Energy and Climate Change 7 (2026) 100232

Contents lists available at ScienceDirect

Energy and Climate Change

journal homepage: www.sciencedirect.com/journal/energy-and-climate-change

Effects of climate policy attitudes and populism on the acceptance of renewable energy infrastructure in Germany

Elena Hubner *, Peter Dirksmeier

Leibniz Universität Hannover, Institute of Economic and Cultural Geography, Schneiderberg 50, 30167 Hanover, Germany

A R T I C L E I N F O

Keywords:
Energy transition
Renewable energies
Social acceptance
Germany
Climate policy
Populism

A B S T R A C T

The energy transition in Germany, although supported nationally by widespread recognition of climate change, faces significant local opposition. This gap raises questions about the factors influencing individual attitudes towards renewable energy infrastructures. Drawing on the literature about the acceptance of renewable energy, we examine the impact of attitudes towards climate policy, populism and place attachment on the acceptance of renewable energy infrastructure. Additionally, we examine differences in acceptance between East and West Germany. Using instrumental variables (IV) regression and Blinder-Oaxaca decomposition with a representative survey sample of 8,643 individuals, our study shows that positive attitudes towards climate policy significantly increase the acceptance of renewable energy infrastructures in Germany. Conversely, populist attitudes are associated with lower levels of acceptance. While place attachment has no significant effect, acceptance is notably lower in East than in West Germany. These results provide insights into the complex reasons behind the acceptance or rejection of renewable energy projects and highlight the need for climate policies that are sensitive to regional and political nuances. Tailored communication strategies that take these differences into account are essential to foster acceptance and bridge the gap between general acceptance and local rejection. In conclusion, the successful advancement of the energy transition in Germany requires acknowledging and addressing the diverse socio-cultural contexts across the country.

1. Introduction

Tackling climate change necessitates a global reorganisation of current energy systems with a shift from fossil fuels to low-carbon and renewable energies [1]. Meanwhile the transition to renewable energies requires social and political negotiation [2–4]. Central to its success are technical and policy changes, but also willingness to change [5,6]. Emerging literature highlights the crucial role of individuals [7,8]. Their subjective position on renewable energies gives them powerful leverage in implementing the energy transition. In light of what has been described in the literature as the "national-local 'gap'" [9] (p.1077), considering questions of acceptance is particularly relevant in democratic states. This refers to the phenomenon of renewable energy being accepted at the national level, yet facing considerable protest at the local level. In addition to recent studies mainly focusing on local strategies to engage German society in the energy transition [10,11], we examine the sociocultural characteristics that influence the acceptance of renewable energy infrastructures on a national level in Germany. A large survey sample and a new methodological approach, specifically two-step analyses involving regression and decomposition, will be used to adopt a national perspective. This methodology enables us to identify possible actions that could bridge the national-local gap and ensure a successful energy transition.

Our research is embedded in the emerging field of energy geographies [12] that addresses the spatial dynamics of energy production, transportation and consumption [13]. Energy systems are socio-technical systems [14–16] in which social and technical aspects are interdependent [17]. According to this, acceptance – a frequently used concept to measure agreement with the energy transition – is a meaningful relationship between a technology and social acceptors [18]. Considering that individual acceptance is embedded in a broader socio-political context, we test the main influencing variables identified in the previous literature on the acceptance of renewable energy infrastructures in a new dataset for Germany. We chose Germany for two reasons. First, in Germany, the desire for sustainable and low-risk energy production is deeply rooted in society. The so-called "Ener-giewende" (energy transition) was initially established in West Germany as a phase-out of nuclear power [19] and today it denotes the entire

* Corresponding author.
E-mail addresses: hubner@kusogeo.uni-hannover.de (E. Hubner), dirksmeier@kusogeo.uni-hannover.de (P. Dirksmeier).

https://doi.org/10.1016/j.egycc.2025.100232

Available online 6 January 2026

country's commitment to sustainable energy and climate change mitigation [20–22]. Second, while the need to mitigate climate change is widely recognised in Germany [23], significant social and regional disparities impede the implementation of energy transition infrastructures [24]. Our focus is on several key areas of renewable infrastructures, including local wind turbines, solar installations, underground high-voltage power lines and high-voltage pylons. This selection is based on three main considerations. Firstly, these infrastructures are crucial for the current phase of the German energy transition. Secondly, they often face significant acceptance challenges which can lead to protests when energy transition projects are being implemented. Lastly, they represent the types of infrastructure German society is most familiar with.

We use instrumental variables regression with regionally clustered standard errors to analyse the influence of populism, climate policy attitudes, place attachment and the West-East divide on the energy transition in German society, whereby we instrument the importance of climate policy. Causal statements are therefore only possible for the importance of climate policy. The analysis will help to understand the factors influencing the uptake of renewable energy and support the development of policies for promoting it. The paper is structured as follows: Section 2 provide a literature review which forms the basis for our understanding of acceptance and the formulation of four research hypotheses. The methodology of our study is outlined in Section 3, while Section 4 presents the data and variables of our quantitative approach. After presenting the results of our statistical analyses in Section 5, highlighting the impact of political attitudes, climate policy relevance and regional differences on acceptance, Section 6 discusses the implications of our findings for policy and practice, and Section 7 offers recommendations for enhancing local acceptance, which is crucial for Germany's energy transition.

2. Literature review and hypotheses

Acceptance is described as "one of the most policy-relevant social science concepts in the field of energy technologies" [25] (p.101) that can serve as a "'learning laboratory'" [26] (p.1) to propel the energy transition forward. Consequently, recent studies emphasise that acceptance, a concept long regarded as vital for this transition, remains paramount. There are various conceptual approaches to understanding general agreement with the energy transition or the exclusive agreement with one form of renewable energy [27]. Alsheimer et al. (2024) provide a conceptual overview of the distinction between legitimacy and acceptance [18]. Zander et al. (2024), in relation to specific projects, emphasise that acceptance is positively influenced by primarily positive attitudes, such as emotions, perceived benefits, and trust [28]. Similarly, Lindvall et al. (2024) identify value-based factors, such as ideology, trust and environmental concerns, as being crucial for acceptance [29].

Fundamental to all these considerations is the prominent concept of "social acceptance" proposed by Wüstenhagen, Bürer, and Wolsink in 2007 [30]. Introduced to replace the NIMBY approach [31], which was considered insufficient, it aims to theoretically capture the process of generating agreement for renewable energies. To achieve this, it differentiates between various actor groups on different spatial-technological levels: community acceptance (at a local level), market acceptance (at a wider technical and economic level) and socio-political acceptance (at a general level) [30]. This concept is still employed today to identify the factors that influence the acceptance of wind power or solar parks in a specific region or project from the perspective of stakeholders who are either directly involved (community) or have a professional relationship with the project (e.g., investors, politicians, stakeholder groups, institutions [32]). It largely interprets acceptance as an attitude adopted by individuals with a professional relationship to, or who are directly affected by, the energy transition project. Therefore, these groups need to take a position towards the project. However, this need does not apply to the general public or other individuals [33]. Consequently, the concept is not particularly well-suited to capturing ordinary people's (i.e., those not professionally involved in renewable energy) attitudes towards renewable energies.

Our study is therefore based on a nuanced conceptualisation of acceptance. Rather than viewing acceptance as a one-time decision, we consider it to be a spectrum ranging from active endorsement (support [34]) to outright rejection (no acceptance). This perspective encapsulates the varying degrees of support and opposition that individuals show towards renewable energy infrastructures. Using this framework, our aim is to capture the full range of individual opinions, recognising that acceptance can involve active support or opposition.

At least since Walker [35], a rich body of research has emerged, that explores various predictors for the acceptance of renewable energies (for examples for wind farms [36,37] or for solar parks [38]). In addition to socio-demographic factors such as income, age, and gender, whose predictive power is limited in general [39–41], the focus is mainly on factors closely connected to the material outcomes of implementing new renewable technology. These include visibility [42] and intrusiveness on the "landscape scenery" [43] (p.865) or spatial proximity [44,28]. Currently, in the context of hydrogen technologies a lack of knowledge is also being discussed as a trigger for negative attitudes [45]. Three key points are important: First, although these aspects mainly lead to negative responses towards renewable energies, they cannot be summarised as mere selfish NIMBYism (e.g., [46]). Second, these factors more or less depend on the specific dimensions of a given project. In our study, due to its abstract nature, such concrete details are not captured. Third, in the case of wind power it has been demonstrated that impressions associated with wind turbines are more indicative of the social and cultural perceptions related to them than characteristics associated with their physical-material manifestation [41,47].

Therefore, by arguing that the transition to renewable energy is embedded in a wider social structure (technology, lifestyle and politics) [5], from which individuals derive their values, morals and beliefs, we assume that the object of acceptance is (at least in part) aligned with individual convictions. Depending on the socio-technical implementation of renewable energies, these convictions can relate to political action [29] as well as environmental and climate protection [48,43]. Based on the strand of literature that examines how individual dispositions influence acceptance-oriented attitudes towards renewable energies [49,50], we develop our hypotheses.

Building on Knight's observation [51] that political orientation plays a key role in shaping attitudes towards environmental issues, we suggest that for renewable energy issues, examining populist attitudes offers a more promising perspective on their acceptability than relying solely on the left-right political spectrum [52,53]. While Lindvall et al. [29] emphasise that "the more left-wing oriented [the] participant the […] higher [the] support" for wind power in Sweden, a more nuanced view of democratic Western societies with a differentiated party system is instructive. For example, while the expansion of renewable energies is progressing slowly in Eastern European countries due to cheap fossil fuel supplies from Russia [54] or their own large coal reserves [55], renewable energy policy in the United States is influenced more by cross-party differences than by ideology alone [56,57]. Given the context that the current wave of populism is characterised by its global spread [58], the existing literature demonstrates a strong link between populist attitudes and climate scepticism [59,60] and concurs that populist attitudes increase resistance to energy transition projects [61]. Indeed, it can be observed that populists around the world often deny human involvement in climate change and exhibit scepticism towards scientific evidence supporting the need for energy transitions [62]. The conclusion is that the energy transition is inextricably tied to "non-populist political values" [63] (p.5).

Populism refers to an ideology that divides a society into the people and the (corrupt) elite, where political decisions "should be an expression of the volonté général (general will) of the people" [64] (p.562). Adopting populist attitudes means leaning towards populist constructions of reality and possibly voting for populist parties [65]. The energy transition is predestined to be co-opted by "populist framings" [66] (p.848) due to the far-reaching social changes it necessitates. By presenting the energy transition as an elitist green idea, populism on the "supply-side" [67] (p.529) offers "a unique interpretation of the political reality" [65] (p.5), which can frame the pressure for change induced by the energy transition for the 'pure' people as well as feelings of disadvantage by offering simple, anti-elitist solutions. Therefore, as a first hypothesis, we expect *that individuals with populist attitudes are more likely to reject renewable energies* (hypothesis 1).

From the above, we derive the further hypothesis: We expect that *people who ascribe high relevance to climate policy are more likely to accept renewable energies* (hypothesis 2). The literature supports this link [68], as mitigating climate change is a key motivator for the energy transition [69], and there is a clear connection between support for climate protection policies and acceptance of the energy transition [44,29,50]. The implication is that attitudes supportive of climate policy drive the acceptance of renewable energy infrastructures, as these are perceived as pivotal for achieving climate policy goals [70]. Because research suggests that older adults typically have a lower awareness of the negative consequences of climate change [71,72], we expect age to be a significant factor in shaping attitudes toward climate policy and renewable energy acceptance.

The second factor for the acceptance of the energy transition, alongside political preferences, is the overarching spatial characteristics of the energy transition [73]. The traditional energy system relies on large, centralised fossil fuel and nuclear power plants. In contrast, the transition to renewable energy is characterised by decentralised generation with small-scale infrastructure such as solar panels and wind turbines, which can lead to uneven spatial development [74] and disproportionately affect rural areas outside urban centres [75,76]. Resistance in the affected areas has become an obvious phenomenon [49,77] and can lead to stigmatisation of the local population as blockers of the energy transition and backward-looking. However, the socio-political call for a "just transition" [78] raises the question of a fair distribution [79] of the benefits and burdens of energy system transformation [80] across population groups with different cultural backgrounds and expectations [81]. Therefore, we associate the acceptance of renewable energies and their visible infrastructures with individuals' emotional and social attachment to place [82,83]. People with a strong emotional connection to their community are more likely to develop negative attitudes towards local energy transition projects [84]. We therefore expect that *people who feel a strong sense of belonging to their place of residence are less likely to agree with renewable energy infrastructures* (hypothesis 3).

Since it is known that energy production is influenced by geographical factors [74], we additionally control for East-West differences in the German context [85], given that Germany was once divided. In general, these differences can still be observed in political, economic, and identity issues [86] and are so pronounced that they can be expected to explain variance in the acceptance of renewable energies. Addressing these regional dynamics is crucial to understanding the broader landscape of energy production and acceptance. Lignite mining, which still exists today, is not only an important economic factor in Saxony, Saxony-Anhalt, and Brandenburg, but also shapes the self-image of large regions in East Germany. The federal decision to phase out coal mining by 2038 puts these regions under economic pressure and evokes fears of job losses and economic decline [87,88]. Empirical results from research on local differences in attitudes towards climate change in Germany show lower climate awareness in East Germany [89,90] and therefore strongly suggest differences in the acceptance of renewable energies. We therefore *assume that the acceptance of renewable energies among people living in East Germany is lower (Berlin, Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt and Thuringia) than among people living in West Germany* (hypothesis 4).

3. Methodology

Lundberg et al. [91] consider a clear definition of the goal of the statistical analysis, regardless of the statistical method chosen, to be essential for the evaluation of the results. The goal of our statistical analysis is to make statements about the influence of populism, climate policy attitudes, and local rootedness on attitudes towards energy system transformation in Germany. To explore these influences, we have developed a two-stage strategy to test our hypotheses. In the first stage, we estimate two-stage least squares instrumental variable regressions for the acceptance of renewable energy infrastructure. Two-stage least squares instrumental variable regression is used to estimate the effect of explanatory variables on a dependent variable in the case of a distorted correlation between these items. The use of instrument variables is essential. These are characterised by being correlated with the explanatory variable while at the same time being not or only weakly correlated with the dependent variable. Firstly, the explanatory variable is estimated using instruments. In a second step, these estimated values are used to determine the relationship to the dependent variable. We first estimate the influence of the presumably endogenous variables on the exogenous variables, where Y is the dependent variable. Z is the instrumental variable. π_1 is the coefficient that measures the direct effect of the instrumental variable on the dependent variable. X is the endogenous independent variable. The coefficient π_2 describes the change in Y with a change in X and u is the error term:

$$Y_1 = \pi_1 Z + \pi_2 X + u \tag{1}$$

In the second regression Eq. (2), Y_1 is replaced by the predicted values of Y_1 ($\widehat{Y}_1$) estimated in the first regression (1) [92].

$$Y_2 = \alpha + \beta \widehat{Y}_1 + \beta X_1 + \epsilon \tag{2}$$

We use instrumental variable regression for two reasons. First, the literature review clearly shows that there is a lack of consistency in explanations of the acceptance of renewable energy infrastructure to date. In various studies in different regions or nation states, no consistent results can be found and, as shown in the literature review, various explanations for the acceptance of renewable energies are given. In order to avoid an omitted variable bias (OVB) as far as possible, we estimate instrumental variable models [93]. Furthermore, we regress attitude scales on attitude scales, each of which contains specific attitudes towards climate protection, climate policy, renewable energy infrastructures and climate change, and whose selectivity can therefore not be independent. For this reason, we suspect endogeneity in the models and address this problem by using awareness of climate change as an instrument for assessing the importance of climate protection policy. We consider a positive attitude towards restrictive climate policy as a significant factor for the acceptance of energy system infrastructures, while abstract concerns about the social and economic consequences of climate policy are much more closely linked to people's own economic situation. The positive attitude towards restrictive climate policy is significantly more strongly conditioned by the assessment that climate change is a major problem. In addition, we control for a potential weakness of the instrument, which would result in an overestimation of the effects, following a recommendation by Keane and Neal [94] using the Anderson-Rubin test, which they also suggest in the case of strong instruments. As we only instrument the variable *"climate policy: importance"*, causal statements are only possible in relation to climate policy attitudes.

In the second analytical step, we use Blinder-Oaxaca decomposition based on the instrumental variable regressions [95]. We first separate the significant covariates of the regression using the 75th percentile and calculate the mean differences with regard to the acceptance of renewable energy infrastructures. In addition, we calculate the mean difference between East and West Germany. On the basis of the instrumental variables regressions, we use decomposition analysis to explain differences in the acceptance of the infrastructure for renewable energies. The Blinder-Oaxaca decomposition is a method for analysing the difference in average values of a dependent variable between two groups. The decomposition shows how much of the difference can be explained by compositional effects and how much has to be explained by differences in the effects of the covariates [96]. In this way, the influence shown in the regression can be broken down and traced back to underlying factors. This approach explains the influences of the covariates, which can be attributed to pure compositional effects of the different groups [95,97]. This also clarifies which proportions presumably have to be explained in terms of attitudes and behaviour. The analyses were conducted with Stata 18.0 using the packages oaxaca [95] and ivreg2 [98].

4. Data and variables

We use the German Social Cohesion Panel (SCP) as our data source. The SCP is an annual longitudinal study of German households conducted since 2021 in collaboration with the Research Institute Social Cohesion (RISC) and the Socio-Economic Panel (SOEP) with a focus on social cohesion [99]. The SCP is collected using a mixed-mode design (PAPI and CAWI). The longitudinal study is based on a two-stage random sampling procedure with 299 German municipalities as primary sampling units (PSUs). In a second step, 37,874 individuals were drawn from the population registers of the 299 municipalities selected for the first panel survey in wave. These anchors and their household members aged 18 and older were then invited to participate in the study [99]. We used the raw data set from the second round of interviews in 2022, which had a thematic focus on attitudes towards renewable energy, climate change, and climate policy. The data already contains the final weighting and is therefore representative for Germany. The weighting includes a modelling of nonresponse based on the gross sample, using regional indicators at the district level [99]. Furthermore, the weights are calculated via a marginal adjustment using a ranking based on Microcensus data; at the household level according to household size, federal state and municipal size class, at the personal level according to age, gender, East/West and nationality. Our analyses are based on the responses of 8643 individuals.

The dependent variable, which is acceptance of energy transition infrastructure, comprises four items in one scale. The questions elicit attitudes towards local wind turbines, local solar installations, local underground high-voltage power lines and local high-voltage pylons. The response options form a five-point Likert scale ranging from "strongly dislike" to "strongly endorse", with higher values indicating greater agreement. The wording of the questions is "Would you approve or disapprove if, as part of a climate-friendly energy policy, a) wind turbines were built in your area *(Mean = 3.60; SD = 1.10),* b) a high-voltage line was laid underground *(Mean = 3.71; SD = 0.95)*, c) a high-voltage line with pylons was built *(Mean = 2.75; SD = 1.02),* d) a large-scale solar park was built *(Mean = 3.94; SD = 0.95)*". Attitudes towards infrastructure vary only slightly in terms of their polarisation. The van der Ejik polarisation index of agreement (A) [100] shows values between 0.7 and 0.78 on a scale of 0 to 1, with a value of 0 indicating absolute polarisation in the distribution, a value of 0.5 indicating equal distribution, and a value of 1 indicating that all respondents selected the same answer category. Wind turbines show the highest polarisation (0.70), followed by high-voltage pylons (0.71), high-voltage underground cables (0.75) and solar installations (0.78). The mean values for wind turbines and solar installations differ significantly ($t = -30.88$; $p < 0.001$). Overall, all four values indicate a rather low level of polarisation and can only reflect the polarised discourse surrounding their construction in Germany to a limited extent. A mean value scale with the same range of values as the original items is calculated as the dependent variable. The reliability of the scale is acceptable with a Cronbach's alpha of 0.66 and a polychoric alpha of 0.70. A scale value can be calculated for 97.9 percent of respondents.

An explanatory variable for the relevance of climate change policy is included called *"climate policy: importance"*. The question is: "And how important is the issue of combating climate change to you?" The response range extends from "not at all important" to "very important" and comprises a total of five categories. The variable presumably correlates with the error term of an OLS regression on acceptance of renewable energy infrastructure and is considered endogenous. We use *"awareness"* as an instrument that is correlated with the relevance assessment of climate change policy, but potentially not with the error term of the regression model. It has a mean scale (Cronbach's alpha = 0.83; polychoric alpha = 0.85) consisting of six items about climate change assessment. For various reasons, climate change awareness is only weakly or not at all linked to the acceptance of energy transition infrastructure. Recognising anthropogenic climate change says nothing about the acceptance of local energy transition measures, such as landscape change caused by the construction of wind turbines. In particular, pronounced NIMBYism would stand in the way of this [101]. Personal economic concerns such as worries about a reduction in property values and the psychological distance to the very abstract climate change in comparison with the manifest buildings on site are also reasons that make a correlation appear unlikely. The questions are "a) Climate change is not as dangerous as many politicians claim. (reverse), b) Climate change is a topic that I often talk about with relatives, friends or acquaintances, c) I try to contribute to climate protection with my own actions, d) I am afraid when I think about the consequences of climate change, e) It makes me angry that not enough is being done to stop climate change, f) To combat climate change effectively, the economic system must be changed from the ground up." The answers range from "strongly disagree" to "strongly agree" on a five-point scale, with higher values indicating greater agreement. The correlation between climate policy: importance and awareness is r = 0.73 *[ci = 0.72–0.74]*. We also measure the level of concern about the negative effects of climate protection policy for the respondents personally as *"worries about climate policies"*. It can be assumed that a high level of concern leads to a significantly lower acceptance of renewable energy infrastructures. The four questions "a) I am concerned that my own standard of living will decrease due to climate policy, b) I am concerned that climate policy will destroy jobs without creating enough new ones, c) I am worried that conflicts in society will increase because of climate policy, d) I am worried that migration to Europe will increase because of climate change" (each from "strongly disagree" to "strongly agree" on a five-point scale) together form a scale (Cronbach's alpha = 0.66; polychoric alpha = 0.73) that expresses concern about climate policy.

We measure a populist attitude *("populism")* as a rejection of minority opinions. The questions are part of the module on political elitism [102]. The *"populism"* scale is a mean scale (Cronbach's alpha = 0.65; polychoric alpha = 0.74) consisting of the three questions "a) In a democracy, it is important to find compromises between different views, b) In a democracy, it is important to listen to groups with different opinions, c) In a democracy, the opinions of minorities must also be taken into account." The answers range on a five-point scale from "strongly agree" to "strongly disagree". High values indicate a high level of rejection and therefore populism.

Attachment to place of residence is measured by the question "How strongly do you feel emotionally attached to your place of residence?" on a five-point Likert scale from "very strongly" to "very weakly". In addition, a dummy variable *"East"* is created with the value one if the place of residence is in East Germany or Berlin. Socio-demographic control variables include "female" based on self-reporting by respondents, with "male" coded as zero, all other genders as one. *"Age"* is the age of respondent in years in 2022. Education is conceptualised as highest school-leaving qualification from no qualification (1), secondary school (2), comprehensive school, other and current pupils (3), polytechnic (4), advanced technical college entrance qualification (5) to high school diploma (6). Life satisfaction was measured on an eleven-point scale from (0) “completely dissatisfied” to (10) “completely satisfied”. Table 1 shows the descriptive statistics of the cases included in the regressions. A correlation table can also be found in the supplementary material (Table A1).

5. Outcomes

The explanatory variables for attitudes, like the dependent variable, are designed on a scale from one to five, with higher values indicating higher levels of agreement. The variables can thus be compared directly in terms of their effect on acceptance. Since robust standard errors are estimated, Wooldridge’s [103] robust score test and a robust regression-based test are used as a test for endogeneity. The test statistics are highly significant for all five models and suggest treating the variable ‘climate policy: importance’ as endogenous. The Anderson-Rubin tests for the five models indicate a satisfactory strength of the instrument variable to address the endogeneity of the variable [104]. The Kleibergen-Paap statistic, as an improved “statistic to test the rank of a matrix” [105] (p.97), also suggests that the instrument is sufficient to identify the endogenous variable in the models and that the models are therefore not under-identified. Table 2 shows the results of the regression analyses. The standard errors are clustered by spatial planning region (*Raumordnungsregion*), since there is no equal distribution of infrastructure in Germany (see Figure A1 and Figure A2 in the supplementary material) and this approach thus controls for the possibility that the observations within a region are not independent, but that there are independent differences between the regions.

Model 1 shows that the assessment of the perceived importance of climate policy is significantly more important for the acceptance of infrastructures than concerns about negative consequences of this policy ($chi^2 = 344.25$; $p < 0.001$). If the ‘climate policy: importance’ variable increases by one unit, the acceptance of infrastructures increases by 0.33 units, while it only decreases by 0.09 units if the worries variable increases by one unit. Therefore, the effect differs by a factor of 3.8. This result remains even when the populist attitude is taken into account in model 2 ($chi^2 = 322.25$; $p < 0.001$). If populism increases by one unit, acceptance decreases by 0.07 units. Populism thus has a slightly weaker negative effect on the acceptance of energy transition infrastructures than concerns about negative social impacts of climate policy. When controlling for the approval of individual infrastructures using ordered logistic regression (see Table A3 in the supplementary material), populism shows a stronger effect than concerns about climate policy for two out of four infrastructures. For electricity pylons and wind turbines is it the other way around, although electricity pylons are also associated with conventional energy generation. The correlation of attachment to place of residence with the acceptance of renewable energy infrastructures is weak compared to political attitudes, whereby the relation is strongest for wind power plants. The effect of ‘East’ is significant: it can be seen that East Germans are more sceptical about these infrastructures, specifically wind turbines (see Table A3). Attachment to place shows a weaker effect than would theoretically be expected [83]. The addition of the control variables in model five makes little difference to the effects. Gender and age are significant, with women and older people being less willing to accept these infrastructures in their environment. Education and life satisfaction show no significant correlation with the acceptance of infrastructure. As a robustness test, we carry out the regression of the overall model with additional dummies for all federal states to ensure that the estimated effects are not distorted by neglected regional heterogeneity. Table A4 shows that this is not the case and that the regression analyses are therefore valid.

In a second analytical step, we calculate the mean differences in the acceptance of renewable energies for the upper quartile of the variables “*climate policy: importance*”, “*worries about climate policies*”, and “*populism*” in order to check whether the upper values of the distribution behave differently. The breakdown of the explanatory covariates into their 75th percentile shows mean differences in the acceptance of energy transition infrastructure between the groups. The relative difference between the 75th percentile of “*climate policy: importance*” and the top quartile is 12.4 percent *($t = -27.57$; $p < 0.001$)* and is thus the strongest difference, analogous to the effect of the variable in the regression models. In contrast, the relative difference in climate policy concern is only 2.9 percent *($t = 9.79$; $p < 0.001$)* between the most concerned and all others. Concern about climate policy has nowhere near the influence on acceptance of infrastructure as support for this policy. The mean value of the more populist group is 4.2 percent relative to the base *($t = 11.23$; $p < 0.001$)* below the mean value of all others. The value for East Germany is 6.4 percent relative to the base *($t = 14.74$; $p < 0.001$)* lower than for West Germany. Only attachment to place of residence shows no significant difference *($t = 1.26$; $p = 0.207$)* between the 75th percentile of those who feel most attached and all others. We calculated the percentage difference from the national average for each level of place attachment in relation to the acceptance of infrastructures for renewable energies. The result of the one-way analysis of variance (ANOVA) shows that the group differences between the five levels of connectedness in relation to acceptance are significant ($F = 9.97$, $p < 0.001$). The positive deviation from the national average is 8.2 percent for people who feel only very weakly connected ($n = 150$), 0.9 percent for people who feel weakly connected ($n = 570$), and 0.8 percent for the middle category ($n = 1728$). The lowest acceptance, at −1 percent of the national average, is shown by people who feel strongly connected ($n = 3501$), followed by people who feel very strongly connected, at −0.07 percent ($n = 2203$). This shows that there is a correlation between the few people who feel very weakly or weakly connected and a greater acceptance of renewable energy infrastructures.

The decompositions (see Table 3) reveal that between 31.6 percent and 55.7 percent of the mean differences shown can be attributed to composition effects. To explain the 12.4 percent difference between the top quartile of the variable ‘climate policy: importance’ and the other three quarters, people’s own involvement with climate change is particularly decisive and explains more than half of the difference. The significantly smaller difference of 2.9 percent between the people most concerned about climate policy and the others, on the other hand, is correlated more with the older age of those concerned and their lower education. The difference of 4.2 percent in the acceptance of energy transition infrastructures between populist-minded people and the others is correlated not only with education but also with attitudes towards climate policy and climate change. For the East/West difference, on the other hand, age is significant in addition to the different climate change attitudes. Similar to the instrumental variable regressions, the decompositions show the great importance of a positive attitude towards climate policy for the acceptance of sometimes large, far, and wide visible infrastructures of the energy transition in the environment. In contrast, concern about the negative social effects of climate policy is only a factor for the East/West difference. Our analysis ultimately confirms the blurred picture of possible covariates for the acceptance of renewable energy infrastructures that emerges from the previous

Table 1
Descriptive statistics of the cases included in the regression analysis (*N = 8,127*).

	mean	std. dev.	min	max	N
dV acceptance of energy transition infrastructure	3.48	0.70	1	5	8168
climate policy: importance	3.98	0.93	1	5	8255
worries about climate policies	3.44	0.75	1	5	8212
awareness (instrument)	3.61	0.76	1	5	8195
Populism	2.00	0.62	1	5	8247
belonging	3.84	0.98	1	5	8270
East	0.19		0	1	8288
Gender	0.51		0	1	8280
Age	51.59	18.53	18	99	8258
education	3.78	1.68	1	6	8226
life satisfaction	6.495	2.08	0	10	8266

Table 2
Result of the 2SLS regressions, clustered standard errors in parentheses.

	model (1)	model (2)	model (3)	model (4)	model (5)
climate policy: importance	0.333***	0.322***	0.325***	0.319***	0.334***
	(0.016)	(0.017)	(0.017)	(0.018)	(0.019)
worries about climate policies	−0.091***	−0.093***	−0.087***	−0.084***	−0.061***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)
Populism		−0.068***	−0.075***	−0.076***	−0.066***
		(0.022)	(0.022)	(0.023)	(0.021)
belonging			−0.053***	−0.052***	−0.045***
			(0.015)	(0.015)	(0.015)
East				−0.136***	−0.118***
				(0.034)	(0.032)
Gender					−0.193***
					(0.025)
Age					−0.006***
					(0.001)
education					0.008
					(0.007)
life satisfaction					0.004
					(0.007)
Constant	2.478***	2.661***	2.847***	2.887***	3.024***
	(0.090)	(0.107)	(0.116)	(0.117)	(0.120)
R^2	0.096	0.105	0.110	0.118	0.150
Wald chi²(11)	452.53	454.38	477.12	587.37	732.22
Prob > chi²	0.000	0.000	0.000	0.000	0.000
Root MSE	0.665	0.663	0.661	0.658	0.644
N	8,026	8,007	7,992	7,992	7,893
	Instrument (awareness)				
	Instrumented (climate policy: importance)				
First stage Partial-R²	0.514	0.501	0.500	0.497	0.484
First stage Robust F	2467.63	2234.8	2189.28	3041.98	1976.93
First stage Prob > F	0.000	0.000	0.000	0.000	0.000
Anderson-Rubin Chi²	397.85	346.35	344.12	294.2	294.35
Anderson-Rubin Prob > Chi²	0.000	0.000	0.000	0.000	0.000

Table 3
Blinder-Oaxaca decompositions of the acceptance of energy transition infrastructures, 75th percentiles and East/West.

	Climate policy importance (75th percentile)		Worries about climate policies (75th percentile)		Populism (75th percentile)		East/West	
	Percent of difference explained	Coefficient	Percent of difference explained	Coefficient	Percent of difference explained	Coefficient	Percent of difference explained	Coefficient
gender	−2.62	0.011**	−4.054	−0.005	0.28	0.000	1.60	0.003
age	0.56	−0.002	15.50	0.018***	−0.75	−0.001	1.43	0.003
education	1.33	−0.006	8.83	0.010*	4.22	0.006	−2.14	−0.004
life satisfaction	0.38	−0.002	4.77	0.006	3.62	0.005	0.14	0.000
climate policy: importance	-	-	8.84	0.01°	20.26	0.029***	12.70	0.026***
worries about climate policies	1.47	−0.006*	-	-	1.19	0.002	4.72	0.010**
populism	4.23	−0.018***	−6.07	−0.007*	-	-	0.61	0.001
belonging	−0.27	0.001	4.75	0.005*	−3.86	−0.006*	0.20	0.000
East	1.75	−0.007***	6.31	0.007**	0.18	0.000	-	-
awareness (instrument)	48.85	−0.2036***	−7.27	−0.008	27.98	0.040***	14.05	0.029***
Explained	55.68	−0.231***	31.61	0.037*	53.11	0.076***	33.19	0.068***
Unexplained	44.32	−0.184***	68:39	0.079**	46.89	0.067**	66.81	0.137***
Difference	100	−0.415***	100	0.115***	100	0.144***	100	0.205***
Observations		7917		7924		7910		7893

Note: The decompositions are based on instrumental variable regressions with climate policy: importance as the endogenous variable and awareness as instrument. The decomposition of 'Climate policy importance (75th percentile)' is based on OLS regression. The reference group for the counterfactuals is the 75th percentile in each case.

literature. Only a positive attitude towards climate policy and, to a lesser extent, a populist attitude have a really significant effect on the acceptance of these infrastructures in general or on mean differences between the attitude groups. In contrast, attachment to place of residence only promotes acceptance if it is absent, while at the same time it is not accompanied by significant rejection. An East/West difference in the acceptance of renewable energy infrastructures is also still significant.

6. Discussion

The main differences between individuals who tend to accept new renewable energy infrastructures and those who tend to reject them seem to be more strongly linked to political and ideological attitudes rather than their immediate residential surroundings. The findings support hypotheses 1, 2 and 4. Hypothesis 3 is not confirmed despite regional clustering of the standard errors. The results suggest that individuals with populist attitudes are less likely to accept energy transition infrastructures in their neighbourhood. Conversely, support for climate policy is generally associated with higher acceptance. These differences are only secondarily related to whether respondents live in East or West Germany. And respondents' feelings of attachment to their place of residence play only a minor role. Our analysis is based on a nuanced understanding of acceptance, operating on a continuum from active support to outright rejection. This means we cannot ascertain to what extent acceptance of renewable energy infrastructure ultimately translates into concrete actions, such as financial participation in community energy projects.

Our analysis is consistent with existing literature showing that populist attitudes are often associated with opposition towards renewable energy infrastructure. By framing government action as elitist and harmful to 'ordinary' citizens, such individuals tend to view the energy transition as a cause of social problems such as rising energy prices or landscape intrusion [106,53]. Using our instrumental variable approach, we can draw causal conclusions for the instrumented variable. The instrumented variable is the perceived importance of climate policy, which enables us to argue that changes in the perception of climate policy can influence the acceptance of renewable energies. However, we cannot determine the extent to which concerns about the negative impacts of climate policy influence the views of people with populist attitudes. Instead, a lack of emphasis on the importance of climate policy seems to be a more crucial factor. The manifesto of the AfD – Germany's right-wing populist party – clearly denies anthropogenic climate change, leading to a blanket rejection of the energy transition. As the largest opposition party in the current German Bundestag (as of July 2025), it has considerable influence on the evaluative interpretation of current climate policy in Germany. Politicians from this party are creating a discursive space that resonates with individuals who may feel disadvantaged – as Yazar and Haarstadt [53] have shown for carbon-intensive regions. This may ultimately lead to a further and deeper polarisation of German society.

A limitation of our investigation is that we cannot conclusively determine whether the generally lower acceptance of renewable energy infrastructure among those with populist attitudes is a result of their populist views or a contributing factor to those views. We are merely demonstrating a correlation. Does someone subscribe to populism by rejecting climate change and the energy transition, or do they reject the energy transition because they have populist attitudes? Further research using designs that seek causal links, such as longitudinal studies, is needed to address these questions.

As current research indicates [29,50], we can assume that a positive attitude towards climate policy might have a significant positive impact on the acceptance of energy transition infrastructures. In the US context, Hamilton et al. [57] emphasise that successful climate policy must go beyond communicating scientific facts and must emphasise tangible benefits, such as job creation and lower energy costs, to effectively advance renewable energy projects. This also seems crucial for the German context, as our analysis shows that concerns about potential negative impacts of climate policy negatively correlate with support for renewable energy infrastructures. Furthermore, our results suggest generational differences [107]: older people appear to be more fearful of the negative consequences of climate policy and therefore more hostile to renewable energy infrastructure [39], while younger people give the impression of being less concerned about potential changes in energy patterns. However, our results may be open to misinterpretation. Attitudes and behaviours are not merely an inherent characteristic of the individual; they also depend on their social reference group [108]. Since self-reports form the basis of information about attitudes, they may be influenced by social desirability. Considering the cultural backdrop of climate protests in Germany, it is possible that young people feel pressured by their peers to adopt environmentally conscious behaviours. Further inaccuracies in our results on this point could have occurred if we consider that younger people may already be more familiar with renewable technologies and exhibit less scepticism towards them than older individuals.

And as we asked in an abstract way about the general acceptance of new infrastructures for the energy transition, we cannot say whether this generally favourable attitude towards energy policy will endure at the local level, where people are directly affected. Local contexts often present specific challenges and nuances, such as visual impact, changes to the landscape and perceived disturbance, which may alter initial positive perceptions [109]. In this context, Jobert et al. [70] emphasise the importance of specific planning regulations outlined in relevant policies for fostering local acceptance of wind energy.

Given the weak and non-significant correlation between feelings of belonging to the place of residence and acceptance of renewable energy infrastructures, and the lack of significant differences within the 75th percentile group, we cannot confirm hypothesis 3. However, group differences across the five levels of attachment suggest that people with strong and very strong ties to their place of residence are slightly more likely to oppose renewable energy infrastructure than those with weaker ties. Weak attachment to place of residence is associated with greater acceptance of renewable energy infrastructure in the local area, while the reverse effect is only very weak. Although the literature has previously suggested a significant negative relationship between place attachment and acceptance of local energy transition projects [110], our findings support recent research suggesting that spatial proximity [28], involvement in planning processes [111] and perceptions of justice [29,112,113] may have a stronger influence on readiness to accept visible changes in the immediate landscape. It remains an open question whether a certain degree of normalisation has already occurred for renewable energy infrastructures, similar to the normalisation that has already happened for fossil-based energy production infrastructures [114].

The assumed East-West difference in hypothesis 4 is confirmed by the divergent attitudes towards climate policy. However, these observed differences are influenced by more than just topographical factors. Attitudes towards the energy transition in local contexts are very likely shaped by historical developments and may reflect the unique historical backgrounds and cultural identification patterns in eastern and western Germany [115,86]. Age may be an important factor in explaining the difference: older East Germans are likely to attach less importance to climate policy and to be more concerned about its potential negative consequences. This seems to be a result of the special economic factors in East Germany. This is probably due to the particular concerns that the impending coal phase-out is causing in large parts of East Germany [87,88]. In addition to fears of economic decline, these regions are also concerned about the loss of tradition and identity. Higher energy prices and the generally poorer economic situation in the East, as well as a "lower level of trust in government, parties and politicians" [116] (p.2), may also be decisive factors. This suggest that future acceptance research on the transition to renewable energies needs to pay close attention to the complex histories and cultures of places in order to understand geographical differences in the acceptance of renewable energy infrastructures.

Overall, the results enhance our understanding of why infrastructures are accepted or rejected, extending beyond the material aspects of energy transition projects. Taking a step beyond the results of the statistical analysis, our findings suggest that climate policy design emerges as a key factor in acceptance. This highlights the need for political support and effective public relations to communicate the importance of transforming the energy system [117]. Political ideologies and narratives that portray the energy transition as a project of an out-of-touch elite should be actively addressed to reduce potential barriers to acceptance. Future strategies must effectively address the fears and concerns associated with the energy transition, relevant to both older East Germans and the general public. By taking individual energy preferences into account, energy policy can be made more effective [118]. Regional differences are not only due to economic factors, but also reflect deep-rooted historical and cultural contexts. Regions threatened by economic decline should be deliberately included and supported in the transition, to allay fears of loss of identity. It is therefore crucial that energy policies take greater account of local needs and historical circumstances. To sum up, not only individual attitudes, but also socio-cultural and political contexts are crucial for the acceptance of the energy transition. These findings have important implications for the design of policies that go beyond technological implementation to address the social and cultural dimensions of the energy transition.

7. Conclusion

Our study on the predictors of acceptance of renewable energy infrastructures in Germany provides valuable insights into how a successful energy transition can be supported in the sense of achieving broad support. It appears that climate policy attitudes make an important contribution here [29,50], while populist attitudes tend to have a negative impact on acceptance [59]. Although attachment is supportive to a modest extent, its effect is limited compared to political factors. Persistent East-West differences could be due to the historical and cultural underpinnings [86] that influence attitudes towards energy, with East Germans are more likely to be sceptical about renewable energy infrastructure. Our analysis suggests that people who prioritise climate policy are more likely to support renewable energy projects, highlighting the importance of climate knowledge as a key factor in public acceptance.

The correlation between climate scepticism and populism and between support for the energy transition and support for climate policy could be due to the societal danger of *praying for the converted* in the energy transition. Clientelism will certainly lead to a deepening of the divide between those who accept and those who do not accept the energy transition. Our findings emphasise the importance of designing policy communication in a way that effectively takes political sentiment and regional differences into account. While addressing the specific concerns of those who are less supportive of the energy transition, national policy-makers should work with local communities to create a shared understanding of the importance of the energy transition and to enable public participation. Excessive consideration of NIMBYism with a view to democratic elections is just as inappropriate as building infrastructure solely on the basis of environmental considerations. Public engagement strategies should focus on correcting populist narratives by incorporating scientific evidence and emphasising the crucial role of climate policy in promoting socio-economic and environmental health. Above all, it is important to play on the opportunity space in the regions where renewable energy generation is possible and to maximise acceptance here through smart political communication and economic investment. This is certainly a litmus test for modern Western democracy in the near future.

CRediT authorship contribution statement

Elena Hubner: Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Peter Dirksmeier:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to thank Sebastian Losacker for his helpful comments on an early draft of this paper. We would also like to thank Kate Bird for her linguistic corrections and Stephan Pohl for his cartographic and graphic support.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.egycc.2025.100232.

Data availability

The data can be obtained from the RISC data centre after prior registration (fgz-risc-date-de/eu/).

References

[1] G. Bridge, S. Bouzarovsk, M. Bradshaw, N. Eyre, Geographies of energy transition: space, place and the low-carbon economy, Energy Policy 53 (2013) 331–340, https://doi.org/10.1016/j.enpol.2012.10.066.
[2] B.K. Sovacool, S.E. Ryan, P.C. Stern, K. Janda, G. Rochlin, D. Spreng, M. J. Pasqualetti, H. Wilhite, L. Lutzenhiser, Integrating social science in energy research, Energy Res. Soc. Sci. 6 (2015) 95–99, https://doi.org/10.1016/j.erss.2014.12.005.
[3] I. Campos, et al., Narratives, expectations, and policy criteria for a democratic and socially engaging energy transition, Futures 164 (2024) 103496, https://doi.org/10.1016/j.futures.2024/103496.
[4] I.-M. García-Sánchez, S.-Y. Enciso-Alfaro, A. García-Sánchez, Energy transition disclosures and female directors: do gender egalitarian societies matter? J. Clean. Prod. 480 (2024) 144039 https://doi.org/10.1016/j.jclepro.2024.144039.
[5] K. Biely, S. Sareen, De Vries G, E. Chappin, T. Bauwens, F.M. Montagnino, Understanding the embeddedness of individuals within the larger system to support energy transition, Sustain. Sci. 19 (2024) 687–700, https://doi.org/10.1007/s11625-024-01493-7.
[6] M. Kuchler, G.M. Stigson, Unravelling the 'collective' in sociotechnical imaginaries: a literature review, Energy Res. Soc. Sci. 110 (2024) 103422, https://doi.org/10.1016/j.erss.2024.103422.
[7] L. Clarke, Y.-M. Wei, Identifying real energy system solutions to respond to the challenge of climate change, Energy Clim. Chang. 1 (2020) 100018, https://doi.org/10.1016/j.egycc.2020.100018.
[8] M.E. Biresselioglu, M.H. Demir, B. Solak, Z.F. Savas, A. Kollmann, B. Kirchler, B. Ozcureci, Empowering energy citizenship: exploring dimensions and drivers in citizen engagement during the energy transition, Energy Rep 11 (2024) 1894–1909, https://doi.org/10.1016/j.egyr.2024.01.040.
[9] S. Batel, P. Devine-Wright, A critical and empirical analysis of the national-local 'gap' in public responses to large-scale energy infrastructures, J. Environ. Plan. Manag. 58 (2015) 1076–1095, https://doi.org/10.1080/09640568.2014.914020.
[10] L. Greßhake, S. Bosch, R. Tutunaru, U. Holzhammer, What do you mean by '(un-) suitable'? Analysing the diversity of social acceptance towards the deployment of renewable energies in different landscapes, J. Land Use Sci. 20 (1) (2025) 117–150, https://doi.org/10.1080/1747423X.2025.2499280.
[11] M. Pfeiffer, M. Sonnberger, Rushing for the gold of the energy transition: an empirical exploration of the relevance of landownership for the wind energy expansion in Germany, Energy Res. Soc. Sci. 123 (2025) 104030, https://doi.org/10.1016/j.erss.2025.104030.
[12] M. Huber, Theorizing energy geographies, Geogr. Compass 9 (2015) 327–338, https://doi.org/10.1111/gec3.12214.
[13] J. Baka, S. Vaishnava, The evolving borderland of energy geographies, Geogr. Compass 14 (2020) e12493, https://doi.org/10.1111/gec3.12493.
[14] F.W. Geels, From sectoral systems of innovation to socio-technical systems: insights about dynamics and change from sociology and institutional theory, Res. Policy 33 (2024) 897–920, https://doi.org/10.1016/j.respol.2004.01.015.
[15] J. Markard, R. Raven, B. Truffer, Sustainability transitions: an emerging field of research and its prospects, Res. Policy 41 (2012) 955–967, https://doi.org/10.1016/j.respol.2012.02.013.
[16] H. Traill, A. Cumbers, The limits to the urban within multi-scalar energy transitions: agency, infrastructure and ownership in the UK and Germany, Urban Stud. 62 (9) (2024) 1808–1825, https://doi.org/10.1177/00420980241228467.
[17] K. Calvert, From 'energy geography' to 'energy geographies': perspectives on a fertile academic borderland, Pro. Hum. Geogr. 40 (2016) 105–125, https://doi.org/10.1177/0309132514566343.
[18] S. Alsheimer, T. Schnell, C. Chlebna, S. Rohe, Competing terms for complementary concepts? Acceptance and legitimacy, Renew. Sustain. Energy Rev. 20 (2025) 114960, https://doi.org/10.1016/j.rser.2024.114960.
[19] J.-F. Hake, W. Fischer, S. Venghaus, C. Weckenbrock, The german energiewende – history and status quo, Energy 92 (2015) 532–546, https://doi.org/10.1016/j.energy.2015.04.027.
[20] L. Quitzow, W. Canzler, P. Grundmann, M. Leibenath, T. Moss, T. Rave, The german Ener-giewende – what's happening? Introducing the special issue, Util, Policy 41 (2016) 163–171, https://doi.org/10.1016/j.jup.2016.03.002.
[21] O. Renn, J.P. Marshall, Coal, nuclear and renewable energy policies in Germany: from the 1950s to the "Ener-giewende", Energy Policy 99 (2016) 224–232, https://doi.org/10.1016/j.enpol.2016.05.004.

[22] F.C. Paul, Deep entanglements: history, space and (energy) struggle in the German Ener-giewende, Geoforum 91 (2018) 1–9, https://doi.org/10.1016/j.geoforum.2018.02.017.
[23] J. Metag, T. Füchslin, M.S. Schäfer, Global warming's five Germanys: a typology of Germans' views on climate change and patterns of media use and information, Public Underst. Sci. 26 (2017) 434–451, https://doi.org/10.1177/0963662515592558.
[24] BMUV, [Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz], Naturbewusstsein 2021. Bevölkerungsumfrage zu Natur und biologischer Vielfalt, 2023. https://www.bmuv.de/fileadmin/Daten_BMU/Pools/Broschueren/naturbewusstsein_2021_bf.pdf (accessed 12 November 2024).
[25] P. Upham, C. Oltra, À. Boso, Towards a cross-paradigmatic framework of the social acceptance of energy systems, Energy Res. Soc. Sci. 8 (2015) 100–112, https://doi.org/10.1016/j.erss.2015.05.003.
[26] Y. Fournis, M.J. Fortin, From social 'acceptance' to social 'acceptability' of wind energy projects: towards a territorial perspective, J. Environ Plan. Manag. 60 (2017) 1–21, https://doi.org/10.1080/09640568.2015.1133406.
[27] S. Batel, Research on the social acceptance of renewable energy technologies: past, present and future, Energy Res. Soc. Sci. 68 (2020) 101544, https://doi.org/10.1016/j.erss.2020.101544.
[28] K.K. Zander, D. Mathur, S. Mathew, S.T. Garnett, Public views about the world's largest proposed solar farm in remote Australia, Energy Policy 191 (2024) 114197, https://doi.org/10.1016/j.enpol.2024.114197.
[29] D. Lindvall, P. Sörqvist, S. Barthel, Overcoming the headwinds: can policy design shape public acceptance of wind power in Sweden? Energy Res. Soc. Sci. 116 (2024) 103674 https://doi.org/10.1016/j.erss.2024.103674.
[30] R. Wüstenhagen, M. Wolsink, M.J. Bürer, Social acceptance of renewable energy innovation: an introduction to the concept, Energy Policy 35 (2007) 2683–2691, https://doi.org/10.1016/j.enpol.2006.12.001.
[31] P. Devine-Wright, Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy, Wind Energy 8 (2005) 125–139, https://doi.org/10.1002/we.124.
[32] T. Moss, S. Becker, M. Naumann, Whose energy transition is it, anyway? Organisation and ownership of the Ener-giewende in villages, cities and regions, Local Environ. 20 (2015) 1547–1563, https://doi.org/10.1080/13549839.2014.915799.
[33] N. Kluskens, F. Alkemade, J. Höffken, Beyond a checklist for acceptance: understanding the dynamic process of community acceptance, Sustain. Sci. 19 (2024) 831–846, https://doi.org/10.1007/s11625-024-01468-8.
[34] M. Wolsink, Social acceptance revisited: gaps, questionable trends, and an auspicious perspective, Energy Res. Soc. Sci. 46 (2018) 287–297, https://doi.org/10.1016/j.erss.2018.07.034.
[35] G. Walker, Renewable energy and the public, Land Use Policy 12 (1995) 49–59, https://doi.org/10.1016/0264-8377(95)90074-C.
[36] R. Ólafsdóttir, A.D. Sæþórsdóttir, Wind farms in the Icelandic highlands: attitudes of local residents and tourism service providers, Land Use Policy 88 (2019) 104173, https://doi.org/10.1016/j.landusepol.2019.104173.
[37] J.K. Kirkegaard, et al., Tackling grand challenges in wind energy through a socio-technical perspective, Nat. Energy 8 (2023) 655–664, https://doi.org/10.1038/s41560-023-01266-z.
[38] P. Roddis, K. Roelich, K. Tran, S. Carver, M. Dallimer, G. Ziv, What shapes community acceptance of large-scale solar farms? A case study of the UK's first 'nationally significant' solar farm, Sol. Energy 209 (2020) 235–244, https://doi.org/10.1016/j.solener.2020.08.065.
[39] V. Azarova, J. Cohen, C. Friedl, J. Reichl, Designing local renewable energy communities to increase social acceptance: evidence from a choice experiment in Austria, Germany, Italy, and Switzerland, Energy Policy 132 (2019) 1176–1183, https://doi.org/10.1016/j.enpol.2019.06.067.
[40] J. Rand, B. Hoen, Thirty years of North American wind energy acceptance research: what have we learned? Energy Res. Soc. Sci. 29 (2017) 135–148, https://doi.org/10.1016/j.erss.2017.05.019.
[41] J. Firestone, A. Bates, L.A. Knapp, See me, feel me, touch me, heal me: wind turbines, culture, landscapes, and sound impressions, Land Use Policy 46 (2015) 241–249, https://doi.org/10.1016/j.landusepol.2015.02.015.
[42] M.J. Pasqualetti, Morality, space, and the power of wind-energy landscapes, Geogr. Rev. 90 (2000) 381–394, https://doi.org/10.1111/j.1931-0846.2000.tb00343.x.
[43] P. Scherhaufer, S. Höltinger, B. Salak, T. Schauppenlehner, J. Schmidt, Patterns of acceptance and non-acceptance within energy landscapes: a case study on wind energy expansion in Austria, Energy Policy 109 (2017) 863–870, https://doi.org/10.1016/j.enpol.2017.05.057.
[44] M. Westerlund, Social acceptance of wind energy in urban landscapes, Technol. Innov. Manag. Rev. 10 (2020) 49–62, https://doi.org/10.22215/timreview/1389.
[45] J.J. Häußermann, M.J. Maier, T.C. Kirsch, S. Kaier, M. Schrauder, Social acceptance of green hydrogen in Germany: building trust through responsible innovation, Energy Sustain. Soc. 13 (2023) 22, https://doi.org/10.1186/s13705-023-00394-4.
[46] M.A. Petrova, NIMBYism revisited: public acceptance of wind energy in the United States, Wiley Interdiscip. Rev. Clim. Change 4 (2013) 575–601, https://doi.org/10.1002/wcc.250.
[47] B. Hoen, et al., Attitudes of US wind turbine neighbours: analysis of a nationwide survey, Energy Policy 134 (2019) 110981, https://doi.org/10.1016/j.enpol.2019.110981.
[48] V. Westerberg, J.B. Jacobsen, R. Lifran, Offshore wind farms in Southern europe – determining tourist preference and social acceptance, Energy Res. Soc. Sci. 10 (2015) 165–179, https://doi.org/10.1016/j.erss.2015.07.005.
[49] D. Bell, T. Gray, C. Haggett, The 'social gap' in wind farm siting decisions: explanations and policy responses, Environ. Polit. 14 (2005) 460–477, https://doi.org/10.1080/09644010500175833.
[50] S. Vergine, M. del Pino Ramos-Sosa, G. Attanasi, G. D'Amico, P. Llerena, Willingness to accept a wind power plant: a survey study in the South of Italy, Energy Policy 192 (2024) 114201, https://doi.org/10.1016/j.enpol.2024.114201.
[51] K.W. Knight, Public awareness and perception of climate change: a quantitative cross-national study, Environ. Sociol. 2 (2016) 101–113, https://doi.org/10.1080/23251042.2015.1128055.
[52] B. Lockwood, M. Lockwood, How do right-wing populist parties influence climate and renewable energy policies? Evidence from OECD countries, Glob. Environ. Polit. 22 (2022) 12–37, https://doi.org/10.1162/glep_a_00659.
[53] M. Yazar, H. Haarstad, Populist far right discursive-institutional tactics in European regional decarbonization, Polit. Geogr. 105 (2023) 102936, https://doi.org/10.1016/j.polgeo.2023.102936.
[54] A. Novikau, Current challenges and prospects of wind energy in Belarus, Renew. Energy 182 (2022) 1049–1059, https://doi.org/10.1016/j.renene.2021.11.011.
[55] J. Jorge-Vazquez, J. Kaczmarek, L. Knop, K. Kolegowicz, S.L. Náñez Alonso, W. Szymla, Energy transition in Poland and Spain against changes in the EU energy and climate policy, J. Clean. Prod. 468 (2024) 143018, https://doi.org/10.1016/j.jclepro.2024.143018.
[56] P. Bonnet, A. Olper, Party affiliation, economic interests and U.S. governors' renewable energy policies, Energy Econ. 130 (2024) 107259, https://doi.org/10.1016/j.eneco.2023.107259.
[57] L.C. Hamilton, E. Bell, J. Hartter, J.D. Salerno, A change in the wind? US public views on renewable energy and climate compared, Energy Sustain. Soc. 8 (2018) 1–13, https://doi.org/10.1186/s13705-018-0152-5.
[58] S. Berman, The causes of populism in the West, Annu. Rev. Polit. Sci. 24 (2021) 71–88, https://doi.org/10.1146/annurev-polisci-041719-102503.
[59] R.A. Huber, The role of populist attitudes in explaining climate change skepticism and support for environmental protection, Environ. Polit. 29 (2020) 959–982, https://doi.org/10.1080/09644016.2019.1708186.
[60] B. Forchtner, A. Kroneder, D. Wetzel, Exploring far-right climate-change communication in Germany, Environ. Commun. 12 (2018) 589–604, https://doi.org/10.1080/17524032.2018.1470546.
[61] R.A. Huber, T. Maltby, K. Szulecki, S. Ćetković, Is populism a challenge to European energy and climate policy? Empirical evidence across varieties of populism, J. Eur. Public Policy 28 (2021) 998–1017, https://doi.org/10.1080/13501763.2021.1918214.
[62] C. Fraune, M. Knodt, Sustainable energy transformations in an age of populism, post-truth politics, and local resistance, Energy Res. Soc. Sci. 43 (2018) 1–7, https://doi.org/10.1016/j.erss.2018.05.029.
[63] W. Przychodzen, Political factors in renewable energy generation: do populism, carbon tax and feed-in tariffs matter? Energy Res. Soc. Sci. 115 (2024) 103628 https://doi.org/10.1016/j.erss.2024.103628.
[64] C. Mudde, The populist Zeitgeist, Gov. Oppos 39 (2004) 541–563, https://doi.org/10.1111/j.1477-7053.2004.00135.x.
[65] S.M. van Hauwaert, C.H. Schimpf, F. Azevedo, The measurement of populist attitudes: testing cross-national scales using item response theory, Politics 40 (2020) 3–21, https://doi.org/10.1177/0263395719859306.
[66] A. Valquaresma, S. Batel, A.I. Afonso, R. Guerra, L. Silva, The renewable energy transition and "the people" – exploring the intersections of right-wing populism and the renewable energy transition in portuguese media discourses, Environ. Commun. 18 (2024) 847–861, https://doi.org/10.1080/17524032.2024.2326423.
[67] K.A. Hawkins, C.R. Kaltwasser, What the (ideational) study of populism can teach us, and what it can't, Swiss Polit. Sci. Rev. 23 (2017) 526–542, https://doi.org/10.1111/spsr.12281.
[68] K. Huhta, S. Romppanen, Why is energy law resistant to changes required by climate policies? Energy Clim. Chang. 4 (2023) 100096 https://doi.org/10.1016/j.egycc.2023.100096.
[69] F.W. Geels, B.K. Sovacool, T. Schwanen, S. Sorrell, The socio-technical dynamics of low-carbon transitions, Joule 1 (2017) 463–479, https://doi.org/10.1016/j.joule.2017.09.018.
[70] A. Jobert, P. Laborgne, S. Mimler, Local acceptance of wind energy: factors of success identified in French and German case studies, Energy Policy 35 (2007) 2751–2760, https://doi.org/10.1016/j.enpol.2006.12.005.
[71] T.L. Milfont, E. Zubielevitch, P. Milojev, C.G. Sibley, Ten-year panel data confirm generation gap but climate beliefs increase at similar rates across ages, Nat. Commun. 12 (2021) 4038, https://doi.org/10.1038/s41467-021-24245-y.
[72] W. Poortinga, C. Demski, K. Steentjes, Generational differences in climate-related beliefs, risk perceptions and emotions in the UK, Commun. Earth Environ. 4 (2023) 229, https://doi.org/10.1038/s43247-023-00870-x.
[73] N. Balta-Ozkan, J.Le Gallo, Spatial variation in energy attitudes and perceptions: evidence from Europe, Renew. Sustain. Energy Rev. 81 (2018) 2160–2180, https://doi.org/10.1016/j.rser.2017.06.027.
[74] G. Bridge, B. Özkaynak, E. Turhan, Energy infrastructure and the fate of the nation: introduction to special issue, Energy Res. Soc. Sci. 41 (2018) 1–11, https://doi.org/10.1016/j.erss.2018.04.029.
[75] K. O'Sullivan, O. Golubchikov, A. Mehmood, Uneven energy transitions: understanding continued energy peripheralization in rural communities, Energy Policy 138 (2020) 111288, https://doi.org/10.1016/j.enpol.2020.111288.

[76] M. Naumann, D. Rudolph, Conceptualizing rural energy transitions: energizing rural studies, ruralizing energy research, J. Rural Stud. 73 (2020) 97–104, https://doi.org/10.1016/j.jrurstud.2019.12.011.
[77] B. Lennon, N.P. Dunphy, E. Sanvicente E, Community acceptability and the energy transition: a citizens' perspective, Energy Sustain. Soc. 9 (2019) 35, https://doi.org/10.1186/s13705-019-0218-z.
[78] P. Newell, D. Mulvaney, The political economy of the 'just transition, Geogr. J. 179 (2013) 132–140, https://doi.org/10.1007/s11625-023-01412-2.
[79] B.K. Sovacool, M.H. Dworkin, Energy justice: conceptual insights and practical applications, Appl. Energy 142 (2015) 435–444, https://doi.org/10.1016/j.apenergy.2015.01.002.
[80] S.R. Anderson, M.F. Johnson, The spatial and scalar politics of a just energy transition in Illinois, Polit. Geogr. 112 (2024) 103128, https://doi.org/10.1016/j.polgeo.2024.103128.
[81] A. Chapman, et al., The cultural dynamics of energy: the impact of lived experience, preference and demographics on future energy policy in the United States, Energy Res. Soc. Sci. 80 (2021) 102231, https://doi.org/10.1016/j.erss.2021.102231.
[82] P. Devine-Wright, Rethinking NIMBYism: the role of place attachment and place identity in explaining place-protective action, J. Community Appl. Soc. Psychol. 19 (2009) 426–441, https://doi.org/10.1002/casp.1004.
[83] P. Devine-Wright, A. Peacock, Putting energy infrastructure into place: a systematic review, Renew. Sustain. Energy Rev. 197 (2024) 114272, https://doi.org/10.1016/j.rser.2023.114272.
[84] P. Devine-Wright, Y. Howes, Disruption to place attachment and the protection of restorative environments: a wind energy case study, J. Environ. Psychol. 30 (2010) 271–280, https://doi.org/10.1016/j.jenvp.2010.01.008.
[85] G. Bridge, The map is not the territory: a sympathetic critique of energy research's spatial turn, Energy Res. Soc. Sci. 36 (2018) (2018) 11–20, https://doi.org/10.1016/j.erss.2017.09.033.
[86] S. Mau, Ungleich vereint, Warum der Osten anders bleibt, Suhrkamp, Berlin, 2024.
[87] J. Radtke, M. David, How Germany is phasing out lignite: insights from the coal commission and local communities, Energy Sustain. Soc. 14 (2024) 7, https://doi.org/10.1186/s13705-023-00434-z.
[88] A. Furnaro, Geographies of devaluation: spatialities of the German coal exit, Environ. Plan. A: Econ. Space 55 (2023) 1355–1371, https://doi.org/10.1177/0308518X221148731.
[89] S. Levi, I. Wolf, S. Sommer, P.D. Howe, Local support of climate change policies in Germany over time, Environ. Res. Lett. 18 (2023) 064046, https://doi.org/10.1088/1748-9326/acd406.
[90] L. Mewes, L. Tuitjer, P. Dirksmeier, Exploring the variances of climate change opinions in Germany at a fine-grained local scale, Nat. Commun. 15 (2024) 1867, https://doi.org/10.1038/s41467-024-45930-8.
[91] I. Lundberg, R. Johnson, M.S. Brandon, What is your estimand? Defining the target quantity connects statistical evidence to theory, Am. Sociol. Rev. 86 (2021) 532–565, https://doi.org/10.1177/00031224211004187.
[92] A.C. Cameron, P.K. Trivedi, Microeconometrics Using Stata Volume I: Cross-Sectional and Panel Regression Methods, 2nd ed., Stata Press, College Station, 2022.
[93] J.D. Angrist, J.-S. Pischke, Mostly Harmless Econometrics. An Empiricist's Companion, Princeton University Press, Princeton, 2009.
[94] M.P. Keane, T. Neal, A practical guide to weak instruments, Annu. Rev. Econ. 16 (2024) 185–212, https://doi.org/10.1146/annurev-economics-092123-111021.
[95] B. Jann, The Blinder-Oaxaca decomposition for linear regression models, Stata J. 8 (2008) 453–479, https://doi.org/10.1177/1536867X0800800401.
[96] J. Cotton, On the decomposition of wage differentials, Rev. Econ. Stat. 70 (1988) 236–243, https://doi.org/10.2307/1928307.
[97] F.D. Blau, L.M. Kahn, The gender wage gap: extent, trends, and explanations, J. Econ. Lit. 55 (2017) 789–865, https://doi.org/10.1257/jel.20160995.
[98] C.F. Baum, M.E. Schaffer, S. Stillman, ivreg2: stata module for extended instrumental variables/2SLS, GMM and AC/HAC, LIML and k-class regression. http://ideas.repec.org/c/boc/bocode/s425401.html, 2010.
[99] J. Gerlitz, et al., The German Social Cohesion Panel (SCP): theoretical background, instruments, survey design, and analytical potential (2024), https://doi.org/10.31219/osf.io/tew78.
[100] C. van der Eijk, Measuring agreement in ordered rating scales, Qual. Quant. 35 (2001) 325–341, https://doi.org/10.1023/A:1010374114305.
[101] G. DeVerteuil, Where has NIMBY gone in urban social geography? Soc. Cult. Geogr. 14 (6) (2013) 599–603, https://doi.org/10.1080/14649365.2013.800224.
[102] A. Schulz, P. Müller, C. Schemer, D.S. Wirz, M. Wettstein, W. Wirth, Measuring populist attitudes on three dimensions, Int. J. Public Opin. Res. 30 (2018) 316–326, https://doi.org/10.1093/ijpor/edw037.
[103] J.M. Wooldridge, Score diagnostics for linear models estimated by two stage least squares, in: G.S. Maddala, P.C.B. Phillips, T.N. Srinivasan (Eds.), Advances in Econometrics and Quantitative Economics: Essays in Honor of Professor C. R. Rao, Blackwell, Oxford, 1995, pp. 66–87.
[104] K. Finlay, L.M. Magnusson, Implementing weak-instrument robust tests for a general class of instrumental-variables models, Stata J 9 (2009) 398–421, https://doi.org/10.1177/1536867X0900900304.
[105] F. Kleibergen, R. Paap, Generalized reduced rank tests using the singular value decomposition, J. Economet. 133 (2006) 97–126, https://doi.org/10.1016/j.jeconom.2005.02.011.
[106] P. Żuk, K. Szulecki, Unpacking the right-populist threat to climate action: poland's pro-governmental media on energy transition and climate change, Energy Res. Soc. Sci. 66 (2020) 101485, https://doi.org/10.1016/j.erss.2020.101485.
[107] W. Shao, F. Hao, Understanding the relationships among experience with extreme weather events, perceptions of climate change, carbon dependency, and public support for renewable energies in the United States, Energy Clim. Chang. 5 (2024) 100139, https://doi.org/10.1016/j.egycc.2024.100139.
[108] F. Lipari, L. Lázaro-Touza, G. Escribano, Á. Sánchez, A. Antonioni, When the design of climate policy meets public acceptance: an adaptive multiplex network model, Ecol. Econom. 217 (2024) 108084, https://doi.org/10.1016/j.ecolecon.2023.108084.
[109] M. Jefferson, Safeguarding rural landscapes in the new era of energy transition to a low carbon future, Energy Res. Soc. Sci. 37 (2018) 191–197, https://doi.org/10.1016/j.erss.2017.10.005.
[110] P. Devine-Wright, Place attachment and public acceptance of renewable energy: a tidal energy case study, J. Environ. Psychol. 31 (2011) 336–343, https://doi.org/10.1016/j.jenvp.2011.07.001.
[111] L. Liu, T. Bouman, G. Perlaviciute, L. Steg, Public participation in decision making, perceived procedural fairness and public acceptability of renewable energy projects, Energy Clim. Chang. 1 (2020) 100013, https://doi.org/10.1016/j.egycc.2020.100013.
[112] S. Buechler, K.G. Martínez-Molina, 2021. Energy justice, renewable energy, and the rural-urban divide: insights from the Southwest U.S. Energy Clim. Chang. 2 100048. https://doi.org/10.1016/j.egycc.2021.100048.
[113] A. Chapman, et al., The just transition in Japan: awareness and desires for the future, Energy Res. Soc. Sci. 103 (2023) 103228, https://doi.org/10.1016/j.erss.2023.103228.
[114] R.F. Hirsh, C.F. Jones, History's contributions to energy research and policy, Energy Res. Soc. Sci. 1 (2014) 106–111, https://doi.org/10.1016/j.erss.2014.02.010.
[115] S. Küpers, S. Batel, Time history and meaning-making in research on people's relations with renewable energy technologies (RETs) – a conceptual proposal, Energy Policy 173 (2023) 113358, https://doi.org/10.1016/j.enpol.2022.113358.
[116] M. Reiser, R. Reiter, A (new) east–west-divide? Representative democracy in Germany 30 years after unification, Ger. Polit. 32 (2023) 1–19, https://doi.org/10.1080/09644008.2022.2049598.
[117] P. Upham, N. Simcock, B. Sovacool, G.A.T. Contreras, K. Jenkins, M. Martiskainen, Public support for decarbonisation policies: between self-interest and social need for alleviating energy and transport poverty in the United Kingdom, Energy Clim. Chang. 4 (2023) 100099, https://doi.org/10.1016/j.egycc.2023.100099.
[118] A. Chapman, et al., Cultural and demographic energy system awareness and preference: implications for future energy system design in the United States, Energy Econom. 112 (2022) 106141, https://doi.org/10.1016/j.eneco.2022.106141.