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Public Participation in the German Energy Transformation: Examining Empirically Relevant Factors of Participation Decisions

Abstract

Public participation is often part of planning and decision-making processes relating to the German energy transformation (*Energiewende*). Factors influencing the active involvement of individuals have not been fully investigated, although these factors may impact the outcome of participatory decision making. However, a few concepts are discussed relating to what kind of people participate in governance processes: political efficacy, place attachment, value orientation, and sociodemographic characteristics. We further assumed that the aspects of attitudes toward renewable energy technologies, general knowledge about environment and energy, specific knowledge about electricity-generating technologies, personality strength, and living situation might influence people's participation in planning and decision making related to energy issues. In this study, we examine the relevance of these concepts based on a survey for which (n=) 2400 respondents were recruited from an access panel to build up a quota sample on the three crossed characteristics: gender, age, and school education. Many of the respondents are aware of participation options but very few become actively engaged in participation processes. The multivariate analyses conducted showed that attitudes towards renewable energy technologies, value orientation towards nature, political efficacy, personality strength, and individuals' specific knowledge have a strong influence on whether someone becomes actively involved or not.

Keywords: public participation, Energiewende, renewable energy sources, political efficacy, personality strength, knowledge

Highlights:

- More people are aware of participation options than actually participate.
- Informal participation formats attract more people than formal participation.
- Participation depends largely on political efficacy, personality strength, and knowledge.
- Combining formal and informal participation may improve equal participation.

1. Introduction

Public participation (in the following also participation) is often seen by both scholars and practitioners as a governance tool to counteract negative attitudes towards energy transformation projects and thus improve the implementation of energy policy (Kamlage et al., 2014; Schroeter et al., 2016). Public participation is understood here as a communication process influencing decision making beyond the conventional modes of voting, party involvement, and economic co-determination (Webler and Renn, 1995), aiming at including not only the responsible decision makers and representatives of agencies but also lay people. On the one hand participation is highlighted by some scholars as a negotiation process between different (conflicting) parties that should lead to agreement and action (Carr et al., 2012). On the other hand, other scholars view participation quite critically as manipulative and to strengthen those stakeholders, who are already well represented (Cooke and Kothari, 2007). Instead of fostering political capacity building and democratic renewal within society, such "elite" participation can exclude citizen from being able to take part in political process, leaving important matters of public policy to a limited number of people, and detach some publics from governance structures (Parkins and Sinclair, 2014). In addition, a study on participation within the German energy transformation has found that the diversity of people participating in decision making related to energy issues influences the perception of the process as fair, effective, efficient, and legitimate (Ernst, 2019).

Fair Participation

Whether participation is "successful" in the sense that it leads to more socially inclusive decision making and contributes to environmental sustainability (Kapoor, 2001) depends on how the process is designed (Rowe and Frewer, 2000; Webler, 1995) and how it is perceived often based on

normative understandings of what participation should accomplish. The aspects of procedural fairness, legitimacy, effectiveness, efficiency (similar "competence" referring to "the best decision possible given what was reasonably knowable under the present conditions" (Webler and Tuler, 2000, p. 568)), and satisfaction are discussed as important criteria characterizing successful participatory decision making (Carr et al., 2012; Schroeter et al., 2016). Especially procedural fairness (also procedural justice) – understood here as a subjective judgement (Schroeter et al., 2016) as to whether the participation process corresponds to the understanding and expectations of a fair process – is discussed as a key characteristic of successful participation processes. Jenkins et al. (2016) argue that procedural fairness leads to inclusion, which has three mechanisms beneficial for decision making: achieving just outcomes through local knowledge mobilization, greater information disclosure, and better institutional representation. Essential prerequisites for a fair process include obtaining a broadly representative sample of the population affected by decision making at least to the extent of gathering their opinion (Rowe and Frewer, 2000) and enabling them to become involved (Webler and Tuler, 2000). Bidwell (2016) assumes that if decision-making processes incorporate diverse interests and perspectives the likelihood of successful implementation, improved knowledge, and strengthened democracy will follow. Empirical studies have found that the number of participants and the representation of interest values and knowledge can prevent power imbalances and may influence social learning, trust building, and acceptance (de Vente et al., 2016; Ernst, 2018, 2019). The content of discourse and outcome of participation processes is influenced by the number and diversity of participants (Koontz and Johnson, 2004) indicating that the interest and values of those who engage in public participation processes are represented in the final decision. In order to determine whether this leads to a dominance of

those who are already well represented, the characteristics of those who participate need to be investigated.

Participation and the Energiewende

The German energy transformation (Energiewende) is one example that demonstrates how public participation is applied to implement energy policy. The "Ethics Commission on a Secure Energy Supply" appointed by German Chancellor Angela Merkel to develop options for the *Energiewende* declared that public participation was essential to transform the German energy system from fossil fuels to renewable energy sources (RES) (Ethikkommission "Sichere Energieversorgung", 2011). The aim of the *Energiewende* is to increase the share of renewables in total energy consumption to 60 percent and to reduce primary energy consumption by 50 percent to become largely greenhouse-gas-neutral (-80 percent to -95 percent) by 2050 (BMWi, 2018). To reach these targets, policies need to be implemented and energy projects, such as constructing wind farms, need to be realized which require the cooperation of various actors on all policy levels.

Public participation in the *Energiewende* can take many different formats, which differ in the intensity of communication such as written consultation or face-to-face dialogue, length of participation, timing of participation (e.g., before the planning process, during planning), and also how much power is shared with the public to co-decide (Ernst, 2018). A common option is possibilities for participation within formal consultation processes with regard to urban and spatial planning. The German Federal Building Code stipulates that public participation processes are mandatory for most planning procedures related to wind turbines, open space photovoltaics, etc. In addition,

planning and decision-making processes regarding the expansion of the electric grid are accompanied by several participation processes. A special form is to financially participate in the *Energiewende* by investing in energy projects such as wind power plants or expansion of the grid. However, we assume that factors for financial participation differ from public participation factors. One option to participate financially and at the same time to become socially involved is to become a member of an energy cooperative. In Germany the number of energy cooperatives has increased from 147 in 2008 to 1024 in 2016 (Kahla et al., 2017). Overall the *Energiewende* is understood as a highly participatory project representing a variety of participation opportunities (Radtke and Renn, 2019). However, there is as yet no general overview of who participates in the various projects related to the *Energiewende*.

Research Gap

We assume that a cornerstone of successful participation processes is a fair and equal opportunity to participate but empirical data about who participates in the Energiewende is scare. Equal opportunities for participation may lead to a greater diversity of interest, values, and knowledge thus improving the knowledge basis, which leads to decisions that are better informed. Although scholars such as Kapoor (2001) argue that both those who participate and what participation formats are offered determine the type and impact of participatory governance, research often focuses only on the respective participation format, i.e., dialogue intensity, frequency or opportunities of co-decision. Studies that examine thoughtfully who participates are less often conducted. Often case studies are conducted to analyse participation processes related to the *Energiewende*, which describe some characteristics of who became actively involved in the respective participation process (Richter, 2016; Roose and Scholl, 2013; Roose et al., 2012; Ziekow et al., 2013). Very

few researchers have examined within a large-scale research design who participates in the *Energiewende* but as a concomitant phenomenon of their analyses or only regarding specific issues (Kalkbrenner and Roosen, 2016; Schumann et al., 2015; Sonnberger and Ruddat, 2016). Accordingly, there is no detailed study of factors that explain active involvement in participation processes related to the *Energiewende*.

Aim

The overall objective of this article is to enhance knowledge about who becomes involved in public participation processes in the *Energiewende* and to reveal barriers to participation. Does everyone have a fair chance to become actively engaged in participation processes? Besides the choice of facilitators (who determine the process by inviting people to participate), what other barriers to participation are there? We answer these questions by investigating factors for participation, which also point to barriers of equal opportunities to voice interests and concerns. We do not only discuss a scarcely empirical analysed topic – who becomes involved – but consider that very different participation formats (i.e., one-way, face-to-face, online, etc.) exist which may attract different people (more detailed discussion of participation formats follows in Section 3.1.1). We have derived from existing studies the concepts of "attitudes towards renewable energy technologies", "political efficacy", "place attachment", "personality strength", "socio demographic characteristics", "knowledge", "living situation", and values such as "environmental awareness", which we also understand as factors of participation decisions. We examined whether these factors explain participation in the *Energiewende*. On the one hand, the findings of this paper will help to understand whether current outcomes of participation processes related to the *Energiewende* are dominated by a few interests or represent a broad range of interest and

values. On the other hand, our results enable policy implications to be derived of what can be done by practitioners to reach a greater variety of people.

Structure

In the following second section we present a brief literature review to identify factors explaining participation in environmental or energy-related issues and to derive hypotheses to guide our analysis. The third section is concerned with the methodology used for this study and describes both data collection from a quota-sample-based survey as well as the measurement of the identified factors. Section 4 reports on the results, which are further discussed in Section 5. The paper ends with conclusions and implications for policy and research.

2. Literature Review and Hypotheses

In the following, we provide a brief review of the literature to identify factors explaining participation in environmental or energy-related issues. Existing research provides some insights into who might be participating and assumptions about why people participate in the *Energiewende*. The discussion of the literature resulted in the formulation of eleven hypotheses that we have examined in our empirical analysis.

Carr and Halvorsen (2001) consider that those people who participate are not representative of the community as a whole. They found that different participation instruments still attract similar people and thus a combination of participation instruments does not seem to increase participant diversity. Also Hunt (2015), Koehler and Koontz (2008) and Beierle and Konisky (2000) point out that participants are often not representative of the general public. Furthermore, Beierle and Cayford (2002) highlight the fact that the selection of participants is rather demanding because it

affects the range of participation and the kind of representation, which influences the motivation of participants, quality of deliberation, and degree of public control. A relatively new participation instrument associated with low participation costs is online participation, which might offer more people easy access to join in decision making. Schulz and Newig (2015) argue that online participation is a useful instrument for including large numbers of lay citizens and thus tends to result in an enhanced variety of values and knowledge. However, research on the effectiveness of online participation is just beginning.

Carreira et al. (2016) found that social relationships with the local setting are a driver for participation in environmental governance. Furthermore, they argue that those citizens who perceive their actions as promoting the vigour of democracy further increase the degree of participation. Moreover, the findings of Mannarini et al. (2009) suggest that both previous participatory experience and the sense of belonging to a larger community, as well as trust in decision makers, government etc., explain whether someone becomes actively engaged or not. The conviction that understanding political processes and influencing them through individual political engagement (Vetter, 1997) is considered one of the most important predictors of political participation (Reichert, 2016; Verba et al., 1995). The concept of political efficacy goes back to Campbell et al. (1954) and refers to the "feeling that political and social change is possible, and that the individual citizen can play a part in bringing about this change"(Campbell et al., 1954, p. 187). Political efficacy can be differentiated into "internal political efficacy" and "external political efficacy" (Balch, 1974). Internal political efficacy is understood as "the feeling that one is capable of understanding political facts and processes and that one feels capable of influencing politics successfully" (Reichert, 2016, p. 222). Internal political efficacy describes a person's self-referred conviction

that he or she is able to understand political issues and to act politically. In contrast, external political efficacy is defined here as the perceived system legitimacy (Knobloch and Gastil, 2014) and a person's non-reflexive belief that the political system is open to individual and collective persuasive attempts (Beierlein et al., 2014; Caprara et al., 2009). External political efficacy incorporates the aspect of organizational trust, which refers to trust in decision makers to produce a preferred outcome without having to influence the decision maker (Driscoll, 1978) and is a further reason why people become actively involved. Accordingly, we expect that persons with high political efficacy are more likely to engage in the in the planning and decision making of energy projects than persons with low political efficacy.

Koehler and Koontz (2008) found a statistically significant relationship between greater self-reported knowledge about watershed issues before the participation process started and active participation in watershed management groups. In addition, Diduck and Sinclair (2002) found that a lack of knowledge about the respective topic was an important barrier to participation. Therefore, we assume that the level of knowledge about a topic is an impact factor for becoming actively engaged in participation processes. However, there is little empirical literature analysing this relationship. That is why we will investigate the influence on participation of the two concepts "general knowledge about environment and energy" and "specific knowledge about electricity-generating technologies".

Whether a particular energy project is implemented without conflicts depends, among other things, on the public's attachment to a particular location and the symbolic values of the site to both residents and non-residents (Wolsink, 2012). Local identity is an emotional and cultural construct closely related to the specific landscape and thus renewable energy projects such as wind

farms or open-space photovoltaics affect these identities (Pasqualetti, 2011; Pasqualetti and Schwartz, 2011; Wolsink, 2012). These social relations, emotional bonds, and physical coordinates are referred to as place attachments (Devine-Wright and Batel, 2017) and determine the individuals' acceptance of an energy project. However, they might also influence whether someone becomes actively involved (Walker et al., 2011). Therefore, it is assumed that those people who display strong place attachment are more likely to participate in the planning and decision making of energy projects to preserve their local identity than people with weak place attachment. At the same time, it is reasonable to assume that persons showing strong place attachment will more likely participate in the *Energiewende* the more they feel themselves to be capable of understanding the facts and processes relevant to the *Energiewende* and the higher their self-referred conviction to act politically, (i.e., the higher their political efficacy is).

Although a large variety of actors with different motives are actively engaged in the *Energiewende* (Schmid et al., 2016) and values such as environmental awareness or scepticism about climate change seem to impact participation (Engels et al., 2013), the relationship between values and personal characteristics such as personality strength are as yet understudied, do not relate to Germany or the *Energiewende*, or do not fully explore these concepts. For instance, one study found that those people in Germany who are between 30-45 years old, are fairly well educated, cosmopolitan, tolerant, and have diverse intellectual and cultural interests are aware of environmental risks and are more actively engaged in environmental issues than other societal groups (BMU and UBA, 2015). However, older people between the ages of 50 and 70, better educated, and those with higher incomes are more likely to know and actively participate in planning and decision-making processes related to environmental questions in Germany (BMU and UBA, 2015).

Unfortunately, this study lacks controls for various factors, such as values and property ownership, that might mediate age effects in the context of participatory decision making. We therefore intend to test whether sociodemographic aspects impact participation in the *Energiewende* assuming that those who are male and are older than the general population will be more likely to participate.

The study conducted by Diduck and Sinclair (2002) found that a lack of public speaking skills and personal characteristics such as shyness are barriers to participation. In the context of the *Energiewende*, "personality strength" is an important personal characteristic that allows us to identify so-called "influentials" (cf. e.g., Weimann, 1991). That is, persons who exhibit relatively great media use, are well informed about current topics and issues reported by the mass media, have wide-ranging social networks, are better linked to other individuals in their community, are especially active as communicators of information, and influence others, while at the same time they hold positions that differ from general public opinion (Noelle-Neumann, 1983; Schenk and Rössler, 1997; Weimann, 1991, 1994). Today, "influentials" (i.e., persons with high personality strength) might be even more effective as disseminators than in the past (Schenk and Scheiko, 2011; Winter and Neubaum, 2016), because numerous social networking sites (e.g., Twitter, Facebook) "offer various opportunities to express opinions on politics or public affairs, raise awareness of specific topics, and send links to media contents to the whole friend list" (Winter and Neubaum, 2016, p. 1). Therefore, it is important to investigate whether "influentials" are particularly inclined to participate.

Liebe and Dobers (2019) conducted a large-scale survey (n=3400) in Germany to analyse among other things what influences a person's intention to protest against the *Energiewende*. They

found that specific attitudes towards renewable energies and natural gas, not-in-my-backyard attitudes, place attachment, degree of urbanization (rural areas, mid-sized cities, large cities), and conditional cooperation influence whether someone protests against a renewable energy plant. Although protest is not the same as public participation, protest can be understood as a specific form of participation. The definition of protest as the attempt by people to articulate and advocate their concerns and interests that are perceived as being insufficiently represented and considered by decision makers (Cuppen, 2018) provides an important factor to actively participate. That is why the results of Liebe and Dobers (2019) are used as a point of reference to include further factors in our investigation. It is assumed that the individual attitude towards renewable energy technologies influences public participation. A person who regards renewable energy technologies negatively probably has a stronger desire to voice his/her opinion than people who have a positive attitude towards renewable energy technologies. We will test the extent to which the attitude towards renewable energy technologies influences people to actively participate. Homeowners and people living in rural areas are assumed to be more likely to participate in *Energiewende* topics. *Energiewende* projects such as renewable energy plants are often built in rural areas, which is why people living in rural areas are more frequently affected by *Energiewende* projects and thus participate in planning and decision-making processes. The fear of depreciation in their land and property is a reason to oppose RES projects (Hildebrand et al., 2018). Therefore, we assume that homeowners are more likely than tenants to become actively engaged in planning and decision-making processes in order to protect the value of their property. At the same time, this self-interest-based tendency is expected to increase with increasing place attachment.

Hypotheses

We have derived, based on the above elaborations, the following nine main-effect hypotheses that we will address in this article:

H1: The less a person is in favour of renewable energy technologies, the more likely it is that the person will attend public participation processes related to the *Energiewende* (*renewable energy technologies attitude* hypothesis).

H2: The more importance a person attaches to the conservation of nature, the more likely it is that the person will attend public participation processes related to the *Energiewende* (*value-orientation* hypothesis).

H3: The greater a person's feeling of internal and external political efficacy is, the more likely it is that the person will attend public participation processes related to the *Energiewende* (*political-efficacy* hypothesis).

H4: The more a person feels attached to their place, the more likely it is that the person will attend public participation processes related to the *Energiewende* (*place-attachment* hypothesis).

H5: The greater a person's personality strength is, the more likely it is that the person will attend public participation processes related to the *Energiewende* (*personality-strength* hypothesis).

H6: The more a person knows about general issues of environment and energy, the more likely it is that the person will attend public participation processes related to the *Energiewende* (*general-knowledge* hypothesis).

H7: The more a person knows about the specific advantages and disadvantages of electricity-generating technologies, the more likely it is that the person will attend public participation processes related to the *Energiewende* (*specific-knowledge* hypothesis).

H8: People's living situation (i.e., living in their own property, living in the countryside) impacts whether they attend public participation processes related to the *Energiewende* (*living-situation* hypothesis).

H9: Those persons who are male and older than the general population are more likely to attend public participation processes related to the *Energiewende* (*sociodemographic* hypothesis).

In addition to these main-effect hypotheses, we will also test two two-way interaction effect hypotheses:

H10: The greater political efficacy is among persons with strong attachment to place, the more likely it is that they will attend public participation processes related to the *Energiewende* (*political-efficacy-place-attachment* hypothesis).

H11: The more a property owner feels attached to their place, the more likely it is that they will attend public participation processes related to the *Energiewende* (*property-owner-place-attachment* hypothesis).

3. Methodology & Data

3.1 Methodology

In order to examine our research hypotheses, we co-designed parts of a questionnaire examining local acceptance of electricity-generating technologies among German residents. The questionnaire included substantial survey items for the measurement of respondents' awareness and experience with different participation formats in energy projects as well as attention check items to identify careless respondents and, hence, ensure data quality (Maniaci and Rogge, 2014; Meade and Craig, 2012; Shamon and Berning, 2020). Besides these survey items, which will be the main focus of our analyses, the questionnaire included survey items measuring psychological concepts (i.e., place attachment, political efficacy, personality strength, concern for nature), respondents' knowledge (i.e., general knowledge of environment and energy and specific knowledge of different electricity-generating technologies), respondents' living situation (i.e., living in their own or rented property, place of residence), and sociodemographic characteristics (i.e., gender, age, education).[1] The main purpose of the questionnaire was to examine the impact of arguments on respondents' attitudes towards electricity-generating technologies in an experimental design. That is why, our opportunities to measure further relevant concepts influencing participation decisions, such as trust in different actors, were limited. In the following, we explain how we measured the concepts identified in Section 2 with respect to their influence on participation.

3.1.1 Public Participation

[1]We randomized the order of all items within their respective item-batteries to prevent response-order effects (Lavrakas, 2008), except for the survey items on respondents' living situation and sociodemographic characteristics.

The conceptualization of participation is still an ongoing debate (Alcántara et al., 2016), which is challenged by the various formats of and contexts in which participatory governance is applied. Participation processes vary in duration, intensity (e.g., face-to-face, written consultation), timing of participation (e.g., before or after the planning phase), and opportunity to co-decide. These aspects constitute here the "participation format", which summarizes the most important characteristics that determine each individual process. With respect to the *Energiewende*, numerous participation formats are applied both during smaller projects, such as the construction of renewable energy plants, and also major projects, such as the expansion of the electrical grid or the search for deep geological repository sites, whereas the aims and expectation of these public participation processes are manifold (Ernst, 2017). Scholars such as Rowe and Frewer (2005), Hurlbert and Gupta (2015) and Rau et al. (2012) have defined categories to better conceptualize participation. Participation processes are often differentiated based on the levels of involvement (i.e., degree of co-decision or intensity of communication (dialogue or one-way communication)), and methods or instruments such as round tables, hearings etc. However, these categories are rather generic and do not consider different (legal) and specific contexts of participation processes within the *Energiewende*. That is why, we used the cited literature as a starting point to define our own categories. To account for the broad range of participation opportunities for the public to become involved in the *Energiewende*, we distinguish between "Financial Participation", "Formal Participation", and "Informal Participation", which is subdivided into "Information and Consultation Instruments" and "Cooperation and Solution-Finding Instruments".

Participation in planning and decision-making processes related to the *Energiewende* represents either obligatory (formal) or voluntary (informal) attempts to involve the broader public. Formal

participation processes are required by law, for example by the Building Code or the Federal Emission Control Act, which are implemented by public agencies. Here we asked the respondents on a dichotomous yes/no answer scale whether they are aware of opportunities to hand in written statements concerning planning and decision-making processes related to energy projects. Respondents who answered "yes" to this question were asked in another survey item with a yes/no answer scale whether or not they had responded to an energy project in such a way. To provide the respondents in both survey items with a concrete understanding of energy projects, we listed examples of energy projects (i.e., the construction of a wind power plant, the construction of a power plant, the expansion of the electric grid).[2] In the following "formal participation" refers to the filing of objections in the course of planning and decision-making processes and can be broadly understood as a form of consultation (the public is heard (Rowe and Frewer, 2005)).

Increasingly, companies and project developers organize informal participation processes to inform and involve the public at an early stage (Hildebrand et al., 2018), which are often more dialogue-oriented than formal participation opportunities. Informal participation processes capture the wide spectrum of participation formats including information, consultation, cooperation, and citizen control (Rau et al., 2012). To investigate awareness of and active engagement in participation formats, questions were posed in the survey about various commonly applied participation

[2] The question was worded as follows: "In Germany, citizens have the legal right to submit objections to energy projects (e.g., the construction of a wind turbine, the construction of a power plant, the expansion of the electric grid) to the responsible regulatory authority. Did you already know about this possibility prior to this study?" If respondents answered "yes" to this survey question they were presented with the following survey item: "And have you ever submitted objections to an energy project (e.g., the construction of a wind turbine or a power plant, the expansion of the electric grid) to a regulatory authority?".

instruments by applying the same two-step question procedure as with formal participation.[3] Participation instruments are single events, specific methods of an event, or ways to include actors. These instruments differ regarding how many people can participate, their purpose, intensity of dialogue, and to which phase of the planning and decision-making process they contribute. That is why we divided these instruments, listed in Table 1, into two categories: "Information and Consultation Instruments" and "Cooperation and Solution-Finding Instruments". The category "Information and Consultation Instruments" summarizes those instruments which represent levels of information (one-way communication) and consultation (gathering opinions from the public). The category "Cooperation and Solution-Finding Instruments" comprises instruments that are more dialogic and offer options for co-decision. However, we do not consider them as "citizen control" i.e., delegation of decision-making power to the citizen (Rau et al., 2012) because the actual impact of informal participation processes on decision-making is very uncertain.

Table 1: **Information and consultation instruments** and cooperation and solution-finding instruments

Information and Consultation Instruments	**Cooperation and Solution-Finding Instruments**
Specialist lecture	Round table
Panel discussion	Residents' conference
Survey	Online dialogue

[3] To measure respondents' awareness of informal participation measures, respondents were presented with the following survey item: "Some project initiators (e.g., a municipality, a company) take measures to inform citizens about details of energy projects (e.g., the construction of a wind turbine or power plant, the expansion of the electric grid) and to discuss energy projects with citizens. For each of the following measures to inform about and discuss energy projects (e.g., the construction of a wind turbine or a power plant, the expansion of the electric grid), please mark whether you knew or did not know about them before this study?". Respondents who marked the answer option "I knew the measure" were asked in a subsequent question whether or not they had participated in the respective informal participation measure.

Site visit	Workshop
Interview, conversation	Scenario workshop
Inaugural event	World Café
Citizens' office	Open-space conference
Hearing of experts	
Joint fact clarification	
Focus group	

Financial participation covers aspects such as "energy purchase decisions, ownership and co-ownership of assets, participation in financial returns from these assets, payments from asset owners (rent, compensations), economic benefits for the community, or value added for the local economy" (Radtke et al., 2018, p. 22). Here, we asked the respondents to indicate on a yes/no answer scale whether they were aware of financial participation opportunities in energy projects (i.e., in the construction and operation of a wind power plant or a power plant, or the expansion of the electrical grid) and, if so, whether they were involved in the following financial participation opportunities: closed-end fund; loan; citizen bond; silent partnership; cooperative share; profit participation right; debenture bond.

3.1.2 Independent Variables

Attitude Towards Renewable Energy Technologies

We asked our participants about their attitudes towards renewable energy technologies (i.e., onshore wind power plants, offshore wind power plants, open-space photovoltaics, and biomass power plants). Respondents' answers were registered on a bipolar nine-point scale (0: strongly against the technology; 4: neither against nor in favour of the technology; 8: strongly in favour of the technology), whereas we offered respondents an exit option (cannot choose). Each respondent's answers to the four technologies were averaged such that "0" refers to strongly against

renewable energy technologies and “8” refers to strongly in favour of renewable energy technologies.

Value Orientation Nature

Values “serve as guiding principles in the life of a person or group” (Schwartz et al., 2012, p. 664) and are used as criteria “to select and justify actions and to evaluate people (including the self) and events”(Schwartz, 1992, p. 1). Schwartz (1992) suggested and provided evidence for a typology of ten human values. Schwartz et al. (2012) refined the initial typology by identifying 19 values. We used a three-item scale applied by Schwartz et al. (2012) for measuring the importance respondents attach to nature as a value (cf. Table 4 the Appendix Section). Wording of these items was taken from Schwartz et al. (2012).

Political Efficacy

We adapted a short scale on political efficacy (PEKS), developed and validated by Beierlein et al. (2014). While the PEKS poses questions about politics and political issues in general, we modified all four items by relating the items to energy policy issues. Items one and three measure respondents’ internal political efficacy while items two and four measure external political efficacy (see Table 5 in the Appendix Section). In contrast to Beierlein et al. (2014), who suggested a fully verbalized five-point answer scale, we registered respondents’ answers on endpoint verbalized nine point scales that were in line with most of the answer scales used in the questionnaire. Respondents‘ political efficacy was calculated as a mean score index, as proposed by Beierlein et al. (2014).

Place Attachment

The measurement of place attachment is based on four items used by Lewicka (2010)(Table 6 in the Appendix Section).[4] Respondents' answers to these items were registered on an endpoint verbalized nine-point scale (0 "does not apply at all to me", 8 "applies to me"). Lewicka (2010) uses the item "I would not like to move away from here". However, the survey methodology literature suggests that negative wordings should not be used (e.g., Porst, 2008). Thus, we re-phrased this item to avoid the negation (cf. 6 item 4) and considered its inverse coding for the calculation of a place attachment index.

Personality Strength

To measure personality strength, we applied the validated scale of Noelle-Neumann (1983) (cf. also Weimann, 1991). The scale consists of ten items that were arranged in an item-battery (see Appendix Section Table 7). In order to be consistent with the answer scales used in the other item batteries of this study, we registered respondents' answers on an endpoint verbalized nine-point scale (0 "does not apply at all to me", 8 "applies to me"). In accordance with Noelle-Neumann (1983) and Schenk and Scheiko (2011), we multiplied respondents' answers (i.e., value of the scale point) to an item by 0.125 (cf. also Schenk and Scheiko, 2011).[5] Hence, respondents who reported "does not apply at all" were scored 0 (=0x0.125) for the respective item, while respondents who reported "applies to me" were scored 1 (=8x0.125) for the respective item. Subsequently, for each respondent we created a personality strength index by adding their scores for each of the ten items. Thus, the index can take values between zero and ten, whereby high values reflect high

[4] Item randomization was applied in all item batteries that we used in the survey and is described in the following.
[5] Noelle-Neumann (1983) offered respondents a binary response scale to answer the items and assigned one point to affirmative answers and zero points to negative answers. This procedure was transferred to a five-point scale by scoring respondents' answers to an item as 0, 0.25, 0.5, 0.75 or 1.

personality strength. Finally, we grouped respondents in quantiles on the basis of their index values. By doing so, we obtained a categorical variable indicating that a respondent has a weak (=0), moderate (=1), above average (=2), or strong personality strength (=4).

General Knowledge of Environment and Energy

We formulated four statements (cf. Appendix Section Table 8) intended to measure respondents' general knowledge of environment and energy issues. We asked respondents to indicate for each statement whether the statement was "definitely not true", "probably not true", "probably true", or "definitely true". Only those answers that respondents specified as "definitely not true" for item 1 or as "definitely true" for items 2, 3, and 4, respectively, were judged to be correct. Finally, we counted the number of correct answers for the four items, such that general knowledge can vary between 0 (limited attitude-relevant knowledge) and 4 (extensive attitude-relevant knowledge), i.e., when all questions are answered correctly.

Specific Knowledge of Electricity-Generating Technologies

In contrast to the general knowledge scale that measures knowledge on a factual basis, specific knowledge is measured by self-report scales. This procedure is necessary because the self-report scales were part of an experimental survey, whose primary objective was to measure the impact of arguments on respondents' attitudes towards electricity-generating technologies (reference omitted during review). In this experimental survey, respondents were randomly exposed to six arguments (three supporting arguments and three counterarguments) about one of six electricity-generating technologies, while the three supporting arguments as well as the three counterarguments differed in terms of their quality (i.e., strong, moderate, or weak supporting argument

or counterargument)[6]. After exposure to the arguments, respondents were asked to state for each of the six arguments on a dichotomous answer scale whether they had been aware of the argument before the experimental survey or not. We counted the number of known arguments for each respondent. Hence, respondents who are not aware of any of the presented arguments have no (specific) knowledge of electricity-generating technologies (=0), while respondents who are aware of all presented arguments are knowledgeable about electricity-generating technologies (=5).

Respondents' Living Situation

Participants were asked whether their primary residential address referred to a flat or house owned by themselves or a family member (living in property = 1) or to a rented flat or rented house (living in property = 0). Furthermore, respondents were asked whether their primary residential address was in a rural municipality (with less than 5,000 inhabitants), a small town (with 5,000 to less than 20,000 inhabitants), a medium-sized town (with 20,000 to less than 100,000 inhabitants) or a major city (with more than 100,000 inhabitants). The differentiation of the four categories according to the number of inhabitants is based on an administrative classification by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR, 2015) and was expected to contribute to a common understanding of the four different categories among the respondents.

Sociodemographic Characteristics

[6] Argument quality was determined in a previous study (reference omitted during review), in which respondents were asked to rate the presented arguments according to their persuasiveness.

Age, gender, and education constituted the (crossed) quota of the sample and, hence, respondents were asked to supply this information at the beginning of the survey.

3.2 Data

The survey was administered to members of an access panel provided by a commercial panel operator at the end of 2017 and beginning of 2018. The target population was restricted to persons between 18 and 74 years of age resident in Germany. Respondents were selected from the commercial access panel following a combined quota scheme for age, gender, and education that was retrieved from "Best for planning 2017" by GIK (2017). The commercial panel operator agency paid a small monetary incentive (€ 1.25) to those 2400 participants who completed the questionnaire. Respondents' average age in the gross sample was 46.9 years (SD = 15.61), and 50.4 percent of the respondents were female. Furthermore, 32.3 percent of the respondents had a university matriculation qualification, 65.8 percent of the respondents had an intermediate school-leaving certificate, and 4.3 percent said they were employed in the energy sector. Table 10 in the Appendix Section shows the descriptive statistics of the other independent variables.

4. Empirical Results

4.1 Descriptive Analyses of Awareness of and Active Engagement in Participation Instruments

Both awareness of and active engagement in participation formats are described in Table 2. It shows that 47.4 percent of the respondents are aware of their legal right to raise objections to energy projects in spatial und urban planning. The awareness rates for information and consultation instruments of 78.3 percent and 62.2 percent for cooperation and solution-finding instruments indicate that the majority of respondents know about these instruments whereas only 33.1

percent of the respondents are aware of the option to participate financially in the *Energiewende*. However, the active participation rates are substantially lower than the awareness rates. Only about two percent have raised objections to energy projects in the past, 19 percent have experience of at least one of the information and consultation instruments, 11.8 percent have engaged in at least one cooperation and solution-finding instrument, and 1.5 percent of the respondents stated that they had made use of at least one financial instrument. The high rates of respondents who are actively engaged in the informal participation instruments is a rather unexpected outcome, given the results of previous studies (BMU and UBA, 2015; Schumann et al., 2015; Sonnberger and Ruddat, 2016). Below we will examine in more detail possible explanations for this outcome and the sharp discrepancy between awareness and usage rates.

Table 2: Awareness and usage of different participation formats

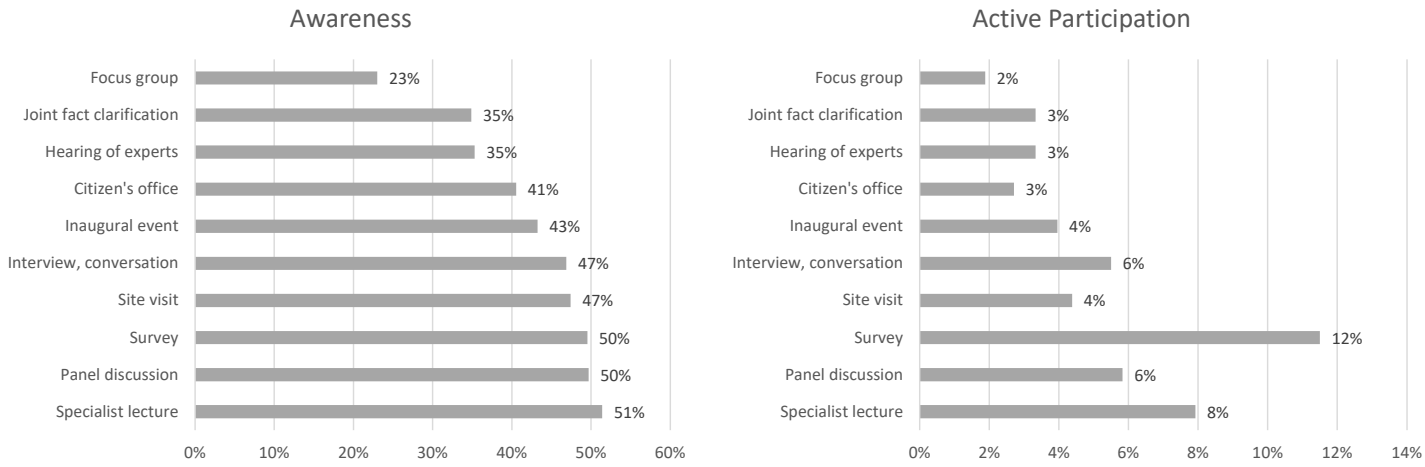
(n=2400)	Formal Participation	Information & Consultation Instruments	Cooperation & Solution-Finding Instruments	Financial Participation
Awareness	47.4%	73%	62.2%	33.1%
Active Participation	2 %	19%	11.8%	1.5%
No response to any of the items	2.8%	5.3%	4.6%	2.7%

Information and Consultation Instruments

Figure 1 shows the awareness and active participation rates for each surveyed information and consultation instrument. Awareness rates vary between 23 percent (i.e., focus group) and 51 percent (i.e., specialist lecture). The highest usage rate is 12 percent (i.e., survey), four instruments (i.e., focus group, joint fact clarification, hearing of experts, citizen's office) were used by only two

to three percent of the respondents. The relatively high number of 276 respondents indicating that they had participated in a survey regarding energy issues may be explained by the fact that the respondents were recruited via an access panel of a commercial panel operator and thus it can be expected that they regularly take part in surveys. However, these surveys probably serve to research energy topics and are not a tool for planning and decision-making purposes, which is why it cannot be ruled out that this high number may be biased.

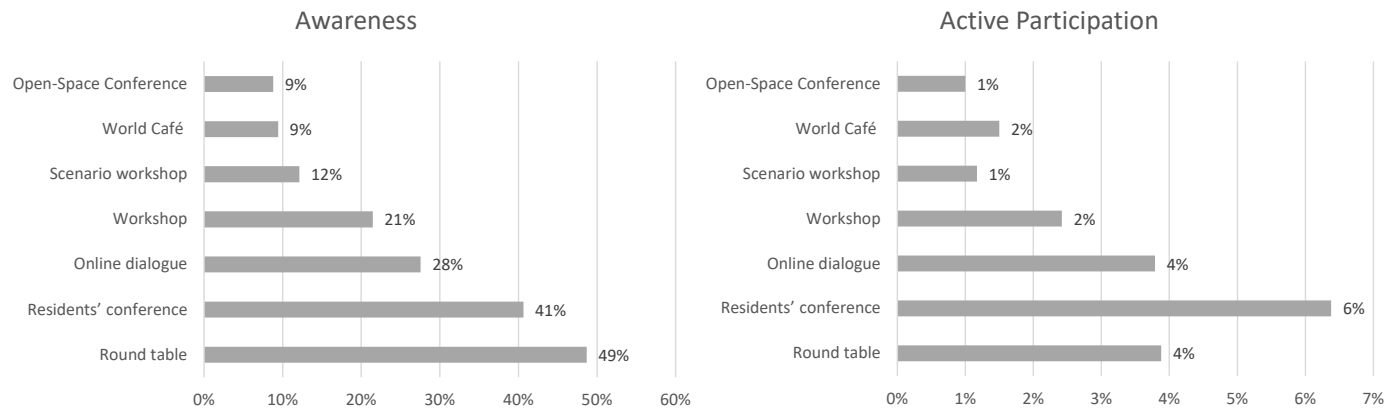
Figure 1: Information and consultation instruments (N=2400)



Cooperation and Solution-Finding Instruments

The discrepancy between awareness and usage rates is less pronounced among the instruments for consultancy and solution-finding purposes (cf. Figure 2). The instrument of a round table is most widely known among the respondents (49 percent) while the format of an open-space conference is least well known among the respondents (9 percent). Usage rates vary between one percent (i.e., open-space conference) and six percent (i.e., local residents' conference).

Figure 2: Cooperation and solution-finding instruments (N=2400)



4.2 Multivariate Analyses on Public Participation

To investigate the hypotheses put forward in Section 2, we estimated a multivariate logistic regression for each of the four participation formats described above. A logistic regression is an appropriate method for analysing dichotomous dependent variables such as those used in this study to measure awareness and involvement in formal, informal, and financial participation measures. Table 3 summarizes the results for the multivariate logistic regressions for the different participation instruments in the context of the *Energiewende* on the basis of all valid observations. The pseudo R^2 varies between 0.096 (M3) and 0.118 (M2).

Examining the results with respect to attitude towards renewable energy technologies reveals evidence in favour of the *renewable energy technologies attitude* hypothesis (H1). The likelihood of participation decreases by 24.4 percent ($p<0.05$) with respect to a formal participation process (M1) and by 10.4 percent ($p<0.01$) (M3) with respect to participation in cooperation and solution-finding instruments. This means that respondents with a negative attitude to renewable energy technologies are more likely to participate in participation formats which offer the opportunity

for co-decision. In contrast, even if insignificant, it is worth to mention that attitude towards renewable energy technologies has rather a positive than a negative coefficient on financial participation likelihood.

As expected in our *value-orientation* hypothesis (H2), the chance of participating depends on a respondent's value orientation towards nature. With each scale point of value orientation towards nature, the chance of participating in a formal participation process (M1) increases by 56.8 percent ($p<0.05$), the chance of participating in an information-and-discussion instrument (M2) increases by 29.7 percent ($p<0.001$), and the chance of participating in an instrument for consultancy and solution finding purposes (M3) increases by 28.4 percent ($p<0.01$).

In accordance with our *political-efficacy* hypothesis (H3), we also find a significant main effect for political efficacy in models M1 to M3, meaning that respondents with higher confidence in their ability to understand political issues and with higher general trust in the functioning of the political system are more likely to participate than respondents with low political efficacy. With every scale point of political efficacy, the likelihood of participating in a formal participation process increases by 22.1 percent ($p<0.05$) (M1), the chance of participating in information and consultation instruments increases by 32.3 percent ($p<0.001$) (M2), and the chance of participating in cooperation and solution-finding instruments increases by 18.5 percent ($p<0.001$) (M3). Table 12 in the Appendix Section demonstrates that the significant effect of political efficacy is rather driven by internal than by external efficacy. This suggest that a person's self-referred conviction of understanding political issues and acting politically is a stronger factor to become engaged than the perceived system legitimacy.

Contrary to the expectation in our *place-attachment* hypothesis (H4), the decision whether to participate in the context of energy projects does not depend on respondents' place attachment as the insignificant main effects for the respective variable show in all models. Furthermore, the effect of place attachment does not depend on political efficacy in any of the models, undermining our *political-efficacy-place-attachment* hypothesis (H10).

In accordance with our *personality-strength* hypothesis (H5), we find evidence that *personality strength* is an important factor for participation both in instruments for information and consultation purposes (M2) and in instruments for cooperation and solution finding purposes (M3). Compared to the sample mean, respondents with strong personality strength exhibit a significantly higher chance (32.3 percent in M2 ($p<0.01$) and 63.2 percent in M3 ($p<0.001$)) and respondents with weak personality strength exhibit a significantly lower chance (49.7 percent in M2 ($p<0.05$) and 63.2 percent in M3 ($p<0.001$)) of participating in these instruments.

With respect to the *general-knowledge* hypothesis (H6) and the *specific-knowledge* hypothesis (H7), our analysis reveals that specific knowledge on electricity-generating technologies rather than general knowledge is an important factor, which increases the likelihood of participating in the *Energiewende*. The chance of participating increases between 23.4 percent (M3, $p<0.001$) and 31 percent (M1, $p<0.01$) with increasing specific knowledge on electricity-generating technologies, while general knowledge is only significant with respect to information and consultation instruments.

We also find evidence in favour of our *living-situation* hypothesis (H8). The odds of participating in formal participation processes are 1.7 times (M1) higher and the odds of participating in information and consultation instruments are 1.3 times (M2) higher among respondents living in *small towns or the countryside* than among respondents living in medium-sized towns or big cities. Furthermore, the odds of participating in information and consultation instruments (M2, $p<0.01$) as well as in cooperation and solution-finding instruments (M3, $p<0.05$) are 1.3 times higher among *respondents living in a dwelling owned by themselves or a family member* than among respondents who live in rented accommodation. The odds of participating in information and consultation instruments increase among respondents living in their own properties with increasing place attachment as the significant effect of the *interaction between property ownership and place attachment* shows (M2, $p<0.05$). Hence, we only find evidence of our *property-owner-place-attachment* hypothesis (H11) among information and consultation instruments.

Concerning our *sociodemographic* hypothesis (H9) we found that respondents' age is only significant ($p<0.001$) regarding participation in instruments for information and consultation purposes (M2) and cooperation and solution-finding instruments (M3). The chance of participating in these instruments decreases by two percent with each *year of age*, which implies that younger people are more likely to participate in informal participation instruments than older people. This result is contrary to our assumption that older people are more likely to participate. Furthermore, our results reveal gender differences regarding participation in cooperation and solution-finding instruments. The odds for men participating in these instruments are 1.3 times higher ($p<0.05$) than for female respondents.

Finally, we tested the extent to which the driving factors of attending a public participation process can be used to explain financial participation in the *Energiewende*. M4 demonstrates that only living situation and specific knowledge significantly enhance the chance to financially participating in the *Energiewende*. The odds of participating financially in the *Energiewende* are 2.6 times higher among respondents living in a dwelling owned by themselves or a family member than among respondents who live in rented accommodation and increases by 31 percent with increasing specific knowledge. The residents in the immediate vicinity of wind turbines are often offered the opportunity to participate financially in wind turbines in order to increase the acceptance of these plants. The fact that wind turbines are only built in the countryside keeping a certain minimum distance to settlements where people often live in their own houses indicates that this result is plausible.

Table 3: Results of multivariate logistic regressions

	M1 Formal Participation	**M2** Information and Consultation Instruments	**M3** Cooperation and Solution-Finding Instruments	**M4** Financial Participation
Attitude to RES Technlogies[1]	-0.28*	-0.04	-0.11**	0.14
	(0.10)	(0.04)	(0.05)	(0.14)
Concern for Nature[1, a]	0.45*	0.26***	0.25***	0.22
	(0.20)	(0.04)	(0.08)	(0.21)
Political Efficacy[1, b]	0.20*	0.28***	0.17***	0.07
	(0.11)	(0.04)	(0.05)	(0.13)
Place Attachment[1, c]	0.15	-0.00	-0.00	0.23
	(0.13)	(0.04)	(0.05)	(0.17)
Political Efficacy[1] x Place Attachment[1]	-0.02	-0.03	0.00	0.02
	(0.05)	(0.02)	(0.02)	(0.06)
Weak Personality Strength[d]	-0.56	-0.30*	-0.55***	-0.46
	(0.40)	(0.12)	(0.16)	(0.47)
Moderate Personality Strength	0.17	0.04	0.03	0.04
	(0.27)	(0.10)	(0.12)	(0.32)
Above-Average Personality Strength	0.05	-0.02	0.06	0.13

	(0.30)	(0.1)	(0.12)	(0.33)
Strong Personality Strength	0.35	0.28**	0.49***	0.30
	(0.26)	(0.1)	(0.11)	(0.30)
General Knowledge[1]	-0.05	0.12*	-0.01	0.23
	(0.17)	(0.06)	(0.07)	(0.18)
Specific Knowledge[1]	0.27**	0.22***	0.21***	0.27*
	(0.11)	(0.04)	(0.05)	(0.13)
Small Town or Countryside (=1)	0.52	0.23*	-0.03	0.34
	(0.31)	(0.12)	(0.14)	(0.36)
Property Ownership (= 1)	0.23	0.28*	0.25*	0.96*
	(0.33)	(0.12)	(0.15)	(0.40)
Property Ownership x Place Attachment[1]	-0.03	0.13*	0.12	-0.26
	(0.18)	(0.07)	(0.08)	(0.21)
Age[1]	-0.01	-0.02***	-0.02***	-0.00
	(0.01)	(0.00)	(0.00)	(0.01)
Male (=1)	-0.1	0.16	0.30*	0.38
	(0.32)	(0.12)	(0.14)	(0.38)
Intercept	-4.62***	-1.95***	-2.51***	-5.43***
	(0.33)	(0.11)	(0.13)	(0.42)
Log-Likelihood Model	-205.840	-1001.995	-769.032	-163.045
Log-Likelihood Null Model	-228.432	-1136.370	-850.694	-181.065
Pseudo-R^2 (McFadden)	0.098	0.118	0.096	0.100
n	2255	2291	2291	2290

Notes: [1] Mean centred variable; [a] Cronbach's alpha amounts to 0.846 for the three items measuring concern for nature; [b] Cronbach's alpha among the modified items measuring internal political efficacy amounts to 0.848, and 0.877 for the modified items measuring external political efficacy; [c] Cronbach's alpha amounts to 0.846 for the four items measuring place attachment; [d] Cronbach's alpha amounts to 0.897 for the ten items measuring personality strength; * p<0.05, ** p<0.01, *** p<0.001, (one-sided hypotheses); standard errors in parentheses; we additionally estimated models controlling for respondents' education and monthly household net income. However, as these explanatory variables were not significant and the remaining results were robust with respect to these alternative model specifications, we ignored these factors for reasons of parsimony; observational basis of the models differs due to item nonresponse.

5. Discussion

The results of the online survey of 2400 respondents presented in this study showed that only a limited number of people attend public participation processes related to the *Energiewende*. The comparison of our results with other empirical studies suggests that our results are robust and

therefore provide important insights for practitioners organizing participation processes in the *Energiewende*. In the following, our results will be compared and discussed with findings from other studies in order to further interpret their implications and identify possible limitations.

Although almost half of the respondents were aware formal participation opportunities, only two percent of the respondents had actively taken part in such an option. In contrast, among informal participation processes awareness and active participation rates were substantially higher. Nearly 73 (or 62) percent of our respondents stated that they were aware of at least one of the information and consultation instruments (or cooperation and solution-finding instruments) which we presented to them in the survey, but only 19 (or 12) percent indicated that they had participated in at least one of the instruments. Albrecht et al. (2013) also questioned 1500 people about their awareness of informal participation instruments in relation to infrastructure planning and decision making in Germany (including energy infrastructure). The awareness rates they obtained for the participation instruments "workshop" of 23 percent, "online participation" 21 percent, and "open-space conference" seven percent are similar to our results (see Figure 2). In addition, Albrecht et al. (2013) also asked 150 companies and 380 local authorities what informal participation instruments they offered to enable people to participate, and these rates were often lower than people's awareness rates. This indicates that although many people are aware of participation instruments, the opportunity to participate in them is not always given, which may explain the detected discrepancy between awareness rates and active participation.

In comparison with previously conducted surveys about public participation in the Energiewende, the rates for formal participation are similar but our results for people participating in informal instruments are considerably higher. A survey conducted in 2015 by Sonnberger and Ruddat

(2016) found that six percent of 2009 respondents participated in planning processes and five percent in energy cooperatives. The representative survey of 1000 respondents conducted by Schumann et al. (2015) collected data on whether and how the respondents had participated in the expansion of the German electric grid. Their results showed that 0.1 percent participated in a formal consultation process, 1.3 percent went to an information and dialogue meeting organized by the Federal Network Agency, and 1.1 percent participated in an information or dialogue meeting organized by one of the transmission system operators. However, the findings of Schumann et al. (2015) showed that the participation rates in information or dialogue meetings organized by a citizens' initiative of 3.4 percent and signatures against a power line of 3.3 percent were much higher than participation in formal decision-making processes. Thus, Schumann's findings also imply that more people participate in informal than in formal public participation processes. The high rates of our study with 12 or 19 percent of the respondents stating that they had participated in one of the informal participation instruments can be explained by the fact that we asked about a relatively large number and variety of participation instruments. For example, we also included one-way participation instruments such as survey, interview, specialist lecture, citizens' office, and site visit that were not considered in previous studies. In addition, as already mentioned, the high response rate of 12 percent of respondents who indicated that had been involved in a survey (c.f. Section 4.1) might be explained by the fact that our respondents were gathered from an online access panel and participate in surveys on a regular basis. Accordingly, we cannot entirely disregard the possibility that respondents have mistakenly considered a survey on energy issues to be a participation tool and consequently the results for the instrument "survey" might

be overestimated. However, even if the participation instrument "survey" is ignored in our calculation, 15 percent of the respondents have still participated in at least one information and consultation instrument. Therefore, our findings indicate that especially participation formats aiming at informing the public are used more often than previous studies have indicated.

Besides the differences in how many of the respondents had participated in formal and informal participation processes, the regression analysis showed that formal participation decisions are driven by fewer factors than informal participation decisions (see Table 3). This implies that reasons to hand in written statements to planning and decision-making processes related to energy projects differ from reasons for engaging in informal participation processes. Our results demonstrate that people whose attitude towards renewable energy technologies is negative are more likely to participate in formal participation processes and informal participation formats which offer opportunities of co-decision (i.e., to have the opportunity to make objections or statements in order to encourage, for example, a modification of planning documents). This means that people with a negative attitude towards renewable energies seek opportunities to influence the Energiewende and the respective decision-making processes.

Our findings showed that the stronger respondents' value orientation towards nature is, the more likely they are to participate in decision-making processes related to the Energiewende. Furthermore, political efficacy is a driver for participating in the Energiewende. Reichert (2016) suggests that political efficacy only increases the likelihood to participate in conventional political action such as election campaigns and membership of a political party and not in unconventional political participation such as becoming actively involved in a citizens' initiative. In contrast, our results indicate that political efficacy has a stronger influence on participation in those instruments which

comprise face-to-face interactions. This seems plausible because people must have strong confidence in their ability in order to speak in front of a large audience and become involved in a public discussion. This assumption is also underlined by our results indicating that personality strength and specific knowledge are important impact factors for participation.

However, we cannot disentangle the underlying causal relationship(s) between political efficacy and participation decisions on the basis of our cross-sectional analysis. Previous studies have found a mutual reaction between experienced participation and political efficacy (Ikeda et al., 2008). Knobloch and Gastil (2014) found that participation processes stimulated a cognitive change process of how individuals view themselves and fostered their sense of community by seeing themselves as more capable of participating in politics and as more active members of their local communities. That is why political efficacy is not only a driver for participation but also participation enhances political efficacy. Similar effects can be assumed for the two tested concepts of general knowledge about environment and energy and specific knowledge about electricity-generating technologies. Ernst (2018) found that participation processes enhance social learning among participants in planning and decision-making processes in the Energiewende. It is difficult to differentiate between causes and effects, but it can still be assumed that political efficacy and knowledge are factors impacting whether someone participates because previous studies have drawn similar conclusions (Koehler and Koontz, 2008; Reichert, 2016; Verba et al., 1995)

Interestingly, our results showed that place attachment has no significant effect on whether someone participates in the Energiewende. This can be explained by different values and perceptions of the population: not everyone experiences the construction of a wind turbine etc. as a disfigurement of the landscape and thus does not feel that such wind turbines jeopardize their

place. Some persons even find windfarms to be an attractive feature in the landscape (Warren et al. 2005). Hein et al. (2006) found that stakeholders on different spatial scales can have very different interests in ecosystem services. This indicates that other interests or commitments are more important to the individual than becoming engaged in an energy project. In addition, Walker et al. (2011) stress that expectations such as how the energy project impacts upon the place or community and engagement actions form a dynamic relationship: "Initial expectations shape engagement actions, which feed into interactions, which then shape expectations, and so on" (ibid. p. 8).

Reflecting Scope and Generalisability

The scope of this study was limited because we were not able examining in depth all participation formats and possible factors for participation decisions. We have examined whether or not financial participation is influenced by the same set of factors as public participation, but it was not the primary aim of our study to investigate thoroughly factors for participating financially in the Energiewende. Our results suggest that financial participation is influenced by different factors than factors explaining other forms of public participation. Financial participation decisions were significantly affected only by a small subset of the factors (i.e., living situation and specific knowledge), which were also found to significantly influence public participation decisions. This suggests that different participation formats attract different people. In addition, we have considered organizational trust, which refers to trust in decision makers to produce a preferred outcome without having to influence the decision maker (Driscoll, 1978) as part of the factor external political efficacy in our study. However, trust has multiple dimensions (Focht and Trachtenberg, 2005; Koontz, 2014) and can be both a factor influencing participation decisions (Kalkbrenner and

Roosen, 2016) as well as an intermediate outcome of participation (Carr et al., 2012). Our study examines only one dimension of trust because an in-depth analysis of trust that both captures the dynamics of trust and differentiates between trust as an input and out-put variable did not fit within the scope of this study. Future research should investigate financial participation and trust more closely with appropriate research designs that specifically address each of these aspects.

The generalisability of our results may be restricted by focusing on the *Energiewende*, because factors for participation may differ depending on the context and the respective topic. The example of results reported by Wiebe (2000), who examined participation in development projects in Guatemala, found that the hope of improving one's own economic situation influences active participation. This indicates that factors influencing active participation may vary slightly depending on the topic and context. However, formal participation in projects of the *Energiewende*, such as building wind turbines or infrastructure such as the electric grid, have a legal basis similar to other infrastructure or construction projects in Germany. That is why we assume that similar impact factors influence active engagement in other policy fields in Germany such as mobility or urban planning. Whether the results can be applied to other contexts cannot be concluded at this point, instead future studies should investigate in more detail whether social, economic, cultural, and legal framework conditions and the complexity of or controversy about a topic may impact how many and which people become actively engaged.

6. Conclusions and Policy Implications

Previous studies have found that inclusive participatory decision-making processes (i.e., all those affected are able to attend), the number of participants, and the representation of interests, values, and knowledge influence the outcome of participatory decision making (Bidwell, 2016; de Vente et al., 2016). A fair participation process is characterized by equal opportunities for everyone to attend, initiate, and participate (Webler and Tuler, 2000). In this paper, we investigated factors explaining people's active involvement in participation processes related to the *Energiewende* in order to better understand how participation processes should be designed to involve as wide a range of people as possible. We conducted a large-scale survey representing the German population with respect to the distribution of age, education, and gender to examine several theoretically derived factors influencing participation in the *Energiewende*. The findings suggest that about two percent of the German public aged between 18-70 years engage in formal participation as part of decision-making processes related to the transformation from a fossil-fuel to a renewables-dependent energy system. Various instruments are applied to involve the general public, in addition to state and government actors, but respondents were actively engaged in only a few instruments. These findings imply that only a limited number of people become actively engaged in the *Energiewende*, which suggests politicians and public authorities should set up participation processes comprising different instruments to reach a greater number of people and to include more diversified interests and perspectives.

The involvement of all interests and ensuring that participants are representative of the respective population seem to be normative expectations that hardly occur in reality and perhaps do not have to be met in order to achieve a fair procedure. Our results suggest that the interests and

values of the participants are balanced, in the sense that different stakeholders have their say and there is no one-sided dominance. Further, we found that important factors of participation decisions for both formal and informal participation formats are knowledgeability about specific energy-generating technologies, a value orientation towards nature, and political efficacy. Whereas personality strength and age are only relevant regarding decisions related to informal participation. Attitude towards renewable energy technologies is an important factor to participate only if the formats offer the possibility of co-decision. Those people who live in a dwelling owned by themselves or by a family member are more likely to become actively involved in informal participation processes or to participate financially than people living in rented accommodation. In contrast, people living in small towns or rural areas are more likely to participate only in information and consultation instruments than residents of bigger cities. Knowledge about general issues of environment and energy showed weak relations with information and consultation instruments. Gender as an influencing factor plays a subordinate role according to our results: it was only a statistically significant factor regarding cooperation and solution-finding instruments. These findings indicate that people participating in the Energiewende are not representative of the German public, but, on the other hand, no clear dominance of a certain already well-represented group of people was detected either.

Policy Implications

Interestingly, these findings show that different participation formats attract different people, which implies that some participation instruments are barriers to becoming actively engaged in the *Energiewende*. The results indicate that it seems more appealing to participate in round tables or lectures than to make a written statement. However, our results show that participation in

face-to-face dialogues seems to require personal characteristics such as personality strength. Thus, the combination of informal and formal participation formats would allow people with different personal characteristics to choose a format that makes them feel comfortable. Such a design would attract a greater diversity of people, which is assumed to lead to improved decision making. Procedural fairness and the legitimacy of the final outcome can be further increased by using information tools such as site visits, information stands, and regional conferences.

Webler and Renn (1995) identified four major problems for participation. Participation is perceived as merely rubber stamping by the citizens because the decision has already been made; the facilitators have insufficient knowledge about the citizens' concerns and neglect the experiences and preferences of the public; distrust in public institutions and limited confidence in the decision-making process; conflicting rationalities of facilitators, decision makers, public authorities, and citizens. Our findings may help to overcome these deficits by providing information for decision makers to enable them to better understand what kind of people participate and, thus, to be able to design better participation processes. For instance, we found that informal participation processes attract a far greater number of people than formal participation procedures. Only two percent of the respondents stated that they had submitted comments in planning and decision-making procedures (see Table 2). On the other hand, up to 19 percent of the respondents had participated in an informal participation instrument. This indicates that especially informal participation formats such as citizen questionnaires, which address citizens directly, offer a lower threshold for participation than formal procedures. Formal participation procedures often offer only the opportunity to comment within a tight timeframe and are usually communicated through

official journals or in online council information systems that are not frequented by a large proportion of the population. This may lead, on the one hand, to the perception that the participation process is only a tool to approve a decision that has already been made. On the other hand, the previously described rigid framework conditions of formal participation lead to the fact that such participation does not correspond to the needs and opportunities of the population. Accordingly, laws specifying formal participation should be amended to allow for participation processes tailored to the target group.

While more informal participation formats are being offered by companies such as the transmission system operators (Hildebrand et al., 2018), it is often unclear how the results of these formats influence the final decision or whether the results are considered at all. However, Firestone et al. (2017) found that simply involving people is not enough to enhance support for wind projects, but it is essential that people feel they are actually being heard by the respective decision makers. In addition, also Ernst (2019) concludes that co-decision opportunities not only lead to positive perception of the decision-making process but also increase trust. Therefore, the combination of the benefits of formal – legally guaranteed opportunities for hearing and considering objections – and informal participation formats – reaching a greater number of people – may improve participatory decision making and foster the transformation to a RES-based energy system.

Implications for Future Research

Several questions still remain to be answered by future research. Our study focused on what kind of people participated in the Energiewende and thus, we were not able to completely examine

all possible factors influencing participation decisions. The motives for participation (such as the desire to change the outcome) have not yet been sufficiently explored and their inclusion in this study were beyond the scope of this paper, thus future studies should explore their significance. In addition, future research should investigate whether our findings may be applicable in other contexts such as different cultural or political systems and other policy fields such as mobility or health. Our results indicate a need for further research to identify and empirically test theoretically relevant factors influencing financial participation in the Energiewende. In addition, the relevance of political efficacy for public participation as suggested by several studies (Reichert, 2016; Verba et al., 1995) is clearly supported by the current findings. However, the mutual effects of participation and political efficacy, participation and trust, as well as of participation and knowledge, need to be the subject to future research. Future research should conduct a longitudinal study to disentangle the reciprocal effects between these concepts. Such investigations should also look closely into what participants expect to be the result of their individual engagement and what they expect from the participation process. Another issue to be considered in future studies is individuals' perceptions of the visual and noise impact of renewable energy installations. Warren et al. (2005) showed that positive attitudes to wind power plants are rooted in reasons at a global level, such as in the production of "clean" energy and environmental protection, whereas negative attitudes arise from local concerns about the visual and noise impact of wind power plants on the landscape. Since these (local) concerns are particularly salient in the phase when sites for wind farms are proposed, it can be assumed that they motivate locals to engage in the participation process because of an increased need for information on the project or the desire to express their concerns about the projects.

7. Appendix

Table 4: Value orientation - Nature

Item no.	In the following, we will briefly describe a few people. Please read each description carefully and then decide how similar or dissimilar the person described is to you.
1	It is important to him/her to care for nature.
2	It is important to him/her to take part in activities to protect nature.
3	It is important to him/her to protect the natural environment from destruction or pollution.

Notes: In the online survey, we adjusted the wording of the items measuring value orientation nature to respondents' gender.

Table 5: Modified short scale on political efficacy for energy political issues (Source: Modified PEKS (Beierlein et al., 2014))

Item no.	You may agree more or less with the following statements in relation to energy policy issues (e.g., expansion of the electric grid, nuclear phase-out, expansion of renewable energies). To what extent do you agree or disagree with the respective statement?
1	I am good at understanding and assessing important energy policy issues.
2	Politicians care about what ordinary people think about energy policy issues.
3	I'm sufficiently confident to become actively engaged in a discussion about energy policy issues.
4	Politicians try to keep in close touch with the people regarding energy policy issues.

Table 6: Place attachment scale (Source: Items are taken from Lewicka (2010))

Item no.	Below are some statements that deal with how attached you are to your place of residence. For each of the following statements, please indicate whether the statement does or does not apply to you.
1	I miss my city/town/village, when I am not there.
2	I feel secure in my city/town/village municipality.
3	I am proud of my city/town/village municipality.
4	I would like to move away from my city/town/village.

Notes: In the online survey, we adjusted the wording of the items in the place attachment scale to respondents' answer to a previous question about their living place (city or a rural municipality).

Table 7: Personality strength scale (Source: Items are taken from Noelle-Neumann (1983))

Item no.	And what about the following aspects? Please also mark here which properties apply or do not apply to you.
1	I usually count on being successful in everything I do.
2	I am rarely unsure about how I should behave.
3	I like to assume responsibility.
4	I like to take the lead when a group does things together.
5	I enjoy convincing others of my opinions.
6	I often notice that I serve as a model for others.
7	I am good at getting what I want.
8	I am often a step ahead of others.
9	I own many things others envy me for.
10	I often give others advice and suggestions.

Table 8: Scale for measuring general knowledge

Item no.	You cannot know everything in life. Nevertheless, we would like to ask you to tell us whether you consider the following four statements to be "definitely not true", "probably not true", "probably true" or "definitely true".
1	The ozone layer will never heal.
2	Carbon dioxide (CO_2) is released every time we burn oil, coal or gas.
3	The EEG levy[7] is used to finance the energy transition in Germany.
4	In a private household, most of the energy is used for space heating.

Source: Authors' own.

Table 9: Original PEKS by Beierlein et al. (2014)

Item no.	The following questions ask how you feel about politics. The statements may apply to you to a greater or lesser extent. To what extent do you think each statement applies to you personally?
1	I am good at understanding and assessing important political issues.
2	Politicians try to keep in close touch with the people.
3	I have the confidence to take an active part in a discussion about political issues.
4	Politicians care about what ordinary people think.

[7] Since 2008, households in Germany supplied with electricity from the public grid have to pay a levy for every kilowatt-hour of electricity consumed (2008: €0.0117, 2017: €0.0688). This levy is paid to owners of renewable electricity-generating technologies (e.g., photovoltaic systems, wind turbines) for every kilowatt-hour of electricity they feed into the electric grid. This reallocation is referred to as the EEG levy.

Table 10: Descriptive statistics of explanatory variables

	N	Mean	Standard Deviation	Minimum	Maximum
Attitude to RES Technologies	2,365	5.89	1.47	0	8
Concern for Nature	2,321	3.67	1.04	0	5
Political Efficacy	2,336	3.19	1.62	0	8
Place Attachment	2,378	4.49	1.88	0	7.25
Personality Strength	2,400	1.47	1.12	0	3
General Knowledge	2,400	1.05	0.94	0	4
Specific Knowledge	2,400	3.58	1.72	0	6
Share of respondents …	N	Proportion			
with weak strength	2,400	25.54 %			
with moderate strength	2,400	26.79 %			
with above-average strength	2,400	22.96 %			
with strong personality strength	2,400	24.71 %			
living in own property p	2,400	36.42 %			
living in a small town or the countryside	2,400	38.63 %			

Table 11: Marginal effects of the respective logistic regressions reported in Table 9

	M1 Formal Participation	**M2** Information and Discussion Instru-ments	**M3** Consultation and Solution-Finding Instruments	**M4** Financial Participation
	dy/dx	dy/dx	dy/dx	dy/dx
Attitude to RES Technologies[1]	-0.004***	-0.006	-0.010**	0.001
	0.001	0.005	0.004	0.001
Concern for Nature[1]	0.006**	0.037***	0.026***	0.002
	0.002	0.009	0.007	0.002
Political Efficacy[1]	0.003**	0.038***	0.018***	0.001
	0.001	0.005	0.004	0.001
Place Attachment[1]	0.002	0.006	0.005	0.001
	0.001	0.004	0.003	0.001
Moderate Personality Strength	0.002	-0.002	0.003	-0.004
	0.004	0.015	0.012	0.004
Above-Average Personality Strength	0.000	0.013	0.013	0.000
	0.004	0.015	0.011	0.003
Strong Personality Strength	0.001	0.017	0.027**	0.004
	0.004	0.014	0.011	0.003
General Knowledge[1]	-0.001	0.017*	-0.001	0.002
	0.002	0.008	0.006	0.002
Specific Knowledge[1]	0.004***	0.030***	0.019***	0.002*
	0.001	0.005	0.004	0.001
Small Town or Countryside (=1)	0.007*	0.032*	-0.001	0.003
	0.004	0.016	0.012	0.003
Property Ownership (= 1)	0.003	0.039*	0.022*	0.010*
	0.005	0.017	0.013	0.005
Property Ownership x Place Attachment[1]				
Age[1]	0.000	-0.003***	-0.002***	0.000
	0.000	0.000	0.000	0.000
Male (=1)	-0.001	0.021	0.026*	0.003
	0.004	0.016	0.012	0.003
Intercept				
Pseudo-R^2 (MacFadden)	0.098	0.118	0.096	0.100
n	2255	2291	2291	2290

Table 12: Results of multivariate logistic regressions in which both dimensions of the construct political efficacy (i.e., external and internal political efficacy) are considered separately

	M1 Formal Participation	**M2** Information and Consultation Instruments	**M3** Cooperation and Solution-Finding Instruments	**M4** Financial Participation
Attitude to RES Technlogies[1]	-0.26**	-0.03	-0.10*	0.14
	(0.10)	(0.04)	(0.05)	(0.14)
Concern for Nature[1, a]	0.39*	0.19**	0.19**	0.24
	(0.20)	(0.07)	(0.08)	(0.22)
External Political Efficacy[1, b]	0.01	0.03	-0.01	0.05
	(0.07)	(0.03)	(0.03)	(0.09)
Internal Political Efficacy[1, b]	0.19*	0.28***	0.21***	0.02
	(0.10)	(0.04)	(0.04)	(0.11)
Place Attachment[1, c]	0.12	-0.01	-0.01	0.24
	(0.13)	(0.04)	(0.05)	(0.18)
Internal Political Efficacy[1] x Place Attachment[1]	0.03	0.01	0.02	-0.00
	(0.04)	(0.02)	(0.02)	(0.05)
Weak Personality Strength[d]	-0.51	-0.24*	-0.49**	-0.46
	(0.41)	(0.12)	(0.16)	(0.47)
Moderate Personality Strength	0.20	0.07	0.06	0.03
	(0.27)	(0.10)	(0.12)	(0.32)
Above-Average Personality Strength	0.05	-0.02	0.05	0.13
	(0.30)	(0.10)	(0.13)	(0.33)
Strong Personality Strength	0.28	0.19	0.39**	0.32
	(0.26)	(0.10)	(0.12)	(0.30)
General Knowledge[1]	-0.09	0.07	-0.07	0.24
	(0.17)	(0.06)	(0.08)	(0.18)
Specific Knowledge[1]	0.26**	0.19***	0.19***	0.27*
	(0.11)	(0.04)	(0.05)	(0.14)
Small Town or Countryside (=1)	0.55*	0.25*	0.00	0.33
	(0.32)	(0.12)	(0.14)	(0.36)
Property Ownership (= 1)	0.22	0.28*	0.24*	0.96**
	(0.33)	(0.12)	(0.15)	(0.40)
Property Ownership x Place Attachment[1]	-0.04	0.13*	0.12	-0.26
	(0.17)	(0.06)	(0.08)	(0.21)
Age[1]	-0.01	-0.02***	-0.02***	-0.00
	(0.01)	(0.00)	(0.00)	(0.01)
Male (=1)	-0.20	0.04	0.22	0.33
	(0.32)	(0.12)	(0.15)	(0.36)
Intercept	-4. 60***	-1.94***	-2.51***	-5.42***
	(0.33)	(0.11)	(0.14)	(0.44)
Log-Likelihood Model	-204.747	-987.326	-759.077	-162.992

Log-Likelihood Null Model	-228.137	-1130.488	-846.896	-180.848
Pseudo-R^2 (McFadden)	0.103	0.127	0.104	0.099
n	2241	2277	2277	2276

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