acceptance of wind energy in the “ambivalence” group.

A dominant factor, which influences the “active non-acceptance” group, is infrasound. This factor has recently received more attention from local communities and is typically regarded negatively (Knopper and Ollson 2011; Baxter et al. 2013). This is consistent with the results of our study. Therefore, the study concludes that the publication of information about wind energy and infrasound could increase knowledge and promote acceptance of wind energy by citizens. Alibi participation discourages acceptance of wind energy. With respect to the factor distance from place of residence, the results show that if there are no wind turbines nearby, there is less acceptance of wind energy. This may have some relation to experience, as those citizens who have had experience with wind energy may be more likely to accept it (Fachagentur Windenergie an Land 2016; Warren et al. 2005). Socio-demographic factors also show that financial income and age are relevant for non-acceptance of wind energy. In particular, older people with higher income are more likely to be in the “non-acceptance” group. These findings contrast with those of Devine-Wright (2007), who showed that there are positive correlations between higher income and older age and acceptance of wind energy. However, other studies (Greenberg 2009; Hobman and Ashworth 2013) have also found that there is a negative relation between older age and acceptance of wind energy.

5 Discussion

This chapter brings together the findings from all three papers and identifies the key findings of the thesis as a whole. The following sections also address the methodological and thematic discussions as well as the limitations of the three papers.

5.1 Methodological discussion

The study design for this thesis included both qualitative and quantitative methods, which were intended to draw holistic conclusions about the acceptance of wind energy by citizens. After performing an in-depth literature review, expert interviews and focus groups were conducted. The quantitative analysis was based on data obtained through an online survey. This combination of methods was chosen because it was considered to be an efficient way to collect data. The use of both qualitative and quantitative methods ensures that the data provide a wide perspective, prevents narrow perspectives being taken and can contribute to the validity of the data. The methods chosen here complemented one another and enabled acceptance in the field of wind energy to be investigated (Bogner et al. 2014; Bryman 2008; Gläser and Laudel 2010; Kuckartz 2011).

Qualitative methods, such as focus groups and expert interviews, allow data to be collected efficiently. These methods also promote the validity of the data as experts are involved. However, there are some disadvantages arising from their use and analysis of the data. Some of the data for this study was collected through expert interviews. Criticisms of this method include possible distortions and influence by the interviewer caused by the interaction between the interviewer and interviewee (Bogner et al. 2014; Bryman 2008). By using the same guideline in all interviews, an attempt was made to reduce this effect. A further phenomenon, which frequently occurs in interviews, is the problem of respondents giving socially desirable answers, meaning interviewees adapt their responses to the expectations of their surrounding environment (Buber 2009; Gläser and Laudel 2010). In order to minimize social desirability bias, questions were formulated neutrally and without any evaluation. The results of the expert interviews do not provide any evidence that socially desirable answers were given. However, the possibility of there being slight distortions due to socially desirability bias cannot be completely excluded (Kuckartz 2012; Buber 2009).

The results of the qualitative analysis were incorporated into the design of the quantitative method. The use of quantitative data leads to quantifiable and verifiable results with a high level of objectivity and comparability. This allows phenomena to be described in the form of models, interrelationships and numerical expressions. Quantitative data were collected to generate reproducible data on the acceptance of wind energy by citizens. The quantitative data were collected through an online-survey. Online surveys are very advantageous as they save both time and money. However, statistical issues can arise, such as panel conditioning.

This occurs when respondents' answers are influenced by their participation in prior studies, which may affect estimates. However, there may also be advantages as experienced participants might give more precise and truthful answers (Dillman et al. 2014).

Some restrictions were incorporated into the selection process for the questionnaire to ensure that (1) respondents were 18 years or older and (2) that they belonged to one of the five specified participation groups (see chapter 2.2). These restrictions were important for ensuring that people with different degrees of experience in the field of wind energy were included in the study. It was expected that people with higher levels of experience would be better informed about wind energy. To generate a holistic overview about acceptance of wind energy, it made sense to invite respondents with different levels of experience with it to participate. However, the adaptive choice based conjoint analysis showed no significant differences among the five participation groups. Therefore, the focus was placed on the differences among the three acceptance levels and the participation levels. Due to the strict restrictions on participation, the age and gender distribution as well as education and income levels of the sample population deviated from the German population. Although this might weaken the representative character of the study, the validity of the study is ensured through the large sample size (n=1,363).

Almost no evidence was found that wind energy project preferences were influenced by participation experience. Respondents were asked to state their experience with wind energy with regard to the levels (1) no participation, (2) information, (3) consultation, (4) cooperation, and (5) financial participation. This selection of levels might not have worked well for the computer-based experiment as it is difficult to differentiate between the different levels. It is important that choice experiments include all relevant attributes of a wind energy project without overwhelming the participants with too much information. The thesis used an adaptive choice based conjoint approach to counteract this potential problem by only using those attributes which the participants judged as being crucial for them. Nevertheless, some respondents may have been overwhelmed by the number of attributes included in the experiment, despite adoption of this adaptive approach.

By limiting the number of attributes and the attribute levels in order to avoid overloading the participants with too much information, a further limitation is also introduced. The choice of product attributes and attribute levels considered in the wind energy project did not necessarily reflect the entire market. Specifically, the attribute participation included only six general levels. By taking a general view about these levels, it is not possible to conduct a detailed analysis, for instance, of the different forms of financial participation. Thus, the results have to be interpreted with care, considering that there might be other attributes which influence consumers' preferences, which have not been included.

Another issue is the problem of endogeneity. The term endogeneity usually refers to observed explanatory variables which correlate with the error term (Louviere et al. 2005). According to Liu et al. (2008), endogeneity is present in adaptive conjoint analysis as respondent's answers to previous questions are used to informatively construct the next question. In this sense, the future product description is influenced by past responses, which by equation are also linked to past error terms. However, endogeneity is not really a concern as it does not change the likelihood function of the data. The reason is due to the selection mechanism being completely determined by answers to previous questions. This is coupled with the fact that these previous answers are also included in the likelihood. Therefore, this thesis ignored the influence of endogeneity on the data.

5.2 Thematic discussion

In this section, the findings will be discussed in relation to the research questions outlined at the beginning of this thesis (see chapter 1.2). The relevant factors are explained in accordance to the four categories "personal characteristics", "perceived-side effects", "technical and geographical issues" and "process-related variables" (see chapter 3.1.1). The discussion is based on all three papers. Based on the first paper, the general influence of various factors on the acceptance of wind energy is evaluated. Through an extensive literature review, a number of factors were identified for each of the four categories. The discussion focuses only on the most dominant factors, while a complete list of factors can be found in the first paper. The second paper deals with the quantitative analysis of the identified dominant factors through an adaptive choice-based conjoint analysis. The factor distributive and procedural justice is analysed in an indirect way. Finally, the last paper applies a multinomial logistic regression analysis in order to identify the factors which explain citizens' active acceptance, ambivalence and active non-acceptance of wind energy.

Within the category "personal characteristics", two factors are of importance, namely experience with wind energy and conservative attitude. The finding of the qualitative analysis that experience with wind energy plays an important role is in line with findings of different studies (Ribeiro et al. 2011; Devine-Wright 2007; Ladenburg 2010; Ek et al. 2013). The quantitative analysis confirms these findings, as the probability of a citizen accepting wind energy increases with experience. Analysis of the adaptive choice based conjoint analysis showed that experience with wind energy has a positive impact on acceptance and this is in line with the study of Kaldellis et al. (2013), which showed that citizens with local experience of wind energy farms have increased noise tolerance and the vast majority of the respondents were not annoyed by the noise produced by the wind turbines. Kalkbrenner and Roosen's (2016) study about citizens' willingness to participate in local renewable energy projects showed that ownership of a renewable energy system positively affects willingness to participate in these projects. This result demonstrates again that the experience with

renewable energy contributes positively to its acceptance. All in all, the results of this thesis show that with increasing experience with wind energy, the utilities for wind energy project preferences where there is financial participation increases. This demonstrates that the more experience people have, the more they prefer financial participation.

With respect to the adoption of technology innovation, a traditional and conservative attitude might form a barrier to innovation. In this thesis, this factor was only analysed through the qualitative study. The qualitative study revealed that in the field of wind energy technology, traditionalism related to conformity and security predicts less support for environmentally friendly behaviour. This corresponds with the findings of the first paper, where the fear of change and the unknown facts related to a new energy technology are shown to have a negative influence on acceptance. This is in line with the study by Laukkanen (2016), which shows that individuals' existing values and past experience as well as social norms can form a potential tradition barrier towards innovations. Citizens might have special habits resulting from the use of a specific kind of energy technology over a long period of time. In addition, social and family values as well as social norms can influence the adoption of innovative products. Behaviour, in contrast to the adopted norms and values, mobilise the tradition barrier and disrupt adoption of an innovative product.

Within the category perceived side effects, infrasound and visual appearance of wind turbines were the factors which demonstrated the greatest influence on acceptance of wind energy. Infrasound has often been discussed by the scientific community in recent years (Baliatsas et al. 2016; Zajamšek et al. 2016; Crichton et al. 2014; Krahé et al. 2014). However, the issue has not been sufficiently investigated and remains disputed (Baliatsas et al. 2016). The study of LUBW (Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg 2016) concludes that infrasound has no adverse health effects. Magari et al. (2014) show that there is no relationship between infrasound and an individual's level of satisfaction. In contrast, other studies (Onakpoya et al. 2015; Groth and Vogt 2013; Liu et al. 2013; Pedersen et al. 2009) state that infrasound generated by wind turbines can influence sleep quality, mood, concentration and quality of life. According to our results, infrasound creates and generates the most resentment and antipathy towards wind energy technology. The higher the negative perception of infrasound is, the higher the probability is that citizens are not in favour of wind energy. In particular, the results of the adaptive choice based conjoint analysis demonstrate that the utilities for wind energy projects with none and alibi participation increases when negative perceptions of infrasound increase. This shows that people are afraid of the negative effects of infrasound on them and their environment. This is emphasized by the decreasing utility values for financial participation, which implies that a negative perception of infrasound cannot be compensated through financial participation.

This thesis defined visual appearance as the visibility of wind turbines in the landscpae from the place of residence. According to the adaptive choice based conjoint analysis, this factor plays a moderate role in the acceptance of wind energy. However, findings of the analysis of the multinomial regression suggest that the factor visual appearance has no significant influence.

With respect to the category “technical and geographical issues”, the factors hub height, the number of wind turbines and the distance to the place of residence are crucial to the acceptance of wind energy. In recent years, the hub height of wind turbines has increased, because there are higher wind velocities at greater heights, meaning that more electricity can be generated and profits can potentially increase. According to the choice experiment, hub height is the least important attribute. The low importance of this factor may be due to citizens already including it in the visibility at place of residence.

The number of turbines can have both a positive and a negative effect on the acceptance of wind energy. According to the qualitative results, a higher number of wind turbines impacts more negatively on acceptance of this technology. This is in line with the literature (Gibbons 2015; Ladenburg et al. 2013), which indicates that increasing the number of wind turbines leads to greater resistance towards wind energy amongst citizens. The scientific literature (Thayer and Freeman 1987) also suggests that acceptance of wind energy depends upon how often and how many wind turbines are seen by residents. Ladenburg et al. (2013) showed that there is a relation on whether the respondent has one or more wind turbines in their view from the residence. In other words, if respondents cannot see the turbine, there is no evidence that acceptance is affected by the number of turbines in the local area. If the resident can see the turbine, acceptance is significantly influenced by the number of turbines present. Furthermore, the results suggest that the cumulative effects of wind turbines can be mitigated or even removed if wind power capacity is increased by reducing the net number of turbines by replacing smaller turbines with larger ones, even though the larger turbines might be visible from a higher number of residences. Other studies suggest the existence of both positive and negative influences from the number of wind turbines on acceptance of wind energy (Ladenburg and Möller 2011; Ladenburg and Dahlgaard 2012) but the results of the choice experiment and multinomial regression in this thesis show that this factor has minor importance. Taking into consideration that this conclusion was reached through both quantitative methods, we can conclude that the number of turbines plays a minor role in the category “technical and geographical issues”, which is in line with the findings of other studies (Ladenburg 2010; Krohn and Damborg 1999).

Distance to the place of residence is a factor which is often discussed in scientific literature. The so called NIMBY effect implies a negative correlation between acceptance of wind

energy and a short distance to wind turbines from the place of residence. This has been supported by some studies (Jones and Eiser 2010; Devine-Wright 2007). However, more recently, the negative effect of NIMBY has been increasingly questioned (Spiess et al. 2015; Petrova 2016; Komendantova and Battaglini 2016). According to Warren et al. (2005) and Braunholtz (2003), the installation of wind turbines close to the place of residence has positive impacts on the acceptance of wind energy by citizens. According to the results of the choice experiment, citizens prefer wind turbines installed further away from their place of residence. In addition, the factor was the second most important attribute with respect to the acceptance of wind energy projects in the choice experiment. This finding supports previous studies (Devine-Wright 2005; Ladenburg 2008) which identified the NIMBY theory as a crucial part of acceptance. According to the results of the multinomial logistic regression, distance to the place of residence only showed significant values for the specific level “wind turbines not present”. The other two levels, which included different kilometre scales, were not found to be significant. The significant level for “wind turbines not present” correlates with the non-acceptance group. This finding implies that if citizens would be confronted with wind turbines, they would accept the technology. Citizens who are already used to wind turbines close to their place of residence (which is a form of experience) are more positive towards wind energy. The lack of acceptance of wind energy by citizens living further away might be explained through (1) lack of local experience (van der Horst, Dan 2007), (2) the time stage of the development of the wind project (Breukers and Wolsink 2007) and (3) the scale of economic benefits (Jones and Eiser 2010). Altogether, the findings of this thesis contribute to research both addressing contributors and antecedents of the NIMBY theory.

Relevant factors within the category “process-related variables” are the regulatory framework for wind energy, participation mode, and procedural and distributive justice. The perception of policy processes in the context of wind energy can be influenced by the consistency, reliability and stability of the policy framework. According to the study by Ek et al. (2013), political changes on energy issues can be divided into indirect and direct factors. An indirect factor would be, for instance, government electricity policy, which can be transformed to a direct factor, such as explicit incentive programs or planning and approval procedures. The study by Ek et al. (2013) found that a change in Swedish energy policy affected the investments in wind power in Sweden. While the first wind power investments in Sweden were highly influenced by individual wind energy enthusiasts, the more recent large-scale investments are influenced by market-based judgments about future profitability. This result is in line with the outcome of this thesis, i.e. that energy policy can play a convincing and decisive factor with respect to the acceptance of wind energy. The qualitative analysis identified the perception of political processes as being relevant for the acceptance of wind

energy. However, the quantitative analysis demonstrated that the perception of the policy framework only plays a minor role.

The finding that financial participation is of minor importance compared to the information, consultation and cooperation participation levels was surprising at first, as it is contradictory to previous findings (Corscadden et al. 2012; Upham and García Pérez 2015; Yildiz et al. 2015). Possible explanations might be that (1) citizens prefer to actively take part in the decision-making process during planning and construction of a wind farm, (2) there is lack of knowledge about financial investments, or (3) the German population is generally risk averse with respect to financial investments. In addition, the results of this thesis demonstrate, as expected, that alibi and no participation forms are evaluated negatively by citizens. Our analyses shed light on preferred participation modes. The information mode was the most preferred participation level. Thus, it could be particularly important for the acceptance of wind energy to provide enough relevant information to citizens. People also preferred participation modes in which they could state and discuss their opinion on specific wind energy projects.

The factor “procedural and distributive” justice was shown to be crucial for acceptance in both the qualitative and quantitative analyses. This outcome is confirmed by existing literature (Walter 2014). One should take into account that the form of justice also depends on the form of participation. For instance, distributive justice is connected to financial participation, as this participation entails the distribution of profits, while procedural justice is related to consultation and cooperation, with citizens actively participating in the planning and realisation of wind energy projects. The qualitative study showed that a sub-item of justice is envy amongst citizens. This envy can be classified into two dimensions, namely at the neighbour and regional levels (Langer et al. 2016). The neighbour level involves conflicts among citizens arising from the perception of unjustly distributed financial support. These discrepancies can develop, for instance, if a farmer or land owner receives a financial benefit because the wind farm is built on their property, whereas neighbours nearby experience a reduction in the value of their land but do not receive any financial compensation for this. This situation can be drive envious feelings and lead to division in the community with respect to wind energy. At the regional level, envy refers to the concentration of wind farms within certain federal states or regions. An unequal distribution of wind farms in certain areas can cause annoyance and feelings of injustice among those citizens who live in those areas with a high concentration of wind turbines.

Another important aspect of the acceptance of wind energy are demographic/ geographic variables. These factors are also valuable to know as they give further insights into the target group. A better understanding of which individuals are more likely to accept or reject wind

energy may help policy makers to design relevant interventions. Therefore, in addition to analysing the four abovementioned categories, this thesis additionally analysed the relationship between socio-demographic/ geographic variables and the acceptance of wind energy. Our results showed that socio-demographics (i.e. age, income and gender) or geographic (i.e. size of city) variables have little influence on acceptance. Gender and education had no significant influence on the acceptance of wind energy, a finding which is in line with Ek et al. (2013), The variables age ($P< 0.1$), financial income ($P< 0.1$ for Model 1, $P< 0.05$ for Model 3) (see paper 3) and number of inhabitants ($P< 0.1$) had a small but significant influence. The results of the multinomial logit model demonstrate that financial income impacts the ambivalence and non-acceptance groups but not the acceptance group. Age also had an influence on the non-acceptance group, while the number of inhabitants in the community affected the acceptance group. These results imply that people with higher financial incomes and older people tend to dislike wind energy, while people living in cities with a high number of inhabitants are more likely to favour it. The finding that rural areas are classified more in the non-acceptance group is in line with the study of Ek et al. (2013), who explains this issue through extensive infrastructure such as grids and roads.

6 Conclusions and future implications

This section summarises the thesis and takes into account the results of all three papers in order to draw the final conclusions and give a short overview about future implications of this research.

Having shown the negative effect of infrasound on acceptance of wind energy, this thesis suggests that education measures for citizens about the specific issue of infrasound are needed. This finding could be of particular interest when developing communication strategies. Additional information clarifying this issue and informing citizens about the term infrasound could prevent and reduce misunderstandings, distrust and anxieties about wind energy technologies. The issue of infrasound seems to generate a fear in society. The interplay between experience with wind energy and the issue of infrasound should be emphasized. The more experience citizens have with wind energy, the more knowledge they have and the less they fear infrasound. Further studies should concentrate on the interplay between knowledge, perception of infrasound and the acceptance of wind energy. Future studies could also examine how information about infrasound from wind energy is received and its influence on acceptance levels. It would be interesting to investigate acceptance in a community with a wind farm, where information campaigns or education events about infrasound have been conducted. It is crucial to understand how providing information to citizens about infrasound affects acceptance of wind energy.

The acceptance of wind energy seems to be decisively influenced by communication about the acceptance object. Active participation forms and information are becoming increasingly important for the political-administrative system. The right to information and participation has been steadily expanded in recent decades. There are increasing rights to participate. This thesis shows that the level of participation influences the acceptance of wind energy by citizens. Distribution of information about specific wind energy projects could reduce the chances of rejection of the project. A communication strategy could help to influence citizen's opinion of wind energy positively. Therefore, the wind energy industry should also take into account communication methods where people can express their opinion. Future research should also elaborate on the interplay between acceptance and different forms of communication and involvement mechanism of citizen into wind energy projects. This thesis summarised and comprised different participation mechanism in a broad and general way into five groups: (1) no participation, (2) information, (3) consultation, (4) cooperation and (5) financial participation. As these levels can include a lot of different activities, future studies should delve deeper into the specific participation levels.

In order to increase financial investment by private individuals in this field, financial institutions could inform citizens more about investment possibilities in wind energy

technologies. The activities of wind energy developers and operators could be complemented by more responsive and deliberative forms of participation. Future studies could elaborate on specific types of financial participation with respect to the acceptance of wind energy and examine which types are more dominant in influencing this acceptance. Gamel et al. (2016) show that typical capital investment criteria such as the minimum investment amount, the duration of the investment offer in years and the return on investment per year are the most important attributes of private wind energy investors' preferences. The differences between these various forms of financial participation might have an influence on the acceptance of wind energy.

With respect to socio-demographic characteristics, age and the number of inhabitants play a crucial role for the level of acceptance. This is an important consideration for policy makers which requires further investigation, especially to analyse how older people in small towns could be become more accepting of wind energy technologies.

Experience with wind energy also has an important role in influencing the acceptance levels. However, further studies which concentrate on the different forms of experience would be interesting, as experience itself can range from private to professional experience. Research could focus on the differences between the levels of acceptance among citizens living close to a wind turbine (private experience) and those who work in the area of renewable energies (professional experience).

The factor justice also has a significant influence on acceptance of wind energy. It could be interesting to investigate whether there are differences between northern and southern Germany arising from the unequal distribution of wind turbines. Future studies should also expand to incorporate different countries. Cross-national studies of the European Union and other countries could analyse the similarities and differences between these countries, as the quantity installed of wind energy in a given country seems to impact the acceptance (Toke et al. 2008). Countries with different targets for renewable energies would be interesting subjects of research. It would be worth researching countries which take different approaches to their energy supply to uncover the differences among them.

The conclusion which can be drawn from this thesis is that a number of factors have an influence on the acceptance of wind energy. Key factors for citizens' acceptance levels are the level of participation and the perception of infrasound. In addition, it seems important to further understand the interplay between the motives, beliefs and resulting citizens' preferences.

References

Aegerter, I.; Bucher, P. (1993): Public participation in political decisions on nuclear energy: the Swiss practice. In: Proceedings of An International Workshop, S. 164–167.

Agatz, Monika (2014): Windenergie Handbuch. 11. Aufl.

Agentur für Erneuerbare Energien (2016): Die Akzeptanz für erneuerbare Energien im Spiegel von Umfragen in Industriestaaten. In: Renews Kompakt (29).

Agnew, S.; Dargusch, P. (2015): Effect of residential solar and storage on centralized electricity supply systems. In: Nature Climate Change 5 (4), S. 315–318.

Agora Energiewende (2015): Understanding the Energiewende. FAQ on the ongoing transition of the German power system. Berlin.

Agora Energiewende (2016): Energiewende: what do the new laws mean? Ten questions and answers about EEG 2017, the Electricity Market Act, and the Digitisation Act. Berlin.

Agora Energiewende (2017): Die Energiewende im Stromsektor: Stand der Dinge 2016. Rückblick auf die wesentlichen Entwicklungen sowie Ausblick auf 2017. Berlin.

Albers, Sönke (Hg.) (2009): Methodik der empirischen Forschung. 3., überarb. und erw. Aufl. Wiesbaden: Gabler.

Álvarez-Farizo, Begoña; Hanley, Nick (2002): Using conjoint analysis to quantify public preferences over the environmental impacts of wind farms. An example from Spain. In: Energy Policy 30 (2), S. 107–116. DOI: 10.1016/S0301-4215(01)00063-5.

Araújo, Kathleen (2014): The emerging field of energy transitions: Progress, challenges, and opportunities. In: Energy Research & Social Science 1, S. 112–121. DOI: 10.1016/j.erss.2014.03.002.

ARL (2013): Privilegierung von Außenbereichsvorhaben i. S. d. § 35 BauGB. Hg. v. Akademie für Raumforschung und Landesplanung. Hannover.

Arnstein, Sherry A. (1969): A ladder of citizen participation. In: AIP Journal, S. 216–224.

Atteslander, Peter (2008): Methoden der empirischen Sozialforschung. 12., durchges. Aufl. Berlin: Erich Schmidt (ESV basics).

Backhaus, Klaus (2016): Multivariate Analysemethoden. Eine anwendungsorientierte Einführung. 14. Aufl. Berlin, Heidelberg: Springer Gabler.

Baliatsas, Christos; van Kamp, Irene; van Poll, Ric; Yzermans, Joris (2016): Health effects from low-frequency noise and infrasound in the general population: Is it time to listen? A systematic review of observational studies. In: The Science of the total environment 557-558, S. 163–169. DOI: 10.1016/j.scitotenv.2016.03.065.

Bavarian Ministry of Economic Affairs and Media, Energy and Technology (2013): Wegweiser für Energieprojekte in Bayern. Beratung und Förderung. Hg. v. Bayerische Energieagentur ENERGIE INNOVATIV und Bayerisches Staatsministerium für Wirtschaft und Medien, Energie und Technologie. München.

Bavarian State Ministry of the Environment and Consumer Protection (2013): Klimaschutz Bayern 2020. Hg. v. Bayerische Staatsregierung. München.

Baxter, Jamie; Morzaria, Rakhee; Hirsch, Rachel (2013): A case-control study of support/opposition to wind turbines: perceptions of health risk, economic benefits, and community conflict. In: Energy Policy 61, S. 931–943. DOI: 10.1016/j.enpol.2013.06.050.

Beierle, Thomas C. (1998): Public participation in environmental decisions: an evaluation framework using social goals. Hg. v. Resources for the Future. Washington.

Bell, Derek; Gray, Tim; Haggett, Claire; Swaffield, Joanne (2013): Re-visiting the 'social gap': public opinion and relations of power in the local politics of wind energy. In: Environmental Politics 22 (1), S. 115–135. DOI: 10.1080/09644016.2013.755793.

Bidwell, David (2016): The Effects of Information on Public Attitudes Toward Renewable Energy. In: Environment and Behavior 48 (6), S. 743–768. DOI: 10.1177/0013916514554696.

Bogner, Alexander; Littig, Beate; Menz, Wolfgang (2014): Interviews mit Experten. Eine praxisorientierte Einführung. Wiesbaden: Springer VS.

Braunholtz, Simon (2003): Public attitudes to windfarms. A survey of local residents in Scotland. Edinburgh: Scottish Executive, Social Research.

Brennan, Noreen; Van Rensburg, Thomas M. (2016): Wind farm externalities and public preferences for community consultation in Ireland: a discrete choice experiments approach. In: Energy Policy 94, S. 355–365. DOI: 10.1016/j.enpol.2016.04.031.

Breukers, Sylvia; Wolsink, Maarten (2007): Wind power implementation in changing institutional landscapes: an international comparison. In: Energy Policy 35 (5), S. 2737–2750. DOI: 10.1016/j.enpol.2006.12.004.

Brian, Marcus; Weber, Diethard (2014): Öffentlichkeitsarbeit für Geothermieprojekte. Planung, strategische Ausrichtung und Umsetzung von Kommunikationsmaßnahmen durch Projektbetreiber. Enerchange Agentur für erneuerbare Energien. Freiburg i. Brsg.

Bronfman, Nicolás C.; Jiménez, Raquel B.; Arévalo, Pilar C.; Cifuentes, Luis A. (2012): Understanding social acceptance of electricity generation sources. In: Energy Policy 46, S. 246–252. DOI: 10.1016/j.enpol.2012.03.057.

Bryman, Alan (2008): Social research methods. 3rd ed. Oxford, New York: Oxford University Press.

Buber, Renate (Hg.) (2009): Qualitative Marktforschung. Konzepte, Methoden, Analysen. 2. Aufl. Wiesbaden: Gabler (Lehrbuch).

Bundesverband WindEnergie e.V. (2013): Windenergie in Bürgerhand. Energie aus der Region für die Region. Hg. v. Bundesverband WindEnergie e.V. Berlin.

Bundesverband WindEnergie e.V. (2015): Ausschreibungen für Windenergie an Land. Ein Modell für den Leistungsträger Wind? 2. Aufl. Berlin.

Bush, Drew; Hoagland, Porter (2016): Public opinion and the environmental, economic and aesthetic impacts of offshore wind. In: Ocean Coastal Management 120, S. 70–79.

Ciupuliga, A. R.; Cuppen, E. (2013): The role of dialogue in fostering acceptance of transmission lines: the case of a France–Spain interconnection project. In: Energy Policy 60, S. 224–233. DOI: 10.1016/j.enpol.2013.05.028.

Corscadden, Kenny; Wile, Adam; Yiridoe, Emmanuel (2012): Social license and consultation criteria for community wind projects. In: Renewable Energy 44, S. 392–397. DOI: 10.1016/j.renene.2012.02.009.

Cowell, Richard; Bristow, Gill; Munday, Max (2011): Acceptance, acceptability and environmental justice: the role of community benefits in wind energy development. In: Journal of Environmental Planning and Management; 54 (4), S. 539–557.

Crichton, Fiona; Dodd, George; Schmid, Gian; Gamble, Greg; Petrie, Keith J. (2014): Can expectations produce symptoms from infrasound associated with wind turbines? In: Health psychology: official journal of the Division of Health Psychology, American Psychological Association 33 (4), S. 360–364. DOI: 10.1037/a0031760.

Davis, Fred D.; Bagozzi, Richard P.; Warshaw, Paul R. (1998): User acceptance of computer technology: a comparison of two theoretical models. In: Management Science 35 (8), S. 982–1003.

de Sisternes, Fernando J.; Jenkins, Jesse D.; Botterud, Audun (2016): The value of energy storage in decarbonizing the electricity sector. In: Applied Energy 175, S. 368–379. DOI: 10.1016/j.apenergy.2016.05.014.

Devine-Wright, Patrick (2005): Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. In: Wind energy 8 (2), S. 125–139. DOI: 10.1002/we.124.

Devine-Wright, Patrick (2007): Reconsidering public attitudes and public acceptance of renewable energy technologies: a critical review. University of Manchester, School of Environment and Development. Manchester.

Devlin, Elizabeth (2005): Factors affecting public acceptance of wind turbines in Sweden. In: Wind energy, 2005 (29), S. 503–511.

Diekmann, Andreas (2010): Empirische Sozialforschung. Grundlagen, Methoden, Anwendungen. Orig.-Ausg., [21.] Aufl., vollst. überarb. u. erw. Neuausg. Reinbek bei Hamburg: Rowohlt-Taschenbuch-Verl (Rororo, 55678 : Rowohlts Enzyklopädie).

Dillman, Don A.; Smyth, Jolene D.; Christian, Leah Melani (2014): Internet, mail, and mixed-mode surveys. The tailored design method. 4. ed. Hoboken, NJ: John Wiley.

Dimitropoulos, Alexandros; Kontoleon, Andreas (2009): Assessing the determinants of local acceptability of wind-farm investment: a choice experiment in the Greek Aegean Islands. In: Energy Policy 37 (5), S. 1842–1854. DOI: 10.1016/j.enpol.2009.01.002.

Ek, Kristina; Persson, Lars (2014): Wind farms - where and how to place them? A choice experiment approach to measure consumer preferences for characteristics of wind farm establishments in Sweden. In: Ecological Economics (105), S. 193–203.

Ek, Kristina; Persson, Lars; Johansson, Maria; Waldo, Åsa (2013): Location of Swedish wind power— random or not? A quantitative analysis of differences in installed wind power capacity across Swedish municipalities. In: Energy Policy 58, S. 135–141. DOI: 10.1016/j.enpol.2013.02.044.

Eltham, Douglas C.; Harrison, Gareth P.; Allen, Simon J. (2008): Change in public attitudes towards a Cornish wind farm: implications for planning. In: Energy Policy 36 (1), S. 23–33. DOI: 10.1016/j.enpol.2007.09.010.

Energieagentur NRW (2016): WindPlanung.Navi. Wegweiser durch den Planungs- und Genehmigungsprozess von Windenergieanlagen. Düsseldorf.

Enevoldsen, Peter; Sovacool, Benjamin K. (2015): Examining the social acceptance of wind energy: practical guidelines for onshore wind project development in France. In: Renewable and Sustainable Energy Reviews (53), S. 178–184.

Fachagentur Windenergie an Land (2016): Umfrage zur Akzeptanz der Windenergie an Land Frühjahr 2016. Ergebnisse einer repräsentativen Umfrage zur Akzeptanz der Nutzung und des Ausbaus der Windenergie an Land in Deutschland. Berlin.

Fachagentur Windenergie an Land (2017): Genehmigungsverfahren für Windenergieanlagen. Berlin.

Fast, Stewart (Hg.) (2015): Social science explanations for host community responses to wind energy. Berlin: Springer.

Federal Ministry for Economic Affairs and Energy (2014): Die Energie der Zukunft. Ein gutes Stück Arbeit. Erster Fortschrittsbericht zur Energiewende. Berlin.

Federal Ministry for Economic Affairs and Energy (2016a): EEG-Novelle 2016. Fortgeschriebenes Eckpunktepapier zum Vorschlag des BMWi für das neue EEG. Bundesministerium für Wirtschaft und Energie (BMWi). Berlin.

Federal Ministry for Economic Affairs and Energy (2016b): Entwicklung der erneuerbaren Energien in Deutschland im Jahr 2015. Bundesministerium für Wirtschaft und Energie (BMWi). Berlin.

Firestone, Jeremy; Kempton, Willett; Lilley, Meredith Blaydes; Samoteskul, Kateryna (2012): Public acceptance of offshore wind power across regions and through time. In: Journal of Environmental Planning and Management; 10 (55), S. 1387–1402.

Foscht, Thomas; Swoboda, Bernhard; Schramm-Klein, Hanna (2015): Käuferverhalten. Grundlagen - Perspektiven - Anwendungen. 5., überarb. u. erw. Aufl. 2015. Wiesbaden: Springer Fachmedien Wiesbaden GmbH.

Früh, Werner (2011): Inhaltsanalyse. Theorie und Praxis. 7. Aufl. Konstanz: UVK-Verl.-Ges.

Gamel, Johannes; Menrad, Klaus; Decker, Thomas (2016): Is it really all about the return on investment? Exploring private wind energy investors' preferences. In: Energy Research & Social Science 14, S. 22–32. DOI: 10.1016/j.erss.2016.01.004.

Gangale, F.; Mengolini, A.; Onyeji, I. (2013): Consumer engagement: an insight from smart grid projects in Europe. In: Energy Policy 60, S. 621–628.

Geißler, Gesa; Köppel, Johann; Gunther, Pamela (2013): Wind energy and environmental assessments – a hard look at two forerunners' approaches: Germany and the United States. In: Renewable Energy 51, S. 71–78. DOI: 10.1016/j.renene.2012.08.083.

Geissmann, Markus; Hubert, Stefanie (2011): Soziale Akzeptanz von Windenergie. Erfolgsfaktoren und Good-Practice-Beispiele aus einer Arbeitsgruppe der Internationalen Energieagentur IEA. In: Bulletin-online (3), S. 8–11. Online verfügbar unter http://www.socialacceptance.ch/images/VSE_Bulletin_Task28_2011.pdf.

German Wind Energy Association (2015): Wind bewegt Bayern. Informationen zur Windenergie. Hg. v. Bundesverband WindEnergie e.V. Berlin.

Gibbons, Stephen (2015): Gone with the wind: Valuing the visual impacts of wind turbines through house prices. In: Journal of Environmental Economics and Management 72, S. 177–196. DOI: 10.1016/j.jeem.2015.04.006.

Gläser, Jochen; Laudel, Grit (2010): Experteninterviews und qualitative Inhaltsanalyse. Als Instrumente rekonstruierender Untersuchungen. 4. Aufl. Wiesbaden: VS Verlag für Sozialwiss (Lehrbuch).

Green, P. E.; Srinivasan, V. S. (1978): Conjoint Analysis in Consumer Research: issues and outlook. In: Journal of Consumer Research 5, S. 103–123.

Greenberg, Michael (2009): Energy sources, public policy, and public preferences: analysis of US national and site-specific data. In: Energy Policy 37 (8), S. 3242–3249. DOI: 10.1016/j.enpol.2009.04.020.

Gross, Catherine (2007): Community perspectives of wind energy in Australia: the application of a justice and community fairness framework to increase social acceptance. In: Energy Policy 35 (5), S. 2727–2736. DOI: 10.1016/j.enpol.2006.12.013.

Groth, Theresa M.; Vogt, Christine (2013): Residents' perceptions of wind turbines: an analysis of two townships in Michigan. In: Energy Policy 65, S. 251–260. DOI: 10.1016/j.enpol.2013.10.055.

Gustafsson, Sara; Ivner, Jenny; Palm, Jenny (2014): Management and stakeholder participation in local strategic energy planning – examples from Sweden. In: Journal of Cleaner Production. DOI: 10.1016/j.jclepro.2014.08.014.

Hammami, Samiha Mjahed; chtourou, Sahar; Triki, Abdelfattah (2016): Identifying the determinants of community acceptance of renewable energy technologies: The case study of a wind energy project from Tunisia. In: Renewable and Sustainable Energy Reviews 54, S. 151–160. DOI: 10.1016/j.rser.2015.09.037.

Hertel, Manuel (2014): Adoption energieeffizienter Techniken in KMU. Das Management im Fokus einer empirischen Untersuchung. München: Springer Gabler.

Hessisches Ministerium für Umwelt, Klimaschutz, Landwirtschaft und Verbraucherschutz (2014): Verfahrenshandbuch zum Vollzug des BImSchG. Durchführung von Genehmigungsverfahren bei Windenergieanalagen. Wiesbaden.

Hilbe, Joseph M. (2009): Logistic regression models. Boca Raton: CRC Press (Chapman & Hall/CRC texts in statistical science series).

Hinton, Perry R.; McMurray, Isabella; Brownlow, Charlotte (2014): SPSS explained. 2. Aufl. London, New York: Routledge.

Hobman, Elizabeth V.; Ashworth, Peta (2013): Public support for energy sources and related technologies: the impact of simple information provision. In: Energy Policy 63, S. 862–869. DOI: 10.1016/j.enpol.2013.09.011.

Hofinger, Gesine (2001a): "Akzeptanz" - Formen von Sichtweisen auf ein Biospärenreservat. In: Umweltpsychologie 1, 2001, S. 10–27.

Hofinger, Gesine (2001b): Denken über Umwelt und Natur. 1. Aufl. Weinheim: Psychologie Verlags Union; Verlagsgruppe Beltz.

Hopf, Christel; Schmidt, Christiane (1993): Zum Verhältnis von innerfamilialen sozialen Erfahrungen, Persönlichkeitsentwicklung und politis chen Orientierungen. Dokumentation

und Erörterung des methodischen Vorgehens in einer Stud ie zu diesem Thema. Hg. v. Universität Hildesheim. Institut für Sozialwissenschaften.

Hosmer, David W.; Lemeshow, Stanley; Sturdivant, Rodney X. (2013): Applied logistic regression. 3. Aufl. (Wiley series in probability and statistics).

Howard, Tanya (2015): Olivebranches and idiot's guides: frameworks for community engagement in Australian wind farm development. In: Energy Policy 78, S. 137–147. DOI: 10.1016/j.enpol.2014.12.026.

Hübner, Gundula; Löffler, Elisabeth (2013): Wirkungen von Windkraftanlagen auf Anwohner in der Schweiz: Einflussfaktoren und Empfehlungen. Martin-Luther-Universität Halle–Wittenberg; Universität St. Gallen. Halle.

IEA (2016): Key renewables - trends excerpt from: renewable information. Hg. v. International Energy Agency. Paris.

Intergovernmental Panel on Climate Change (2014): Climate change 2014: mitigation of climate change. Working Group III Contribution to the IPCC Fifth Assessment report of the intergovernmental panel on climate change. United States of America.

Jensen, Catherine Ulla; Panduro, Toke Emil; Lundhede, Thomas Hedemark (2014): The vindication of Don Quijote: the impact of noise and visual pollution from wind turbines on local residents in Denmark. In: Land Economics 90 (4), S. 668–682.

Jones, Christopher R.; Eiser, J. Richard (2010): Understanding ‘local’ opposition to wind development in the UK: how big is a backyard? In: Energy Policy 38 (6), S. 3106–3117. DOI: 10.1016/j.enpol.2010.01.051.

Kaldellis, J. K.; Kapsali, M.; Kaldelli, El.; Katsanou, Ev. (2013): Comparing recent views of public attitude on wind energy, photovoltaic and small hydro applications. In: Renewable Energy 52, S. 197–208. DOI: 10.1016/j.renene.2012.10.045.

Kalkbrenner, Bernhard J.; Roosen, Jutta (2016): Citizens’ willingness to participate in local renewable energy projects: The role of community and trust in Germany. In: Energy Research & Social Science 13, S. 60–70. DOI: 10.1016/j.erss.2015.12.006.

Knopper, Loren D.; Ollson, Christopher A. (2011): Health effects and wind turbines: a review of the literature. In: Environmental Health; 10, S. 78. DOI: 10.1186/1476-069X-10-78.

Komendantova, Nadejda; Battaglini, Antonella (2016): Beyond Decide-Announce-Defend (DAD) and Not-in-My-Backyard (NIMBY) models? Addressing the social and public acceptance of electric transmission lines in Germany. In: Energy Research & Social Science 22, S. 224–231. DOI: 10.1016/j.erss.2016.10.001.

Krahé, Detlef; Schreckenberg, Dirk; Ebner, Fabian; Eulitz, Christian; Möhler, Ulrich (2014): Machbarkeitsstudie zu Wirkungen von Infraschall. Entwicklung von Untersuchungsdesigns für die Ermittlung der Auswirkungen von Infraschall auf den Menschen durch unterschiedliche Quellen. Umweltbundesamt. Dessau-Roßlau (40).

Krohn, Soren; Damborg, Steffen (1999): On public attitudes towards wind power. In: Renewable Energy (16), S. 954–960.

Kuckartz, Udo (2011): Mixed Methods. Methodologie, Forschungsdesigns und Analyseverfahren. Wiesbaden: Springer VS (Lehrbuch).

Kuckartz, Udo (2012): Qualitative Inhaltsanalyse. Methoden, Praxis, Computerunterstützung. Weinheim: Juventa.

Ladenburg, Jacob (2008): Attitudes towards on-land and offshore wind power development in Denmark; choice of development strategy. In: Renewable Energy 33 (1), S. 111–118. DOI: 10.1016/j.renene.2007.01.011.

Ladenburg, Jacob (2010): Attitudes towards offshore wind farms—the role of beach visits on attitude and demographic and attitude relations. In: Energy Policy 38 (3), S. 1297–1304. DOI: 10.1016/j.enpol.2009.11.005.

Ladenburg, Jacob (2014): Dynamic properties of the preferences for renewable energy sources – a wind power experience-based approach. In: Energy 76, S. 542–551. DOI: 10.1016/j.energy.2014.08.050.

Ladenburg, Jacob; Dahlgaard, Jens-Olav (2012): Attitudes, threshold levels and cumulative effects of the daily wind-turbine encounters. In: Applied Energy 98, S. 40–46. DOI: 10.1016/j.apenergy.2012.02.070.

Ladenburg, Jacob; Dubgaard, Alex (2007): Willingness to pay for reduced visual disamenities from offshore wind farms in Denmark. In: Energy Policy 35 (8), S. 4059–4071. DOI: 10.1016/j.enpol.2007.01.023.

Ladenburg, Jacob; Möller, Bernd (2011): Attitude and acceptance of offshore wind farms—The influence of travel time and wind farm attributes. In: Renewable and Sustainable Energy Reviews 15 (9), S. 4223–4235. DOI: 10.1016/j.rser.2011.07.130.

Ladenburg, Jacob; Termansen, Mette; Hasler, Berit (2013): Assessing acceptability of two onshore wind power development schemes: A test of viewshed effects and the cumulative effects of wind turbines. In: Energy 54, S. 45–54. DOI: 10.1016/j.energy.2013.02.021.

Lamnek, Siegfried (2010): Qualitative Sozialforschung. Lehrbuch. 5. Aufl. Weinheim, Basel: Beltz.

Langer, Katharina; Decker, Thomas; Roosen, Jutta; Menrad, Klaus (2016): A qualitative analysis to understand the acceptance of wind energy in Bavaria. In: Renewable and Sustainable Energy Reviews 64, S. 248–259. DOI: 10.1016/j.rser.2016.05.084.

Laukkanen, Tommi (2016): Consumer adoption versus rejection decisions in seemingly similar service innovations: The case of the Internet and mobile banking. In: Journal of Business Research 69 (7), S. 2432–2439. DOI: 10.1016/j.jbusres.2016.01.013.

Leuphana Universität; Nestle, Uwe (2014): Marktrealität von Bürgerenergie und mögliche Auswirkungen von regulatorischen Eingriffen in die Energiewende. Bundes für Umwelt und Naturschutz Deutschland; Bündnisses Bürgerenergie e.V. Lüneburg, Kiel.

Liu; Qing; Otter, Thomas; Allenby, Greg (2008): Endogeneity bias- fact or fiction?

Liu, Wenling; Wang, Can; Mol, Arthur P.J. (2013): Rural public acceptance of renewable energy deployment: The case of Shandong in China. In: Applied Energy 102, S. 1187–1196. DOI: 10.1016/j.apenergy.2012.06.057.

Louviere, J. J.; Street, D.; Burgess, L.; Wasi, N.; Islam, T.; Marley, A.A.J. (2008): Modeling the choices of individual decision-makers by combining efficient choice experiment designs with extra preference information. In: Journal of Choice Modelling 1 (1), S. 128–164.

Louviere, Jordan; Train, Kenneth; Ben-Akiva, Moshe; Bhat, Chandra R.; Brownstone, David; Cameron, Trudy A. et al. (2005): Recent progress on endogeneity in choice modeling. In: Marketing Letters 16 (3-4), S. 255–265.

LUBW Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg (2016): Tieffrequente Geräusche inkl. Infraschall von Windkraftanlagen und anderen Quellen. Bericht über Ergebnisse des Messprojekts 2013-2015. Karlsruhe.

Lucke, D. (1995): Akzeptanz. Legitimität in der "Abstimmungsgesellschaft". Opladen: Leske + Budrich.

Magari, Shannon, R.; Smith, Clinton, E.; Schiff, Martin; Rohr, Annette C. (2014): Evaluation of community response to wind-related noise in Western New York State. In: Noise Health 16 (71), S. 228–239.

Mah, Daphne, Ngar-yin; Hills, Peter (2014): Participatory governance for energy policy-making: a case study of the UK nuclear consultation in 2007. In: Energy Policy 74, S. 340–351. DOI: 10.1016/j.enpol.2014.08.002.

Mallett, Alexandra (2007): Social acceptance of renewable energy innovations: The role of technology cooperation in urban Mexico. In: Energy Policy 35 (5), S. 2790–2798. DOI: 10.1016/j.enpol.2006.12.008.

Maruyama, Yasushi; Nishikido, Makoto; Iida, Tetsunari (2007): The rise of community wind power in Japan: enhanced acceptance through social innovation. In: Energy Policy 35 (5), S. 2761–2769. DOI: 10.1016/j.enpol.2006.12.010.

Mayring, Philipp (2015): Qualitative Inhaltsanalyse. Grundlagen und Techniken. 12., aktualisierte und überarb. Aufl. Weinheim [u.a.]: Beltz (Beltz Pädagogik).

Ministerium für Wirtschaft, Klimaschutz, Energie und Landesplanung (2013): Windenergie und Kommunen. Leitfaden für die kommunale Praxis. Hg. v. Ministerium für Wirtschaft, Klimaschutz, Energie und Landesplanung. Mainz.

Musall, Fabian David; Kuik, Onno (2011): Local acceptance of renewable energy—a case study from southeast Germany. In: Energy Policy 39 (6), S. 3252–3260. DOI: 10.1016/j.enpol.2011.03.017.

NABU; BUND (2014): Beteiligungsleitfaden Windenergie. Hinweise zu Beteiligungsmöglichkeiten von Verbänden in Verfahren zur Planung und Genehmigung von Windenergieanlagen. Hg. v. Naturschutzbund Deutschland Landesverband Baden-Württemberg e.V. und Bund für Umwelt und Naturschutz Deutschland e.V. Reinheim.

Onakpoya, Igho J.; O'Sullivan, Jack; Thompson, Matthew J.; Heneghan, Carl J. (2015): The effect of wind turbine noise on sleep and quality of life: A systematic review and meta-analysis of observational studies. In: Environment international 82, S. 1–9. DOI: 10.1016/j.envint.2015.04.014.

Orme, Bryan K. (2014): Getting started with conjoint analysis. Strategies for product design and pricing research. 3. ed. Glendale: Research Publ.

Ottinger, Gwen; Hargrave, Timothy J.; Hopson, Eric (2014): Procedural justice in wind facility siting: recommendations for state-led siting processes. In: Energy Policy 65, S. 662–669. DOI: 10.1016/j.enpol.2013.09.066.

Pedersen, Eja; van den Berg, Frits; Bakker, Roel; Bouma, Jelte (2009): Response to noise from modern wind farms in The Netherlands. In: J. Acoust. Soc. Am. 126 (2), S. 634. DOI: 10.1121/1.3160293.

Petrova, Maria A. (2016): From NIMBY to acceptance: toward a novel framework -VESPA- for organizing and interpreting community concerns. In: Renewable Energy 86, S. 1280–1294. DOI: 10.1016/j.renene.2015.09.047.

Phillips, K. A.; Johnson, F. R.; Maddala, T. (2002): Measuring what people value: a comparison of “attitude” and “preference” surveys. In: Health Services Research 37 (6), S. 1659–1679.

Pohl, Johannes; Faul, Franz; Mausfeld, Rainer (2000): Belästigung durch periodischen Schattenwurf von Windenergieanlagen. Laborpilotstudie. Christian-Albrechts-Universität. Kiel.

Rand, Joseph; Hoen, Ben (2017): Thirty years of North American wind energy acceptance research: What have we learned? In: Energy Research & Social Science 29, S. 135–148. DOI: 10.1016/j.erss.2017.05.019.

Renn, Ortwin; Webler, Thomas (1992): Anticipating Conflicts: Public Participation in Managing the Solid Waste Crisis. In: Gesellschaft & Umwelt (2), S. 84–94.

Ribeiro, Fernando; Ferreira, Paula; Araújo, Madalena (2011): The inclusion of social aspects in power planning. In: Renewable and Sustainable Energy Reviews 15 (9), S. 4361–4369. DOI: 10.1016/j.rser.2011.07.114.

Rogers, Everett M. (2005): Diffusion of innovations. 5. Aufl. New York: Free Press.

Sagebiel, Julian; Müller, Jakob R.; Rommel, Jens (2014): Are consumers willing to pay more for electricity from cooperatives? Results from an online choice experiment in Germany. In: Energy Research & Social Science 2, S. 90–101. DOI: 10.1016/j.erss.2014.04.003.

Salm, Sarah; Hille, Stefanie Lena; Wüstenhagen, Rolf (2016): What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. In: Energy Policy 97, S. 310–320. DOI: 10.1016/j.enpol.2016.07.042.

Sauer, Alexandra; Luz, Frieder; Suda, Michael, Weiland, Ulrike (2005): Steigerung der Akzeptanz von FFH-Gebieten. BfN-Skripten. Hg. v. Bundesamt für Naturschutz (144).

Schweizer-Ries, Petra (2010): Projektabschlussbericht. Aktivität und Teilhabe - Akzeptanz Erneuerbarer Energien durch Beteiligung steigern. Forschungsgruppe Umweltpsychologie; Institut für Zukunftsstudien und Technologiebewertung; Zentrum Technik und Gesellschaft der TU Berlin.

Schweizer-Ries, Petra; Rau, Irina; Hildebrand, Jan (2011): Akzeptanz- und Partizipationsforschung zu Energienachhaltigkeit. FVEE-Jahrestagung. Berlin.

Spiess, Harry; Lobsiger-Kägi, Evelyn; Carabias-Hütter, Vicente; Marcolla, Andrea (2015): Future acceptance of wind energy production: Exploring future local acceptance of wind energy production in a Swiss alpine region. In: Technological Forecasting and Social Change 101, S. 263–274. DOI: 10.1016/j.techfore.2015.06.042.

Stiehler, Willie (2015): Akzeptanz von Biogas in Bayern. Technische Universität München, München. Fachgebiet für Agrarmarktanalyse und Agrarmarketing.

Strom-Report (2016): Windenergie in Deutschland 2016. Installierte Leistung pro Bundesland/ Gebiet in Megawatts (MW).

Strom-Report (2017): Windenergie Factsheet Deutschland On- & Offshore.

Thayer, Robert L.; Freeman, Carla M. (1987): Altamont: public perception of a wind energy landscape. In: Landscape and Urban Planning 14, S. 379–398.

Toke, David; Breukers, Sylvia; Wolsink, Maarten (2008): Wind power deployment outcomes: how can we account for the differences? In: Renewable and Sustainable Energy Reviews (12), S. 1129–1147. DOI: 10.1016/j.rser.2006.10.021.

Upham, Paul; García Pérez, Jesús (2015): A cognitive mapping approach to understanding public objection to energy infrastructure: the case of wind power in Galicia, Spain. In: Renewable Energy 83, S. 587–596. DOI: 10.1016/j.renene.2015.05.009.

van der Horst, Dan (2007): NIMBY or not? Exploring the relevance of location and the politics of voiced opinions in renewable energy siting controversies. In: Energy Policy 35 (5), S. 2705–2714. DOI: 10.1016/j.enpol.2006.12.012.

Walker, Benjamin J.A.; Wiersma, Bouke; Bailey, Etienne (2014): Community benefits, framing and the social acceptance of offshore wind farms: an experimental study in England. In: Energy Research & Social Science (3), S. 46–54.

Walker, Gordon; Devine-Wright, Patrick (2008): Community renewable energy: what should it mean? In: Energy Policy 36 (2), S. 497–500. DOI: 10.1016/j.enpol.2007.10.019.

Walter, Götz (2014): Determining the local acceptance of wind energy projects in Switzerland: the importance of general attitudes and project characteristics. In: Energy Research & Social Science (4), S. 78–88. DOI: 10.1016/j.erss.2014.09.003.

Warren, Charles R.; Lumsden, Carolyn; O'Dowd, Simone; Birnie, Richard V. (2005): 'Green on green': public perceptions of wind power in Scotland and Ireland. In: Journal of Environmental Planning and Management;, 2005 (48), S. 853–875.

Wilcox, David (1994): Community participation and empowerment: putting theory into practice. Hg. v. Joseph Rowntree Foundation. York.

Wolsink, Maarten (2007): Wind power implementation: the nature of public attitudes: equity and fairness instead of ‘backyard motives’. In: Renewable and Sustainable Energy Reviews (11), S. 1188–1207. DOI: 10.1016/j.rser.2005.10.005.

Wüstenhagen, Rolf; Wolsink, Maarten; Bürer, Mary Jean (2007): Social acceptance of renewable energy innovation: an introduction to the concept. In: Energy Policy 35 (5), S. 2683–2691. DOI: 10.1016/j.enpol.2006.12.001.

Yildiz, Özgür; Rommel, Jens; Debor, Sarah; Holstenkamp, Lars; Mey, Franziska; Müller, Jakob R. et al. (2015): Renewable energy cooperatives as gatekeepers or facilitators? Recent developments in Germany and a multidisciplinary research agenda. In: Energy Research & Social Science 6, S. 59–73. DOI: 10.1016/j.erss.2014.12.001.

Zajamšek, Branko; Hansen, Kristy L.; Doolan, Con J.; Hansen, Colin H. (2016): Characterisation of wind farm infrasound and low-frequency noise. In: Journal of Sound and Vibration 370, S. 176–190. DOI: 10.1016/j.jsv.2016.02.001.

Ziekow, Jan; Gabriel, Oscar; Remer-Bollow, Uwe; Buchholz, Frank; Ewen, Christoph (2013): Evaluation und Begleitforschung „Runder Tisch Pumpspeicherwerk Atdorf“.

Forschungsbericht BWPLUS. Hg. v. Deutsches Forschungsinstitut für öffentliche Vewraltung Speyer, Universität Stuttgart und Team Ewen.

Zoellner, Jan; Schweizer-Ries, Petra; Wemheuer, Christin (2008): Public acceptance of renewable energies: results from case studies in Germany. In: Energy Policy 36 (11), S. 4136–4141. DOI: 10.1016/j.enpol.2008.06.026.

Appendix 1: Interview guideline

1. In which capacity or on what occasions have you been involved in the implementation of wind energy projects?
2. Has the wind energy sector changed recently with regard to the development of wind farms?
3. Do technical factors have an influence on the acceptance of wind energy? Which kind of factors?
4. Do the personal characteristics of citizens play a particular role in their approval or rejection of wind energy farms?
5. Why have some citizens' initiatives against wind energy farms developed in recent years?
6. At what time and by which means should citizens be involved in wind energy developments in order to satisfy the concerns of as many citizens as possible and to achieve a high level of acceptance of these developments?
7. Do you prefer active or passive citizens for the implementation of a wind energy farm?
8. Does financial participation in wind energy projects represent a key drive for the acceptance of wind energy?
9. Do we need more direct democracy (e.g. referendum)?
10. Does citizen participation need to be regularized by law?
11. Do you expect a change in mentality of citizens during the project implementation?
12. Where do you see the main problems in the implementation of wind energy projects with regard to citizens' acceptance levels?
13. How can politics help to strengthen acceptance of wind energy?
14. How do media influence citizens?
15. How would you estimate the current level of acceptance of wind energy farms in Bavaria? What are the key factors in defining this level of acceptance?
16. Has the reputation of the wind energy industry been negatively affected by the planned construction of transmission lines?