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Do trust and renewable energy use enhance perceived climate change efficacy in Europe?

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Abstract
In the European Union, mitigation policies in the energy sector are one of the most important fields of political intervention for reducing emissions to achieve sustainability. Using renewable energy is moreover a central arena for perceived personal and political climate change efficacy, which describes an individual's perceived ability to positively contribute to the fight against climate change and their belief in the effectiveness of government and society to tackle climate change collectively. In this paper, we distinguish between perceived personal and political efficacy beliefs. We use multilevel regression to investigate the relationship between these two dependent variables and trust in national governments as well as renewable energy use in 20 European countries for the first time. Our analysis first finds that socio-demographic predictors for perceived personal and political climate change efficacy operate almost diametrically. Second, we find that trust in governments is a much stronger predictor for perceived political efficacy. Third, we find that renewable energy use is a significant and positive predictor for perceived personal efficacy but correlates negatively with political efficacy. Finally, we find some cross-national variation in our European sample for both dimensions of efficacy beliefs. Understanding what shapes personal and political efficacy is salient to enhance public acceptance for sustainable energy transitions.

Keywords Perceived personal climate change efficacy · Perceived political climate change efficacy · Mitigation · Europe · Trust · Renewable energy

1 Introduction

Mitigation policies in the energy sector are one of the most important fields of political intervention to achieve sustainable energy transitions on a national level, as energy use accounts for approximately 35% of human-induced CO_2 emissions (Engels et al., 2013;

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García-Álvarez & Soares, 2018; Hagen et al., 2016; Oztig, 2017; Raihan et al., 2022). The renewable energy sector plays a particularly significant role for emission reduction in the EU (Iacobuta et al., 2018; Landholm et al., 2019; Oztig, 2017; Tutak & Brodny, 2022; Vögele et al., 2022). The amount of energy from renewable resources, i.e. "simple sustainable resource(s) available over the long term at a reasonable cost that can be used for any task without negative effects" (Manzano-Agugliaro et al., 2013, p. 135), such as wind, water, biomass, or solar energy, consumed within the EU is steadily rising, from 33.9 million tons in 2005 to 136 million tons in 2015 (Oztig, 2017, p. 920). However, it is necessary to gain the population's trust in national energy transition projects if these policies and the EU's energy transition projects are to achieve lasting sustainability (Adaman et al., 2011; Devine-Wright & Batel, 2017). While research has found that trust in governments and social institutions is important for sustaining green energy policies (Drews & van den Bergh, 2015; Fairbrother et al., 2019; Kulin & Sevä, 2021), it is less clear to what extent green energy consumption and political trust interact with perceived personal and political climate change efficacy.

In this study, we distinguish between the two dimensions of personal climate change efficacy [which describes an individual's perceived ability to positively contribute to the fight against climate change (Milfont et al., 2015; Tuitjer & Dirksmeier, 2021)] and perceived political efficacy, which refers to a belief in collective action and the responsiveness of governments (Crosman et al., 2019). While various small-sample case studies confirm the importance of feeling efficacious for taking action against climate change (Aitken et al., 2011; Burnham & Ma, 2017; Milfont, 2012; Milfont et al., 2015; Poortinga et al., 2011; Ung et al., 2016), few distinguish and compare the individual and political level of climate change efficacy beliefs (for an exception see, e.g. Crosman et al., 2019). Furthermore, large, cross-country investigations into perceived personal and political efficacy and their interaction with renewable energy use and political trust in Europe are currently lacking. Understanding what shapes personal and political efficacy is salient, however, to enhance public acceptance for sustainable energy transitions.

Our paper builds on two insights. First, renewable energy projects and images of renewable energy sources can positively contribute to perceptions of personal climate change efficacy (Landholm et al., 2019; Metag et al., 2015; O'Neill et al., 2013; O'Neill & Nicholson-Cole, 2009). Second, support for green energy policies hinges on people believing that both their governments as well as wider society can act against climate change (Drews & van den Bergh, 2015; Fairbrother et al., 2019; Kulin & Sevä, 2021). From these two important research strands, we hypothesise that there is a relationship between renewable energy consumption, perceived personal and political climate change efficacy, and trust in national governments in Europe. Based on the literature we assume that there is a positive interaction between political trust, national energy use, and both our dependent variables: perceived personal and political efficacy; yet, we maintain that the nature of this expected positive relationship waits to be more fully investigated.

We thus use multilevel regression to compare perceived climate change efficacy and its relationship with trust in national governments and with renewable energy use across 20 European states, based on data from Round 8 of the European Social Survey (ESS) conducted in 2016. These data provide a theoretically grounded list of statements that allows us to assess climate change efficacy beliefs in a comparative perspective. The European data are complemented by national data on renewable energy use.

This paper aims first to present a robust theorisation of perceived personal and political efficacy and to develop hypotheses on how socio-demographics, trust, and energy use are related to these two core concepts. Second, this research aims then to investigate more

deeply the role of trust in governments for perceived personal and political climate change efficacy. This investigation, third, aims to better understand the role national renewable energy use plays for explaining perceived personal and political climate change efficacy in Europe. The paper is guided by three research questions, corresponding to its aims: Which socio-demographic and attitudinal factors influence perceived personal and political climate change efficacy and are there national differences between the 20 European states under investigation? How does trust in the respective national government mediate perceived personal and political climate change efficacy? Finally, does national renewable energy use influence perceived personal and political climate change efficacy?

The paper continues with section two in which we provide the research background on climate change efficacy, trust in political systems, and renewable energy use. In section three, we discuss our data, measures, and methods. Section four briefly presents our results, showing that there are marked divides between the predictors that influence perceived individual and political climate change efficacy and that the interaction between trust and renewable energy use differs equally for perceived personal and political efficacy across our sample. We then offer systematic answers to our three research questions and discuss our findings in section five and conclude the paper in Sect. 6.

2 Literature review

This section draws on literature that addresses both personal and political efficacy in the context of renewable energy use. Section 2.1 foregrounds socio-demographics and attitudes as important predictors for personal efficacy beliefs; while Sect. 2.2 focuses on the role of trust in the political system as an important predictor for political efficacy.

2.1 Personal climate change efficacy: socio-demographics, attitudes, and renewable energy

Much research has been devoted to unpacking which predictors shape climate change awareness within populations, which means believing that climate change is both happening and anthropogenic (Capstick et al., 2015; Choi & Hart, 2021; Hornsey et al., 2016; Poortinga et al., 2019; Tuitjer et al., 2022; Yilmaz & Can, 2020). Climate change efficacy research builds on this by extending the focus from an acceptance that anthropogenic climate change is happening, to a focus on whether people believe that something can be done about climate change (McLoughlin, 2021; Milfont, 2012; Milfont et al., 2015; Tuitjer & Dirksmeier, 2021). Efficacy beliefs in the context of climate change are hence dependent on a person's climate change awareness (Hornsey et al., 2021; Milfont et al., 2015). Given the high degree of general climate change awareness in Europe (Poortinga et al., 2019), it is timely to focus more closely on perceived climate change efficacy within the geographic context of this study.

Research on climate change efficacy draws on theories from wider behavioural sciences (Aitken et al., 2011; Crosman et al., 2019; Milfont et al., 2015). The efficacy concept has been used in climate change research before and is often traced back to the psychologist Bandura (2000) who made a distinction between personal efficacy beliefs (also called: self-efficacy) and political efficacy (also called: response-efficacy) beliefs (see also: Choi & Hart, 2021). We follow this important distinction here, although it is at times conflated within climate change research (Kellstedt et al., 2008; Milfont, 2012; Tuitjer et al., 2022).

Bandura defines and highlights the importance of personal efficacy as follows: "Among the mechanisms of human agency, none is more focal or pervading than the belief of personal efficacy. This core belief is the foundation of human agency. Unless people believe that they can produce desired effects and forestall undesired ones by their actions, they have little incentive to act" (2000, p.75).

In the context of climate change, this means that individuals who think their actions can positively influence environmental outcomes are more likely to engage in such actions. Measuring perceived personal climate change efficacy thus needs to comprise a scale that accounts for the belief that personal action is beneficial in the fight against climate change. A conceptualisation of personal climate change efficacy, moreover, entails a somewhat more normative element as well. In fact, perceived climate change efficacy is entwined with a person's sense of responsibility to act against climate change (Milfont, 2012; Milfont et al., 2015; Rubio Juan & Revilla, 2021). Measuring perceived personal climate change efficacy thus also entails a scale that addresses this moral responsibility to act against climate change.

Drawing on data from New Zealand, Milfont et al. (2015) have contributed insights into various socio-demographic and attitudinal factors that predict perceived climate change efficacy and act as control variables in this paper. They found: "[…] respondents who were younger, female, educated, politically liberal, belonged to minority groups […]" (Milfont et al., 2015, p. 17) have higher perceived climate change efficacy beliefs. Lucas (2018) confirms the importance of personal values for perceived climate change efficacy in an Australian case study. Our work builds on these insights and investigates which predictors (age, gender, education, personal values, and political beliefs) enhance or inhibit perceived personal climate change efficacy specifically. This analysis is necessary because, to our knowledge, these factors have not yet been systematically studied for Europe.

While we expect socio-demographics and personal attitudes to be paramount for explaining perceived personal climate change efficacy in Europe, we also investigate whether there is an interaction between renewable energy consumption on a national level and personal climate change efficacy. We do so because research on community-based renewable energy projects suggests that feeling climate efficacious could well be achieved through such initiatives (Landholm et al., 2019). Community-based mitigation projects often serve to both educate and activate communities and raise their efficacy (Landholm et al., 2019). Similarly, O'Neill et al. (2013), Metag et al. (2015) as well as O'Neill and Nicholson-Cole (2009) demonstrated how images showing what people can do personally (e.g. sustainable lifestyle options for transport, leisure, or food as well as images of sustainable energy infrastructure) yield a highly positive effect on an individual's perceived climate change efficacy. Such findings support our research motivation for a cross-country examination of the relationship between national renewable energy use and people's perceived climate change efficacy. We thus expect to find a positive correlation between renewable energy use and perceived personal climate change efficacy in Europe.

2.2 Political climate change efficacy, trust in the political system, and renewable energy

Europe as a region clearly stands out in having the highest renewable energy targets worldwide (Bergero et al., 2021; Iacobuta et al., 2018; Landholm et al., 2019), confirming the significance of the renewable energy sector for mitigation in Europe. Yet, the relationship between mitigation action in the energy sector and efficacy beliefs in the population is still

little understood, as mentioned above. This appears to be all the more a research gap as Drummond et al. (2018) suggest that the little mitigation action they have found in some countries—despite high levels of climate change awareness in the country's population—might be due to a lack of perceived climate change efficacy.

We thus conceptualise efficacy as twofold: personal efficacy (see above) is complemented by political efficacy that extends efficacy beliefs from personal agency to collective action and institutions (Choi & Hart, 2021; Gregersen et al., 2021). As Bandura points out: "The growing interdependence of human functioning is placing a premium on the exercise of collective agency through shared beliefs in the power to produce effects by collective action" (2000, p. 75). Since individuals are deeply embedded in communities and larger societies, these groups also shape their efficacy beliefs (Ockwell et al., 2009; Thaker et al., 2016; Yayeh Ayal et al., 2021). Thaker et al. (2016) for example highlight that groups who have mastered challenging situations in the past tend to display higher efficacy beliefs. Focusing on farmer communities in India, they found that groups who have previously worked together to find adaptive responses to climatic events (drought, floods) display higher group efficacy beliefs. Our dimension of perceived political efficacy thus entails a more generalised belief in the actions and capabilities of other people. In other words, political efficacy can be measured through a scale indicating whether people believe that other people will (also) act on climate change. In the context of renewable energy transitions, research confirms that multiple problems can arise if general levels of trust in the various social groups who design and implement projects are low (Stigka et al., 2014; Wolsink, 2010). Support for energy transition projects consequently tends to depend on sociopolitical, community, and market acceptance (Wolsink, 2010). This fits our assumption that political efficacy beliefs are predicted by a person's general trust in diverse social groups, institutions, and administrations to work efficaciously against climate change.

As our EU sample only contains representative democracies, we combine insights on this more general dimension of political efficacy with Hart and Feldman's (2016) observation that political efficacy should also include "an individual's beliefs about the government's responsiveness to citizen demands" (Hart & Feldman, 2016, p. 3). Capturing political efficacy should thus also take into account the specific belief that governments and elected representatives will take sufficient action to address climate change. Perceived political climate change efficacy as conceptualised here, thus entails a general belief in the effectiveness of collective action and a belief in a government's action as being beneficial for the climate.

Political science research can help to further an understanding of this political dimension of efficacy within democracies. Here, a basic yet crucial insight is that "people need to trust the government to support more government" (Hetherington & Husser, 2012, p. 312). In representative democracies, therefore, trust is frequently seen as an important prerequisite for society to function smoothly (Chang, 2021; Poortinga & Pidgeon, 2003). Analogously to this perspective as well as to Hart and Feldman's (2016) work, we argue that trust in politicians and political institutions reflects confidence when deferring one's own efficacy to the political system in representative democracies. Crucially, political efficacy and trust in government are not the same variable, but rather trust in government and political representatives can help us predict who feels political efficacy in the context of our study.

Insights from research focusing on the level of trust people have in their elected politicians and political systems to tackle climate change confirm this perspective (Dietz et al., 2007; Harring & Jagers, 2013; Kallbekken & Saelen, 2011; Kellstedt et al., 2008; Poortinga & Pidgeon, 2003; Stoll-Kleemann et al., 2001). Two recent studies on the relationship between trust and renewable energy in Europe (Fairbrother et al., 2019; Kulin & Sevä,

2021) confirm both the importance of distinguishing between trust in social groups/ institutions and in governing bodies and politicians, as well as the general importance of these two categories on renewable energy acceptance. Therefore, we assume that both trust in government as well as trust in society in general will be strong mediating factors that shape political efficacy across our European sample. Large-scale, comparative research on political efficacy—which comprises both a sense of trusting social groups and elected representatives—in the context of climate change and renewable energy use in Europe, is required to clarify the relation and to reveal potential cultural differences between populations.

3 Method

3.1 Data

The research draws on the European Social Survey (ESS) for data on the individual level. Items concerning climate and energy, developed by Poortinga et al. (2019), are included in the Round 8 sample (European Social Survey, 2016). The ESS is a representative cross-national survey conducted since 2002 (Poortinga et al., 2019), using random probability samples of the respective populations, aged 15 or older (Heath et al., 2019). Data collection uses face-to-face interviews and was carried out between August 2014 and December 2015 (Heath et al., 2019). The sample sizes vary due to the different population sizes in the respective countries, and range from 880 for Iceland to 2852 for Germany. The original data file contains 44,387 individuals nested in 23 countries (sample sizes used in the analysis are displayed in Table 2). The main advantage of using the ESS for cross-national comparisons is its rigorous standard for harmonising the sample across the countries involved (Jowell et al., 2007), including the design of the questionnaire, necessary translations, and data collection. ESS includes a post-stratification weight for considering sampling and non-response errors as well as different likelihoods of selection (Poortinga et al., 2019). The ESS Round 8 data, documentation of methods, and questionnaires can be accessed at https://www.europeansocialsurvey.org/.

The ESS data were complemented with country-level data on the gross domestic consumption of renewable energy (renewable energy in total), greenhouse gas emissions, GDP per capita, and the proportion of people with higher education entrance qualifications (15 years and older; corresponds with the lower age bound of respondents in the ESS sample) as controls. The energy variables as well as the education variable were obtained from Eurostat (https://ec.europa.eu/eurostat/web/main/home), and GDP from World Bank data (https://datacatalog.worldbank.org/). For the Russian Federation, Israel, and Iceland, the relevant energy data were not available. Therefore, these countries were excluded from the final data set. For Switzerland, energy data were sourced from information on renewable energy contained in the electricity statistics, edited and provided by the Swiss Federal Office of Energy.

3.2 Variables

3.2.1 Dependent variable

The research builds on important insights from more than three decades of attitudinal research on climate change (Capstick et al., 2015; Devine-Wright & Batel, 2017; Hamilton

et al., 2015; Hornsey et al., 2016; Jibrillaha et al., 2018; Lebel et al., 2015; Owen et al., 2012; Park & Vedlitz, 2013). Perceived individual and political climate change efficacy is calculated as two factor scores derived from five questions on attitudes towards climate efficacy. The exact formulations of the questions can be found in Table 1. Both perceived individual climate change efficacy ($\alpha = 0.66$) and perceived political climate change efficacy ($\alpha = 0.64$) have acceptable reliability measures. Respondents could answer on an 11-item scale, ranging from zero ("Not at all likely") to ten ("Extremely likely") and from ("Not at all") to ("A great deal") for the personal responsibility question.

The final variables were calculated as factor scores (see Fig. 1 for the spatial distribution), excluding missing cases (3581). Higher values represent greater perceived climate change efficacy. The final data set contains 34,873 respondents nested within 20 countries.

3.2.2 Independent variables

3.2.2.1 Individual level Demographic information was included in the analysis because empirical work reveals that "beliefs in climate change reality and human cause was observed among respondents who were younger, female, educated" (Milfont et al., 2015, p. 17). Sex is indicated by 0 (female) and 1 (male). Age and education (years of education completed) were standardised as a z-score over 20 countries. A left-wing or liberal political orientation enhances a person's climate change efficacy (Dietz et al., 2007; Milfont, 2012; Thalmann, 2004). Within Europe, however, the correlation of belief in climate efficacy with a political left–right spectrum runs into problems (McCright et al., 2016; Rohrschneider & Miles, 2015). While for Western Europe a strong link between environmental concerns and left/liberal political parties can be identified, in Central and Eastern Europe left-wing (former communist) parties tend to be more restrictive about sociocultural topics, including environmental issues (Rohrschneider & Miles, 2015). We therefore use anti-immigrant attitudes as a proxy to control for right-wing political orientation. The anti-immigrant attitude scale ($\alpha = 0.84$) is calculated as the mean of 6 items on opinions towards immigration. The item is standardised as a z-score (over 20 countries), where higher values represent stronger anti-immigrant attitudes.

Since Poortinga et al. (2019) emphasise the high relevance of human values for climate-related attitudes in Europe, we include three scales representing hedonism ($\alpha = 0.79$), altruism ($\alpha = 0.73$), and traditionalism ($\alpha = 0.72$) (Schwartz, 1994), derived from 21 items from the modified portrait values questionnaire (PVQ) that is part of the ESS (Poortinga et al., 2019). The six-stage answer scale is recoded in the direction that high values on the scales represent more strongly held values. The z-scores of means (over all 20 countries) of the three scales are included in the analysis.

We address trust in politicians and institutions by a scale ($\alpha = 0.91$) constructed from the means of three questions (see Table 1 for exact wording). The resulting new variable 'trust in national politics' was standardised using the z-score over the 20 countries in the sample. Higher values indicate greater trust.

Comparative climate change awareness research suggests that climate change awareness is a strong foundation for perceived climate change efficacy (Milfont, 2012). According to this work, perceived climate change efficacy and awareness are related, demonstrating that people who think they have a degree of self-efficacy in environmental matters are also more likely to be aware of climate change and accepting humanity's responsibility for it. To control for that effect, we include the item "Do you think the world's climate is changing?" and recode it into a dummy in a similar manner to Lee

Table 1 Data and measures included in the analysis

	Definition	Data source
Dependent variables (individual level):	Two factors derived from 5 items, each ranging from low (zero) to high (ten) efficacy (z-scores) (1a) "Now imagine that large numbers of people limited their energy use: How likely do you think it is that this would reduce climate change? (1b) How likely do you think it is that limiting your own energy use would help reduce climate change? (1c) To what extent do you feel a personal responsibility to try to reduce climate change?" (2a) "How likely do you think it is that large numbers of people will actually limit their energy use to try to reduce climate change? (2b) And how likely do you think it is that governments in enough countries will take action that reduces climate change?"	European Social Survey (ESS)
Independent variables (individual level):	Sex (1 = male) Age (calculated, z-score) Education by years of education completed (z-score) Anti-immigrant attitude (6-item scale, z-score) Hedonism by portrait values questionnaire [PVQ] (9-item scale, z-score) Altruism by portrait values questionnaire [PVQ] (6-item scale, z-score) Traditionalism by portrait values questionnaire [PVQ] (6-item scale, z-score) Trust in national politics (3-item scale, z-score): "Please tell me on a score of 0–10 how much you personally trust each of the institutions […] [country]'s parliament, […] politicians, political parties?" CC Awareness (1 = yes)	European Social Survey (ESS)
Independent variables (country level):	Renewable energies total in toe, 2016 Greenhouse gas emissions in CO_2 equivalent, 2017 People with higher education entrance qualifications per cent 2018 GDP per capita 2017	Eurostat, Swiss Federal Office of Energy, World Bank data

Source: ESS, 2016; Eurostat, 2019; Swiss Federal Office of Energy, 2018; World Bank, 2019

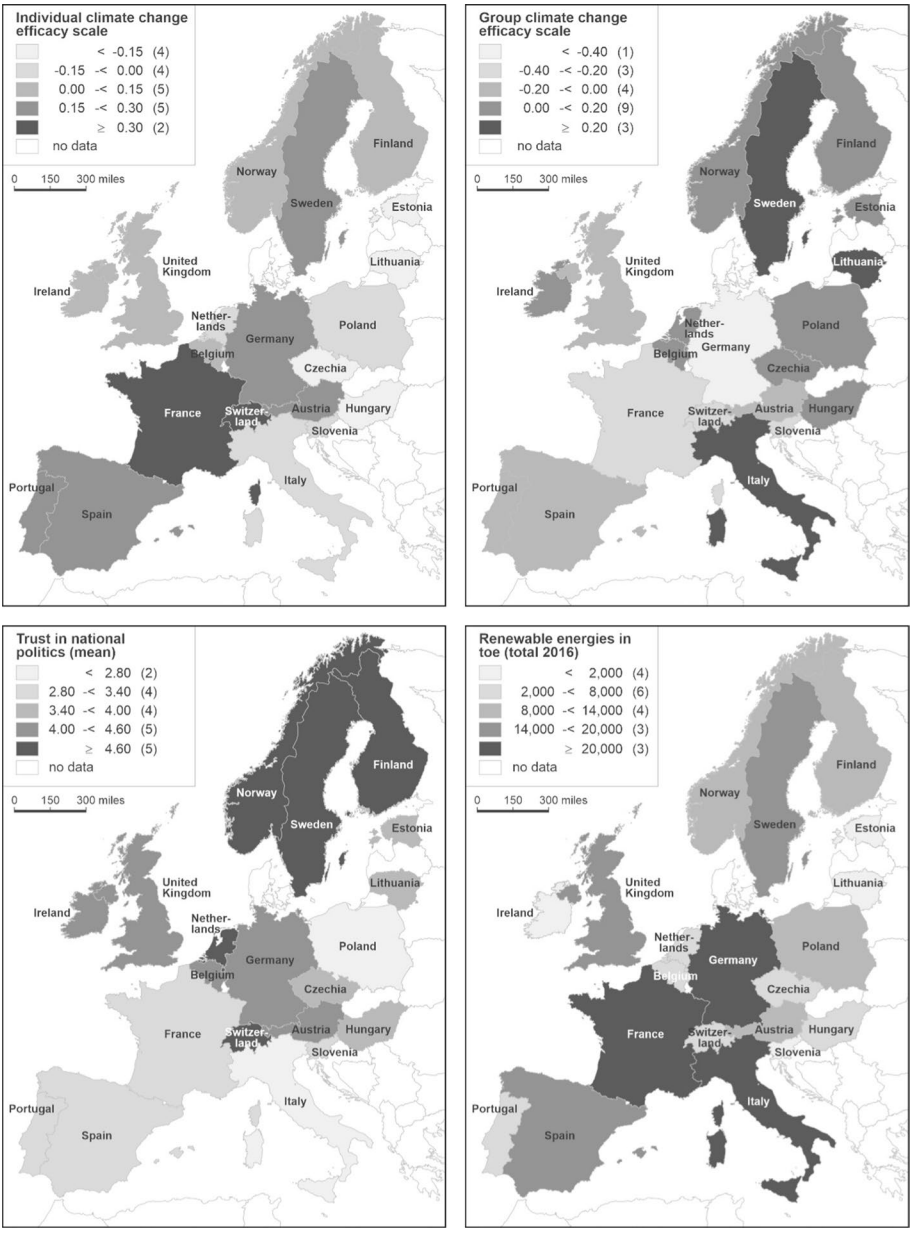

Fig. 1 Mean of perceived personal (individual) and political (group) climate change efficacy in Europe. Source: ESS, 2016, Eurostat, 2019; Swiss Federal Office of Energy, 2018; toe tons of oil equivalent; Graphics: Stephan Pohl

et al. (2015). Climate change awareness is indicated by 1 (aware), subsuming answers "Definitely changing" and "Probably changing". Climate change denial is indicated by 0, subsuming "Probably not changing" and "Definitely not changing".

3.2.2.2 Country level Our main research motivation is figuring out the relationship between context variables at the national level and individuals' perceived personal and political climate change efficacy. Existing attitudinal research on climate change suggests that predictors at the macro-level are rather poorly related to climate change attitudes (Lee et al., 2015). However, we investigate the relationship of national energy use as a predictor for perceived individual and political climate change efficacies. Thus, we concentrate on renewable energy use as our main independent variable as a proxy for the implementation of renewable energy policies. We include the proxy of "Renewable energy in total 2016" in terms of gross domestic consumption in the respective country. The variable is measured in tons of oil equivalent (toe) and is centred on its grand mean.

Furthermore, greenhouse gas emissions measured in CO_2 equivalent in 2017 are added to control for possible opposing effects of pollution practices by the states. Additional control variables are GDP per capita in 2017 and the average educational attainment of each country.

3.3 Analysis strategy

Since the data are structured by individuals ($n=34{,}873$; level 1) nested in national states ($n=20$; level 2), multilevel regression is used. Eight hierarchical linear models were constructed to assess the individual and macro-predictors derived from existing work. Additionally, correlation measures between trust in politicians, parties and the political system and perceived climate change efficacy items indicate the variations in this relationship between the countries in the sample. The ideal number of random slopes, which means that the slopes of the independent variables at the individual level can vary across the countries, is a subject of intense debate in the literature on multilevel models (Bryan & Jenkins, 2016; Heisig et al., 2017; Schmidt-Catran & Fairbrother, 2016). We include random slopes for the three value items, trust, and climate change awareness as we assume that these variables vary between contexts. In this way, we are able to meet the minimum standard formulated in this discourse for a balance between flexibility and economy in the models (Heisig et al., 2017). However, as we are primarily interested in the general association between micro- and macro-level items and perceived individual and political efficacy dimensions, we report the fixed effects of the respective models. Due to the relatively small-sample size at the macro-level, we use restricted maximum likelihood (RML) with the Kenward–Roger Approximation for optimising significance tests of fixed effects (Kenward & Roger, 1997) as the estimation method. RML has the main advantage of being equal to ANOVA estimates in cases of equal group sizes, which yields much better estimates for small numbers of groups (Hox, 2002). However, Hox (2002, p. 174) reports a minimum group size of greater than ten on the macro-level for applying RML. Generally, smaller sample size means that effects between items have to be greater if they are to be significant (Button et al., 2013), which has to be included in the interpretation of macro-effects detected. All items on the macro-level are centred on their grand means.

4 Results

4.1 Preliminary outcomes

The spatial distribution of the dependent variables shows that there are differences between the nations included in the sample concerning perceived individual and political climate change efficacy.

Eastern Europe is characterised by lower levels of perceived individual but higher levels of perceived political efficacy. A higher political dimension refers to a higher responsibility ascribed to the state for minimising climate change. Northern Europe shows higher levels for both perceived individual and perceived political efficacy, while Central and South-West Europe in particular show higher perceived individual efficacy. This pattern could partly follow the former east/west divide or it could also reflect a more individualistic culture in Northern and Central Europe.

The correlation coefficients between individual and political efficacy and trust in national politics give an indication of the structure of this relationship in the sample (Table 2) (Pehrson et al., 2009). It is salient that the correlation between perceived individual efficacy and trust is positive and significant. The weakest relationship ($r=0.042$) is observed for Spain, the strongest for Estonia ($r=0.234$***). The coefficients for the correlation between perceived political efficacy and trust are higher, ranging between $r=0.119$*** for Spain and $r=0.358$*** for France.

Comparing the overall correlations between perceived individual and political climate change efficacy, and trust in national politics at individual and national levels, it becomes obvious that connections between these variables differ between the scales, suggesting multilevel analysis is required to consider these differences (Pehrson et al., 2009) (Table 3).

At the national level, perceived individual and political efficacy correlate strongly and negatively ($r=-0.51$; $p<0.001$), reflecting the fundamentally different underlying dimensions, whereas at the individual level there is no correlation due to the orthogonal rotation of the factors. In contrast, trust in national politics correlates with perceived individual climate change efficacy at the individual and at the national level, but not with renewable energy consumption. Moreover, renewable energy use correlates with individual efficacy strongly and positively, and with political efficacy strongly and negatively at the national level, indicating a relationship between implementing green energy policies and general climate change sensitisation.

4.2 Multilevel regression outcomes

In order to test our hypothesis that the relationship between perceived individual and political climate change efficacy and trust varies between the nations and is dependent on renewable energy policies, we calculated eight multilevel regression models. We start with two empty models, which contain an intercept and error term, in each case both for the individual and the national level of variance of the perceived individual and political climate change efficacy scale. These baseline models serve as the reference for calculating the explained variance (R^2) for all following models. It reveals that 9.6% of variance in the perceived individual efficacy scale but only 3.6% of variance in the perceived political efficacy scale can be traced back to differences between the countries. Concerning perceived climate change efficacy in general, cultural differences are not great, which is somewhat different from Poortinga et al.'s (2019) outcomes of greater cultural differences between states relating to perceptions of climate change. Our finding rather matches Lee et al.'s (2015) result that macro-indices at the national scale are incommensurately linked with attitudinal determinants concerning climate change (Table 4).

Models 1a and 1b contain control variables for demographics and values on the individual level as well as GDP and the proportion of people with higher education entrance qualifications on the national scale. Model 1a explains 18.1% (R^2) and model 1b explains 6.3% (R^2) of variance overall. The models replicate results from climate change awareness

Table 2 Country-specific individual and group CC efficacy, trust in national politics, and their correlations (Pearson)

Country	Sample size	Personal CC efficacy	Political CC efficacy	Trust in national politics	Personal CC efficacy/trust correlation	Political CC efficacy/trust correlation
	N	Mean (SD)	Mean (SD)	Mean (SD)	(Pearson)	(Pearson)
Spain	1614	0.200 (0.97)	−0.097 (1.12)	2.920 (2.10)	0.042	0.119***
Poland	1377	−0.079 (0.88)	0.040 (0.96)	2.780 (2.07)	0.063*	0.150***
Czech Republic	1978	−0.806 (1.00)	0.138 (0.96)	3.892 (2.10)	0.057**	0.206***
France	1980	0.341 (0.86)	−0.212 (0.90)	3.298 (1.90)	0.078***	0.358***
Ireland	2554	0.129 (0.89)	0.106 (0.99)	4.058 (2.04)	0.082***	0.239***
United Kingdom	1848	0.092 (0.93)	−0.197 (0.94)	4.132 (2.01)	0.100***	0.209***
Italy	2228	−0.029 (0.92)	0.212 (1.03)	2.633 (2.18)	0.104***	0.221***
Slovenia	1191	−0.137 (1.01)	−0.253 (0.98)	2.820 (1.98)	0.128***	0.355***
Germany	2723	0.272 (0.94)	−0.404 (0.94)	4.496 (2.04)	0.142***	0.217***
Switzerland	1428	0.399 (0.90)	−0.219 (0.97)	5.664 (1.68)	0.149***	0.183***
Portugal	1131	0.235 (1.05)	−0.083 (1.18)	3.083 (2.09)	0.154***	0.203***
Belgium	1732	0.095 (0.88)	0.089 (0.90)	4.263 (2.03)	0.162***	0.239***
Austria	1814	0.201 (1.04)	−0.106 (1.04)	4.309 (2.17)	0.163***	0.203***
Netherlands	1603	−0.080 (0.95)	0.175 (0.83)	5.300 (1.76)	0.191***	0.179***
Hungary	1374	−0.402 (1.03)	0.157 (1.00)	3.929 (2.37)	0.198***	0.318***
Sweden	1482	0.205 (0.89)	0.214 (0.98)	5.188 (1.92)	0.200***	0.218***
Norway	1501	0.029 (0.94)	0.120 (0.94)	5.851 (1.74)	0.205***	0.150***
Lithuania	1581	−0.219 (0.96)	0.298 (1.05)	3.633 (2.12)	0.227***	0.357***
Finland	1862	0.114 (0.93)	0.105 (0.99)	5.066 (2.06)	0.228***	0.178***
Estonia	1872	−0.644 (1.06)	0.030 (0.97)	3.992 (2.04)	0.234***	0.169***
Mean/sum (pooled)	34,873	0 (1)	0 (1)	4.074 (2.02)	0.145***	0.202***

Source: ESS, 2016; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 3 Mean (SD) and correlations, above diagonal at individual, below diagonal at aggregate level (state)

	Mean (SD)	Personal CC efficacy	Political CC efficacy	Trust in national politics
Perceived personal CC efficacy	0 (1)	–	0.00	0.15***
Perceived political CC efficacy	0 (1)	−0.47***	–	0.20***
Trust in national politics	4.074 (2.02)	0.17***	0.02***	–
Renewable energy total 2016 (in toe)	11,863.59 (11,112.91)	0.47***	−0.51***	−0.07***

Data source: ESS, 2016; Eurostat, 2019; Swiss Federal Office of Energy, 2018; *toe* tons of oil equivalent; Pearson's correlations; ***$p < 0.001$

studies concerning demographics (Dietz et al., 2007; Lee et al., 2015; Milfont, 2012) as well as values (Poortinga et al., 2019). As a proxy for a right-wing mindset, anti-immigrant attitudes are the most evident indicator for individual efficacy followed by altruism, revealing that hostility towards immigrants correlates with low perceived individual climate change efficacy. Both macro-indicators are significant for individual efficacy but not for political efficacy, however higher proportions of people with higher education entrance qualifications correlate with lower levels of perceived individual climate change efficacy. The relationship is probably caused by Eastern European states, for instance Czech Republic, with high rates of higher education entrance qualifications together with high rates of climate scepticism.

In models 2a and 2b, we added 'trust in national politics' and the CC awareness dummy at the individual level. This improves the explained variance of model 2a ($R^2 = 20.3\%$ *overall*) and of model 2b ($R^2 = 11.7\%$ *overall*), indicating the importance of trust and CC awareness for explaining individual and political efficacy beliefs. CC awareness is the strongest predictor for perceived individual climate change efficacy. The perception of climate change as human-induced seems to be the premise for the individual belief in options for action. Trust is the strongest predictor of perceived political efficacy at the individual level, reflecting that trust in politics also encompasses climate mitigating policies.

To investigate our third research question, we included our variables regarding national energy use and greenhouse gas emissions in models 3a and 3b. European states vary to a huge extent in terms of GDP and gross domestic consumption of renewable energy, which clearly affects the results (Lo & Chow, 2015). However, the inclusion of the energy-related variables improves the model fit only slightly ($R^2 = 20.4\%$ *overall for model 3a;* 11.7% *overall for model 3b*), reflecting that macro-level indicators for climate change attitudes are of minor importance (Lee et al., 2015). However, it becomes obvious that renewable energy in total is significant. Gross domestic consumption of renewable energy at the national level is positively correlated with perceived individual climate change efficacy but negatively correlated with political efficacy. Results at the individual level remain robust over the models, confirming the relevance of trust and CC awareness for perceived individual climate change efficacy (Rubio Juan & Revilla, 2021), whereas CC awareness remains insignificant for political efficacy. The multilevel models clearly show that there are two fundamentally different dimensions for individual and group-specific efficacy beliefs in Europe (Choi & Hart, 2021).

5 Discussion

The investigation finds that personal and political efficacy are distinct categories that do not interact in unison with the same control variables. This finding fits Van Zomeren et al.'s (2010) work. They conducted a small experimental study with 78 students from the University of Groningen, finding that self-efficacy and political efficacy in the context of climate change did not interact. A more recent paper by Choi and Hart (2021) equally stresses that self- and collective efficacy beliefs in the context of energy conservation intentions and climate change policy support differ widely. Starting from this important result, we now answer our three research questions and discuss our findings.

First, we asked which socio-demographic and attitudinal factors influence perceived personal and political climate change efficacy and whether there are national differences between the 20 European states under investigation.

Table 4 Two-level regression models predicting the action dimension of climate change in Europe

	Models (0) Baseline		Models (1) Control		Models (2) Individual trust		Models (3) All	
	Personal (0a) β/SE	Political (0b) β/SE	Personal (1a) β/SE	Political (1b) β/SE	Personal (2a) β/SE	Political (2b) β/SE	Personal (3a) β/SE	Political (3b) β/SE
Individual level								
Sex (1 = male)			−0.1055*** (0.0110)	−0.0230* (0.0117)	−0.1041*** (0.0109)	−0.0254* (0.0115)	−0.1045*** (0.0109)	−0.0253* (0.0115)
Age (z-score)			−0.0308*** (0.0061)	0.0508*** (0.0065)	−0.0280*** (0.0061)	0.0560*** (0.0064)	−0.0278*** (0.0061)	0.0559*** (0.0064)
Education (z-score)			0.0527*** (0.0060)	−0.0891*** (0.0064)	0.0480*** (0.0060)	−0.0952*** (0.0063)	0.0481*** (0.0600)	−0.0953*** (0.0063)
Anti-immigrant attitude (z-score)			−0.1811*** (0.0063)	−0.1040*** (0.0067)	−0.1494*** (0.0067)	−0.0225*** (0.0070)	−0.1490*** (0.0067)	−0.0227*** (0.0070)
Hedonism (z-score)			0.0358 (0.0243)	0.0673** (0.0244)	0.0363 (0.0205)	0.0664*** (0.0186)	0.0369* (0.0185)	0.0662*** (0.0182)
Altruism (z-score)			0.1712*** (0.0245)	−0.1000*** (0.0246)	0.1697*** (0.0207)	−0.0807*** (0.0188)	0.1684*** (0.0187)	−0.0802*** (0.0184)
Traditionalism (z-score)			−0.0199 (0.0245)	0.1140*** (0.0246)	−0.0267 (0.0207)	0.0867*** (0.0189)	−0.0264 (0.0188)	0.0867*** (0.0184)
Trust in national politics (z-score)					0.0919*** (0.0205)	0.2449*** (0.0185)	0.0926*** (0.0185)	0.2444*** (0.0181)
CC Awareness (1 = yes)					0.4280*** (0.0340)	−0.0249 (0.0338)	0.4238*** (0.0328)	−0.0233 (0.0336)
Country level (Grand mean)								
GDP per capita 2017			0.0000*** (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000** (0.0000)	0.0000 (0.0000)	−0.0000* (0.0000)
People with higher education entrance qualifications per cent 2018			−0.0088*** (0.0026)	−0.0023 (0.0026)	−0.0078** (0.0028)	−0.0058* (0.0026)	−0.0038 (0.0029)	−0.0077** (0.0028)
Renewable energy total in toe, 2016							0.0000*** (0.0000)	−0.0000 (0.0000)

Table 4 (continued)

	Models (0) Baseline		Models (1) Control		Models (2) Individual trust		Models (3) All	
	Personal (0a) β/SE	Political (0b) β/SE	Personal (1a) β/SE	Political (1b) β/SE	Personal (2a) β/SE	Political (2b) β/SE	Personal (3a) β/SE	Political (3b) β/SE
Greenhouse gas emissions in CO_2 equivalent, 2017							0.0042** (0.0015)	−0.0020 (0.0015)
Constant	−0.0083 (0.0698)	0.0070 (0.0429)	0.0472 (0.0249)	0.0197 (0.0250)	−0.3691*** (0.0343)	0.0500 (0.0341)	−0.3651*** (0.0331)	0.0485 (0.0339)
Level 2: Countries	0.0969** (0.0316)	0.0361** (0.0119)	0.0109*** (0.0019)	0.0109*** (0.0020)	0.0075*** (0.0007)	0.0059*** (0.0010)	0.0060*** (0.0010)	0.0056*** (0.0010)
Level 1: Individuals	0.9082*** (0.0073)	0.9606*** (0.0077)	0.8123*** (0.0069)	0.9232*** (0.0078)	0.7940*** (0.0067)	0.8746*** (0.075)	0.7939*** (0.0068)	0.8747*** (0.0075)
−2 Log-Likelihood	85,494.576	87,220.568	74,036.443	77,612.719	72,147.170	74,779.871	72,155.535	74,810.598
n Countries	20	20	20	20	20	20	20	20
n Individual	35,156	35,156	31,633	31,633	31,062	31,062	31,062	31,062

Source: ESS, 2016; Eurostat, 2019; Swiss Federal Office of Energy, 2018; World Bank, 2019; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; difference to 34,873 in the baseline models due to weighting-related rounding

It seems the predictors for perceived personal and political climate change efficacy are almost diametrical. On the one hand, personal perceived efficacy is positively and significantly influenced by age (younger age contributes to personal efficacy beliefs), gender (women tend to show higher personal efficacy), education (more highly educated respondents show higher degrees of personal efficacy), altruism and an open-minded political orientation (measured through our anti-immigrant attitude proxy) enhance personal efficacy. Moreover, climate change awareness is the strongest predictor and possible foundation for perceived personal climate change efficacy. These findings are in line with Milfont et al.'s (2015) previous study from New Zealand. Furthermore, we can confirm Lucas' (2018) result that holding altruistic values is an important predictor for personal climate change efficacy. This equally corresponds with Bandura's original work on efficacy theories, as he points out that when the "belief in the power to produce results is put to social purposes, it fosters a communal life rather than eroding it. […] a high sense of efficacy promotes a prosocial orientation characterised by cooperativeness, helpfulness, and sharing" (Bandura, 2000, p. 77).

On the other hand, perceived political efficacy, we find, is more pronounced within respondents who are older, less educated, display more conservative views, and are more politically right leaning. Moreover, a strong trust in national governments is a significant predictor for political efficacy, whereas climate change awareness is not significant at all here. Although work that systematically distinguishes between personal and political efficacy is scarce, we can, however, discuss our findings in relation to a study from the US. In Crosman et al.'s (2019) work, personal and political efficacy beliefs are distinguished within two US samples of 405 respondents (here open questions about CC efficacy beliefs were used) and 1820 respondents (here closed questions were used). Across both samples, the only socio-demographic variable that seemed to moderate both types of efficacy beliefs is political orientation: "conservative respondents remained more sceptical than liberals that government action will have an appreciable effect on climate change" (Crosman et al., 2019, p. 2343). It seems within our EU sample the effect is reversed; people who are more conservative tend to have higher political efficacy beliefs; whereas more left-leaning respondents report a higher degree of self-efficacy beliefs. This difference could be explained through the Republican's disdain for strong government action in the US, which is less pronounced in European conservative parties.

Critically, we must acknowledge that our predictors are more accurate for perceived personal efficacy than for perceived political efficacy. It seems that we are missing some variables that shape political efficacy beliefs. We explain this lack with the novelty of our approach and the lack of previous scientific work that systematically distinguishes between predictors for personal and political efficacy. As respondents who report holding more traditionalist views display a higher degree of political efficacy, it could be useful to explore to what extent religion influences political efficacy. Some studies point towards a possible role of religious values on climate change opinions (Kvaløy et al., 2012). Moreover, qualitative studies have revealed how climate change politics in the Maldives are embedded within wider political debates, affinities, and sentiments (Kothari, 2014). Therefore, we assume that political efficacy in the context of climate change might be equally embedded within further—potentially more diffuse—predictors, that have not been systematically tested yet. We maintain that further exploration of this topic is necessary as political efficacy carries an important aspirational and motivational dimension: "collective action becomes more likely when individuals perceive the group to be more resourceful and thus more able to achieve its goal through joint effort" (van Zomeren et al., 2010, p. 340). Political efficacy thus matters as it can be seen as an indicator for the willingness of people to

become active collectively. Moreover, understanding what shapes political efficacy is salient to enhance public acceptance of sustainable energy transitions.

Apart from the differences in predictors that influence personal and political efficacy, we equally find cultural variations within our sample, which are small however. The Scandinavian countries, for example, show both high degrees of perceived personal and political efficacy. In other countries, the results are more mixed. In Germany, for example, perceived personal efficacy is higher than perceived political efficacy and within Eastern Europe, perceived political efficacy outstrips perceived personal efficacy. These latter results could be explained by the lower average climate change awareness in Eastern Europe (Poortinga et al., 2019), which is the most salient predictor for perceived personal climate change efficacy in our study. We propose to view this result in the light of Bandura's (2000) work who points out that a society of individuals who doubt their own actions is not going to achieve much. Applying this insight to climate change, it seems that societies with higher degrees of perceived personal efficacy might indeed do better in the fight against global warming.

Second, we asked whether trust in the respective national government influences perceived personal and political climate change efficacy.

Trust in the political system is an important variable that shapes both personal and political efficacy in our study. However, its influence is much more pronounced for political efficacy beliefs, we find. We therefore tried to further unpack trust in the political system, based on insights from a recent study (Kulin & Sevä, 2021) that used the same ESS data to explore the relationship between trust and renewable energy policies in Europe. Here, the authors distinguished between trust in partial institutions (politicians, political parties, parliaments) and impartial institutions (legal system, police). Our study includes trust in partial institutions only, but we also controlled for impartial institutions (not included in Table 4). However, trust in impartial institutions was neither significant for perceived personal nor political climate change efficacy.

Future studies could usefully broaden their definition of trust and look at trust in social institutions such as trade unions, other social groups, infrastructures, health systems, or the economy, to enhance our understanding of what shapes perceived political efficacy (Cook, 2001). Our analysis is limited in that regard, as the ESS does not contain such measures. We believe a continuation of this line of research is needed as Crosman et al. (2019) find that people identify political efficacy and collective action against climate change as much more effective than individual action. Specifically, they find that respondents appreciate that renewable energy is one of the most effective ways to tackle climate change on a collective level and that government action will yield the greatest results in achieving a slowing down of climate change, if policies are put in place in this domain. The study, however, also points out that respondents across all socio-demographic groups judge collective action to be much harder to achieve than personal action (Crosman et al., 2019, p. 2338). Political efficacy, in other words, appears to be (correctly) perceived as much more effective in the fight against climate change and thus we should strive to better understand which predictors influence this type of efficacy belief.

Third, we investigated whether national renewable energy policies influence the perceived personal and political climate change efficacy of the population.

Interestingly, the relationship between perceived personal and political efficacy and renewable energy use is equally diametrical: while there is a positive correlation between perceived personal efficacy and renewable energy use, the relationship between perceived political efficacy and renewable energy use is negative.

The positive impact of gross domestic consumption of renewable energy on personal climate change efficacy could be explained by the symbolic function of this infrastructure (O'Neill & Nicholson-Cole, 2009; O'Neill et al., 2013; Metag et al., 2015). It is: "images of clean and renewable energies, forms of mobility, and lifestyle and consumption choices; in essence, the images depict ways to reduce carbon emissions" (Metag et al., 2015, p. 219) that foster individual efficacy beliefs within the small sample used in an Austrian study. Since the transition to renewable energy involves large infrastructure systems, these might function as a physical reminder of the energy policies of nation states. Such an interpretation is supported by the research tradition of political ecology, where energy infrastructure has long been understood as carrying huge symbolic value (Gandy, 2002; Kaika, 2006; Kaika & Swyngedouw, 2000). Kaika (2006) for example discusses the iconography of the Marathon dam in Greece that, in her analysis, assumes a representative role for wider ideas of modernity, progress, and civilisation within societies. We thus suggest that renewable energy infrastructure might function as iconic landmarks for decarbonisation, which could explain the significant impact of renewable energy in total in our models.

Yet, it seems paradoxical that the effect of renewable energy use on political efficacy is negative. Research on Korean wind parks (Kim et al., 2018) reveals that the appreciation of renewable energy infrastructure is highly context specific. In particular, Korean indigenous communities, religious and elderly people were found to spurn wind turbines, as they are thought to disturb local spirits. Therefore, the symbolic dimension of infrastructures depends on local values, traditions, and belief systems.

6 Conclusion and implications

Our research has clarified which individual-level factors influence perceived personal climate change efficacy in our European sample and that renewable energy use and political trust modestly contribute to people's perceived personal efficacy beliefs. We found that there is national variation within our sample and that some states (e.g. Switzerland) score higher on perceived personal climate change efficacy than others. These insights can encourage policymakers to further push sustainable developments in the energy sector.

The study has some methodological limitations. For example, the sample sizes for the context level and the respective states are relatively small, which is suboptimal due to presumably different cultural perceptions with regard to individuals' assessment of their possibilities for action against climate change. The study can thus identify factors that have an influence, but not explain these effect mechanisms. Whether it is a matter of habituation effects or historical path dependencies that are decisive could be ascertained primarily through qualitative case studies (Gerring, 2004) on the individual states.

However, we found that significant predictors for our second dependent variable, perceived political efficacy, are almost diametrical to those predicting perceived personal efficacy. This is a significant and novel finding that warrants further research as perceived political efficacy in the context of climate change is particularly important for sustaining support for collective action against climate change, such as achieving a sustainable transition to renewable energy. We find that renewable energy use enhances perceived personal efficacy and interpret this through the symbolic value of renewable energy infrastructures. We propose that future research could look into the role of religion and social trust to further unpack what shapes much needed perceived political efficacy. This result additionally

implies that political decisions on the construction of renewable energy infrastructure should take cultural local factors more into account.

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Data availability The data that support the findings of this study are available from the ESS Website at http://cw.europeansocialsurvey.org/data. Additional data were derived from the following resources available in the public domain: Eurostat: https://ec.europa.eu/eurostat/data/database/information; Swiss Federal Office of Energy: https://www.bfs.admin.ch/bfsstatic/dam/assets/6466360/master; World Bank open data: https://data.worldbank.org/indicator/ny.gdp.pcap.cd.

Code availability The syntax used for the evaluation is available on request.

Declarations

Conflict of interest Not applicable.

References

Adaman, F., Karali, N., Kumbaroglu, G., Or, I., Özkaynak, B., & Zenginobuz, Ü. (2011). What determines urban households' willingness to pay for CO2 emission reductions in Turkey: A contingent valuation survey. *Energy Policy, 39*(2), 689–698. https://doi.org/10.1016/j.enpol.2010.10.042

Aitken, C., Chapman, R., & McClure, J. (2011). Climate change, powerlessness and the commons dilemma: Assessing New Zealanders' preparedness to act. *Global Environmental Change, 21*(2), 752–760. https://doi.org/10.1016/j.gloenvcha.2011.01.002

Bandura, A. (2000). Exercise of human agency through collective efficacy. *Current Directions in Psychological Science, 9*(3), 75–78. https://doi.org/10.1111/1467-8721.00064

Bergero, C., Rich, M. J., & Saikawa, E. (2021). All roads lead to Paris: The eight pathways to renewable energy target adoption. *Energy Research & Social Science, 80*, 102215. https://doi.org/10.1016/j.erss.2021.102215

Bryan, M. L., & Jenkins, S. P. (2016). Multilevel modelling of country effects: A cautionary tale. *European Sociological Review, 32*(1), 3–22. https://doi.org/10.1093/esr/jcv059

Burnham, M., & Ma, Z. (2017). Climate change adaptation: Factors influencing Chinese smallholder farmers' perceived self-efficacy and adaptation intent. *Regional Environmental Change, 17*(1), 171–186. https://doi.org/10.1007/s10113-016-0975-6

Button, K. S., Ioannidis, J. P. A., Mokrysz, C., Nosek, B. A., Flint, J., Robinson, E. S. J., & Munafo, M. R. (2013). Power failure: Why small sample size undermines the reliability of neuroscience. *Nature Reviews Neuroscience, 14*(5), 365–376. https://doi.org/10.1038/nrn3475

Capstick, S., Whitmarsh, L., Poortinga, W., Pidgeon, N., & Upham, P. (2015). International trends in public perceptions of climate change over the past quarter century. *Wires Climate Change, 6*(1), 35–61. https://doi.org/10.1002/wcc.321

Chang, W. C. (2021). Media use, political trust and attitude toward direct democracy: Empirical evidence from Taiwan. *Online Information Review*. https://doi.org/10.1108/OIR-09-2019-029

Choi, S., & Hart, P. S. (2021). The influence of different efficacy constructs on energy conservation intentions and climate change policy support. *Journal of Environmental Psychology, 75*, 101618. https://doi.org/10.1016/j.jenvp.2021.101618

Cook, K. S. (Ed.). (2001). *Trust in society*. Russell Sage Foundation.

Crosman, K. M., Bostrom, A., & Hayes, A. L. (2019). Efficacy foundations for risk communication: How people think about reducing the risks of climate change. *Risk Analysis, 39*(10), 2329–2347. https://doi.org/10.1111/risa.13334

Devine-Wright, P., & Batel, S. (2017). My neighbourhood, my country or my planet? The influence of multiple place attachments and climate change concern on social acceptance of energy infrastructure. *Global Environmental Change, 47*, 110–120. https://doi.org/10.1016/j.gloenvcha.2017.08.003

Dietz, T., Dan, A., & Shwom, R. (2007). Support for climate change policy: Social psychological and social structural influences. *Rural Sociology, 72*(2), 185–214. https://doi.org/10.1526/003601107781170026

Drews, S., & van den Bergh, J. C. J. M. (2016). What explains public support for climate policies? A review of empirical and experimental studies. *Climate Policy, 16*(7), 855–876. https://doi.org/10.1080/14693062.2015.1058240

Drummond, A., Hall, L. C., Sauer, J. D., & Palmer, M. A. (2018). Is public awareness and perceived threat of climate change associated with governmental mitigation targets? *Climatic Change, 149*(2), 159–171. https://doi.org/10.1007/s10584-018-2230-2

Engels, A., Hüther, O., Schäfer, M., & Held, H. (2013). Public climate-change skepticism, energy preferences and political participation. *Global Environmental Change, 23*(5), 1018–1027. https://doi.org/10.1016/j.gloenvcha.2013.05.008

European Social Survey (2016). European Social Survey Round 8 Data. File edition 2.0. Bergen, Norway: Norwegian Centre for Research Data. Retrieved from http://www.europeansocialsurvey.org/data.

Eurostat (2019). Database. Retrieved from https://ec.europa.eu/eurostat/data/database/information.

Fairbrother, M., Sevä, I. J., & Kulin, J. (2019). Political trust and the relationship between climate change beliefs and support for fossil fuel taxes: Evidence from a survey of 23 European countries. *Global Environmental Change, 59*, 102003. https://doi.org/10.1016/j.gloenvcha.2019.102003

Gandy, M. (2002). *Concrete and clay: Reworking nature in New York City*. MIT Press.

García-Álvarez, T. M., & Soares, I. (2018). Empirical assessment of sustainable energy markets in the EU-28. *Environment, Development and Sustainability, 20*(SI1), 83–108. https://doi.org/10.1007/s10668-018-0172-5

Gerring, J. (2004). What is a case study and what is it good for? *American Political Science Review, 98*(2), 341–354. https://doi.org/10.1017/S0003055404001182

Gregersen, T., Doran, R., Böhm, G., & Poortinga, W. (2021). Outcome expectancies moderate the association between worry about climate change and personal energy-saving behaviors. *PLoS ONE, 16*(5), e0252105. https://doi.org/10.1371/journal.pone.0252105

Hagen, B., Middel, A., & Pijawka, D. (2016). European climate change perceptions. Public support for mitigation and adaptation policies. *Environmental Policy and Governance, 26*(3), 170–183. https://doi.org/10.1002/eet.1701

Hamilton, L. C., Hartter, J., Lemcke-Stampone, M., Moore, D. W., & Safford, T. G. (2015). Tracking public beliefs about anthropogenic climate change. *PLoS ONE, 10*(9), e0138208. https://doi.org/10.1371/journal.pone.0138208

Harring, N., & Jagers, S. (2013). Should we trust in values? Explaining public support for pro-environmental taxes. *Sustainability, 5*(1), 210–227. https://doi.org/10.3390/su5010210

Hart, P. S., & Feldman, L. (2016). The influence of climate change efficacy messages and efficacy beliefs on intended political participation. *PLoS ONE, 11*(8), e0157658. https://doi.org/10.1371/journal.pone.0157658

Heath, A., Davidov, E., Ford, R., Green, E. G. T., Ramos, A., & Schmidt, P. (2019). Contested terrain: Explaining divergent patterns of public opinion towards immigration within Europe. *Journal of Ethnic and Migration Studies, 46*(3), 475–488. https://doi.org/10.1080/1369183X.2019.1550145

Heisig, J. P., Schaeffer, M., & Giesecke, J. (2017). The costs of simplicity: Why multilevel models may benefit from accounting for cross-cluster differences in the effects of controls. *American Sociological Review, 82*(4), 796–827. https://doi.org/10.1177/0003122417717901

Hetherington, M. J., & Husser, J. A. (2012). How trust matters: The changing political relevance of political trust. *American Journal of Political Science, 56*(2), 312–325. https://doi.org/10.1111/j.1540-5907.2011.00548.x

Hornsey, M. J., Chapman, C. M., & Oelrichs, D. M. (2021). Why it is so hard to teach people they can make a difference: Climate change efficacy as a non-analytic form of reasoning. *Thinking & Reasoning*. https://doi.org/10.1080/13546783.2021.1893222

Hornsey, M. J., Harris, E. A., Bain, P. G., & Fielding, K. S. (2016). Meta-analyses of the determinants and outcomes of belief in climate change. *Nature Climate Change, 6*(6), 622–627. https://doi.org/10.1038/nclimate2943

Hox, J. (2002). *Multilevel analysis. Techniques and applications*. Lawrence Erlbaum Associates Inc.

Iacobuta, G., Dubash, N. K., Upadhyaya, P., Deribe, M., & Höhne, N. (2018). National climate change mitigation legislation, strategy and targets. A global update. *Climate Policy, 18*(9), 1114–1132. https://doi.org/10.1080/14693062.2018.1489772

Jibrillaha, A. M., Jaafar, M., & Kuok Choy, L. (2018). Climate change awareness and adaptations among the farming and animal rearing communities of the central Sokoto close-settle zone, North-Western Nigeria. *Jurnal Kejuruteraan SI, 1*(6), 71–79. https://doi.org/10.17576/jkukm-2018-si1(6)-09

Jowell, R., Roberts, C., Fitzgerald, R., & Gillian, E. (2007). *Measuring attitudes cross-nationally. Lessons from the European social survey*. Sage.

Kaika, M. (2006). Dams as symbols of modernization: The urbanization of nature between geographical imagination and materiality. *Annals of the Association of American Geographers, 96*(2), 276–301. https://doi.org/10.1111/j.1467-8306.2006.00478.x

Kaika, M., & Swyngedouw, E. (2000). Fetishizing the modern city: The phantasmagoria of urban technological networks. *International Journal of Urban and Regional Research, 24*(1), 120–138. https://doi.org/10.1111/1468-2427.00239

Kallbekken, S., & Sælen, H. (2011). Public acceptance for environmental taxes. Self-interest, environmental and distributional concerns. *Energy Policy, 39*(5), 2966–2973. https://doi.org/10.1016/j.enpol.2011.03.006

Kellstedt, P. M., Zahran, S., & Vedlitz, A. (2008). Personal efficacy, the information environment, and attitudes toward global warming and climate change in the United States. *Risk Analysis, 28*(1), 113–126. https://doi.org/10.1111/j.1539-6924.2008.01010.x

Kenward, M. G., & Roger, J. H. (1997). Small sample inference for fixed effects from restricted maximum likelihood. *Biometrics, 53*(3), 983–997. https://doi.org/10.2307/2533558

Kim, E. S., Chung, J. B., & Seo, Y. (2018). Korean traditional beliefs and renewable energy transitions: Pungsu, shamanism, and the local perception of wind turbines. *Energy Research & Social Science, 46*, 262–273. https://doi.org/10.1016/j.erss.2018.07.024

Kothari, U. (2014). Political discourses of climate change and migration: Resettlement policies in the Maldives. *The Geographical Journal, 180*(2), 130–140. https://doi.org/10.1111/geoj.12032

Kulin, J., & Sevä, I. J. (2021). Who do you trust? How trust in partial and impartial government institutions influences climate policy attitudes. *Climate Policy, 21*(1), 33–46. https://doi.org/10.1080/14693062.2020.1792822

Kvaløy, B., Finseraas, H., & Listhaug, O. (2012). The publics' concern for global warming. A cross-national study of 47 countries. *Journal of Peace Research, 49*(1), 11–22. https://doi.org/10.1177/0022343311425841

Landholm, D. M., Holsten, A., Martellozzo, F., Reusser, D. E., & Kropp, J. P. (2019). Climate change mitigation potential of community-based initiatives in Europe. *Regional Environmental Change, 19*(4), 927–938. https://doi.org/10.1007/s10113-018-1428-1

Lebel, P., Whangchai, N., Chitmanat, C., Promya, J., & Lebel, L. (2015). Perceptions of climate-related risks and awareness of climate change of fish cage farmers in northern Thailand. *Risk Management, 17*(1), 1–22. https://doi.org/10.1057/rm.2015.4

Lee, T. M., Markowitz, E. M., Howe, P. D., Ko, C. Y., & Leiserowitz, A. (2015). Predictors of public climate change awareness and risk perception around the world. *Nature Climate Change, 5*(11), 1014–1020. https://doi.org/10.1038/nclimate2728

Lo, A. Y., & Chow, A. T. (2015). The relationship between climate change concern and national wealth. *Climatic Change, 131*(2), 335–348. https://doi.org/10.1007/s10584-015-1378-2

Lucas, C. (2018). Concerning values: What underlies public polarisation about climate change? *Geographical Research, 56*(3), 298–310. https://doi.org/10.1111/1745-5871.12284

Manzano-Agugliaro, F., Alcayde, A., Montoya, F. G., Zapata-Sierra, A., & Gil, C. (2013). Scientific production of renewable energies worldwide: An overview. *Renewable and Sustainable Energy Reviews, 18*, 134–143. https://doi.org/10.1016/j.rser.2012.10.020

McCright, A. M., Dunlap, R. E., & Marquart-Pyatt, S. T. (2016). Political ideology and views about climate change in the European Union. *Environmental Politics, 25*(2), 338–358. https://doi.org/10.1080/09644016.2015.1090371

McLoughlin, N. (2021). Communicating efficacy: How the IPCC, scientists, and other communicators can facilitate adaptive responses to climate change without compromising on policy neutrality. *Climatic Change, 169*(1–2), 5. https://doi.org/10.1007/s10584-021-03232-8

Metag, J., Schäfer, M. S., Füchslin, T., Barsuhn, T., & Kleinen-von Königslöw, K. (2015). Perceptions of climate change imagery: Evoked salience and self-efficacy in Germany, Switzerland, and Austria. *Science Communication, 38*(2), 197–227. https://doi.org/10.1177/1075547016635181

Milfont, T. L. (2012). The interplay between knowledge, perceived efficacy, and concern about global warming and climate change. A one year longitudinal study. *Risk Analysis, 32*(6), 1003–1020. https://doi.org/10.1111/j.1539-6924.2012.01800.x

Milfont, T. L., Milojev, P., Greaves, L. M., & Sibley, C. G. (2015). Socio-structural and psychological foundations of climate change beliefs. *New Zealand Journal of Psychology, 44*(1), 17–30.

O'Neill, S. J., & Nicholson-Cole, S. (2009). "Fear won't do it". Promoting positive engagement with climate change through visual and iconic representations. *Science Communication, 30*(3), 355–379. https://doi.org/10.1177/1075547008329201

O'Neill, S. J., Boykoff, M., Niemeyer, S., & Day, S. A. (2013). On the use of imagery for climate change engagement. *Global Environmental Change, 23*(2), 413–421. https://doi.org/10.1016/j.gloenvcha.2012.11.006

Ockwell, D., Whitmarsh, L., & O'Neill, S. J. (2009). Reorienting climate change communication for effective mitigation. *Science Communication, 30*(3), 305–327. https://doi.org/10.1177/1075547008328969

Owen, A. L., Conover, E., Videras, J., & Wu, S. (2012). Heat waves, droughts, and preferences for environmental policy. *Journal of Policy Analysis and Management, 31*(3), 556–577. https://doi.org/10.1002/pam.21599

Oztig, L. I. (2017). Europe's climate change policies: The Paris Agreement and beyond. *Energy Sources, Part B: Economics, Planning, and Policy, 12*(10), 917–924. https://doi.org/10.1080/15567249.2017.1324534.

Park, H. S., & Vedlitz, A. (2013). Climate hazards and risk status. Explaining climate risk assessment, behavior, and policy support. *Sociological Spectrum, 33*(3), 219–239. https://doi.org/10.1080/02732173.2013.732900

Pehrson, S., Vignoles, V. L., & Brown, R. (2009). National identification and anti-immigrant prejudice: Individual and contextual effects of national definitions. *Social Psychology Quarterly, 72*(1), 24–38. https://doi.org/10.1177/019027250907200104

Poortinga, W., & Pidgeon, N. F. (2003). Exploring the dimensionality of trust in risk regulation. *Risk Analysis, 23*(5), 961–972. https://doi.org/10.1111/1539-6924.00373

Poortinga, W., Spence, A., Whitmarsh, L., Capstick, S., & Pidgeon, N. F. (2011). Uncertain climate: An investigation into public scepticism about anthropogenic climate change. *Global Environmental Change, 21*(3), 1015–1024. https://doi.org/10.1016/j.gloenvcha.2011.03.001

Poortinga, W., Whitmarsh, L., Steg, L., Böhmd, G., & Fisher, S. (2019). Climate change perceptions and their individual-level determinants: A cross-European analysis. *Global Environmental Change, 55*, 25–35. https://doi.org/10.1016/j.gloenvcha.2019.01.007

Raihan, A., Begum, R. A., Nizam, M., Said, M., & Pereira, J. J. (2022). Dynamic impacts of energy use, agricultural land expansion, and deforestation on CO2 emissions in Malaysia. *Environmental and Ecological Statistics*. https://doi.org/10.1007/s10651-022-00532-9

Rohrschneider, R., & Miles, M. R. (2015). Representation through parties? Environmental attitudes and party stances in Europe in 2013. *Environmental Politics, 24*(4), 617–640. https://doi.org/10.1080/09644016.2015.1023579

Rubio Juan, M., & Revilla, M. (2021). Support for mitigation and adaptation climate change policies: Effects of five attitudinal factors. *Mitigation and Adaption Strategies for Global Change, 26*, 28. https://doi.org/10.1007/s11027-021-09964-3

Schmidt-Catran, A. W., & Fairbrother, M. (2016). The random effects in multilevel models: Getting them wrong and getting them right. *European Sociological Review, 32*(1), 23–38. https://doi.org/10.1093/esr/jcv090

Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values? *Journal of Social Issues, 50*(4), 19–45. https://doi.org/10.1111/j.1540-4560.1994.tb01196.x

Stigka, E. K., Paravantis, J. A., & Mihalakakou, G. K. (2014). Social acceptance of renewable energy sources. A review of contingent valuation applications. *Renewable and Sustainable Energy Reviews, 32*, 100–106. https://doi.org/10.1016/j.rser.2013.12.026.

Stoll-Kleemann, S., O'Riordan, T., & Jaeger, C. (2001). The psychology of denial concerning climate mitigation measures. Evidence from Swiss focus groups. *Global Environmental Change, 11*(2), 107–117. https://doi.org/10.1016/S0959-3780(00)00061-3

Swiss Federal Office of Energy (Bundesamt für Energie) (2018). Statistik der erneuerbaren Energien. Endverbrauch erneuerbare Energien, nach Energieträgern. Retrieved from https://www.bfs.admin.ch/bfsstatic/dam/assets/6466360/master

Thaker, J., Maibach, E., Leiserowitz, A., Zhao, X., & Howe, P. (2016). The role of collective efficacy in climate change adaptation in India. *Weather, Climate, and Society, 8*(1), 21–34. https://doi.org/10.1175/WCAS-D-14-00037.1

Thalmann, P. (2004). The public acceptance of green taxes. 2 million voters express their opinion. *Public Choice, 119*(1/2), 179–217. https://doi.org/10.1023/B:PUCH.0000024165.18082.db

Tuitjer, L., & Dirksmeier, P. (2021). Social media and perceived climate change efficacy: A European comparison. *Digital Geography and Society, 2*, 100018. https://doi.org/10.1016/j.diggeo.2021.100018

Tuitjer, L., Dirksmeier, P., & Mewes, L. (2022). Geographies of climate change opinion. *Geography Compass, 16*, e12619. https://doi.org/10.1111/gec3.12619

Tutak, M., & Brodny, J. (2022). Renewable energy consumption in economic sectors in the EU-27. The impact on economics, environment and conventional energy sources. A 20-year perspective. *Journal of Cleaner Production, 345*, 131076. https://doi.org/10.1016/j.jclepro.2022.131076

Ung, M., Luginaah, I., Chuenpagdee, R., & Campbell, G. (2016). Perceived self-efficacy and adaptation to climate change in coastal Cambodia. *Climate, 4*(1), 1–16. https://doi.org/10.3390/cli4010001

van Zomeren, M., Spears, R., & Leach, C. W. (2010). Experimental evidence for a dual pathway model analysis of coping with the climate crisis. *Journal of Environmental Psychology, 30*(4), 339–346. https://doi.org/10.1016/j.jenvp.2010.02.006

Vögele, S., Govorukha, K., Mayer, P., Rhoden, I., Rübbelke, D., & Kuckshinrichs, W. (2022). Effects of a coal phase-out in Europe on reaching the UN sustainable development goals. *Environment, Development and Sustainability*. https://doi.org/10.1007/s10668-021-02083-8

Wolsink, M. (2010). Contested environmental policy infrastructure. Socio-political acceptance of renewable energy, water, and waste facilities. *Environmental Impact Assessment Review, 30*(5), 302–311. https://doi.org/10.1016/j.eiar.2010.01.001

World Bank (2019). World Bank open data. Retrieved from https://data.worldbank.org/indicator/ny.gdp.pcap.cd.

Yayeh Ayal, D., Tilahun, K., Ture, K., & Zeleke, T. T. (2021). Psychological dimensions of climate change: Perceptions, collective efficacy, and responses in Berehet District, north Shoa, Ethiopia. *Climatic Change, 165*, 32. https://doi.org/10.1007/s10584-021-03033-z

Yilmaz, V., & Can, Y. (2020). Impact of knowledge, concern and awareness about global warming and global climatic change on environmental behaviour. *Environment, Development and Sustainability, 22*(7), 6245–6260. https://doi.org/10.1007/s10668-019-00475-5