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Worldviews as predictors of wind and solar energy support in Austria: Bridging social acceptance and risk perception research

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ABSTRACT

With increasing demand for renewable energy, research focusing on social acceptance of production facilities has firmly established itself over the past decades. While the influence of worldviews on individuals' perceptions and behaviour has received widespread scholarly attention regarding a variety of related issues, social acceptance of renewable energy technologies (RET) has not been one of them. The study presented here addresses this shortcoming in the literature by examining the impact of various constructs, including worldviews, with respect to individuals' acceptance of RET in their vicinity. The study builds on a representative sample of Austrian citizens. Our findings suggest that RET belief is most strongly associated with acceptance regarding the construction of RET in participants' community. Further, we find that the more strongly participants feel about a variety of motives that generally support the use of renewable energies, the more accepting they are of local RET power plants. Regarding the effect of worldviews, we find that individuals who value the common good and equality are more supportive of RET in their vicinity. Our discussion focuses on the theoretical implications with particular attention to the results regarding the effect of worldviews.

1. Introduction

The past decades have seen an increasing spotlight on renewable energy sources as dire climate change prediction have conveyed the need for a radical change in the way we produce energy. Distributed renewable energy technologies (RET), such as wind power and photovoltaics in particular, have been highlighted as part of the solution in mitigating climate change, while at the same time satisfying increasing energy demands.

As the policy discourse has started to lean heavily towards RET, consumers and the private industry have followed suit, increasingly investing in RET. Describing the historic developments on the renewable energy market some authors even speak of a renewable energy gold rush, in particular when it comes to the accelerated nature of wind power developments [1,2]. These developments over the past decades have brought a fickle issue regarding the actual deployment of such technologies to the foreground: social acceptance of RET. Various cases of failed or severely delayed RET developments have demonstrated that developers but equally public authorities have frequently ignored this aspect in pushing for more RET [3,4]. In fact, recent research has supported the conclusion that in determining the success of a RET project the question of social acceptance is just as important, as issues that concern the technology itself or the legislative framework surrounding it [4–6].

Scholarly work on social acceptance of RET emerged in the early eighties developing into an important research stream with major contributions to the diffusion of RET in the past decades [6–12]. This dedicated research stream however appears to have widely neglected scholarship on risk perception, although a recent bibliometric analysis of the social acceptance literature by Gaede and Rowlands [12] proposes that eventually one subgroup of seven larger research fronts they find will look at individual-level psychological determinants of technological risk perception. This would not be a surprise, as especially with regards to issues such as emerging technologies, climate change and related environmental issues this research branch has generated a wealth of insights, applicable to studies of social acceptance. To the best of our knowledge research investigating the joint effect of different predictors that have been found relevant in social acceptance literature but equally considering variables identified in scholarly work on risk perception has not been undertaken yet.

In this paper, we specifically focus on social acceptance of RET at the local scale and investigate the respective predictive power of

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various constructs from social acceptance and risk perception literature. This includes general belief in and scepticism regarding renewable energies, strength of motives for the adoption of RET and lastly, worldview as the central construct adopted from risk perception literature. The study presented here is conceptualized in a psychometric research tradition and aimed at advancing our understanding of social-psychological correlates of social acceptance. We build on a representative sample of Austrian citizens ($N = 1000$) from a survey conducted in 2016. Our findings suggest that beliefs, motives and cultural worldviews are relevant predictors of social acceptance of RET.

We contribute to existing literature by integrating theory on risk perception with social acceptance of RET research providing a novel and theory-guided extension of existing scholarship. Our findings provide insights to scholars studying the impact of social-psychological factors by suggesting novel measures of positive beliefs, scepticism and motives related to RET, which might be further developed in future work. For the risk perception literature, we provide empirical evidence and contribute to the discussion of the applicability of the cultural cognition scales in a different cultural context. Our findings provide novel insights for practitioners and policymakers related to the siting of RET and the framing of communication measures targeting the local community.

The paper proceeds as follows: first, we provide a literature review and derive hypotheses related to contextual, personal and social-psychological factors that determine the social acceptance of RET and regarding the impact of cultural worldviews grounded in the cultural theory of risk. Then data collection, the survey instrument and the variables and measurements are described. In the next section, the results are presented and, finally, the paper ends with a discussion of the results, limitations and suggestions for further research and a final conclusion.

2. Theory and hypotheses

2.1. Social acceptance of renewable energy technology

Research on issues of social acceptance has been lagging behind the actual deployment of RET and development of policy frameworks. Starting in the early eighties, public perceptions of and support for renewable energies were considered as marginal issues, an understanding which is demonstratively expressed with summarizing these under the label: 'non-technical' factors [8]. After Carlman's [8,9] pioneering work other researchers followed suit [7,10,11] but a committed research stream was not established until the turn of the century culminating in Wüstenhagen, Wolsink and Bürer's [6] seminal paper on social acceptance of renewable energy innovation. It is evident that much of the scholarly work so far focuses on wind power. One explanation is that wind power is perceived as more controversial than, for instance, photovoltaics [3,13,14]. However, social acceptance and siting issues related to utility-scale photovoltaic projects have been discussed in literature and practice fields due to their high impact on the 'soft costs' of installations [15,16].

Following Wüstenhagen et al.'s [6] theoretical model three major aspects of acceptance of renewable energies can be differentiated.[1] At the highest level sits *socio-political acceptance*, which describes a favourable policy landscape and public support for RET, which is generally found to be high [17]. Another aspect of social acceptance according to Wüstenhagen et al. [6] is *market acceptance* defined as the degree to which a RET innovation is adopted by consumers but ultimately also by investors and within firms. The third aspect of social acceptance, *community acceptance*, then highlights issues around actual RET projects, such as wind turbines and the process of siting them.

Community acceptance mostly concerns individuals that live in the vicinity of planned or already built RET projects. In this regard, it is often observed that high acceptance on a socio-political level is contrasted by rather low acceptance at the community level [2,18,19]. To explain this apparent discrepancy previous research has discussed the concept of NIMBYism, which in essence proposes, that people's inconsistent attitudes, characterised by support at the global and resistance at the local level, can be explained as a function of general support for RET that is conditional upon not being sited in their backyard (*N*ot *I*n *M*y *B*ack*Y*ard). The NIMBY concept has been exposed to considerable criticism and it has been sufficiently shown that this concept is of limited value, most notably by studies finding evidence for the exact opposite effect, labelled as PIMBY(*P*lease *I*n *M*y *B*ack*Y*ard) syndrome [2,19–26]. However, it remains that the distance to a proposed or existing RET is an important aspect to consider when trying to measure acceptance [25].

In introducing the social acceptance concept, it is important to note that the word 'acceptance' carries specific theoretical and socio-political implications that need to be acknowledged [27,28]. In particular differences between the non-agency and agency character of *acceptance* and *support* for RET respectively have been highlighted, the former implying a 'normative top-down perspective' that carries a questionable focus on acceptance and viewing opposition as something to be overcome and thereby ignoring the latter and other forms of engagement with RET that exist besides acceptance [25,27]. Other authors, for example, have distinguished between *acceptance/acceptability* on one hand as attitudinal concepts and *support* as a behavioural construct on the other [28,29]. Dreyer et al. [29] in discussing these constructs point out an important related issue, that is the temporal dimension of acceptance. Various studies have shown that as concrete RET projects develop, so does acceptance, usually following a u-shaped curve from high acceptance before projects, to relatively low acceptance during the planning and siting stage, to then return to higher acceptance levels upon completion and operation of a finished RET project [2,23,24,30,31]. The study presented here investigates respondents' acceptance by asking them whether they would support RET structures being built in their community. As these structures are neither built, nor projected to be built we do however conceive the operationalization of acceptance/support applied here as an attitudinal construct.

2.2. Contextual, personal and social-psychological factors

Beside the narrow focus on social acceptance as a function of time or proximity, research has highlighted a series of factors that have been linked to individuals' acceptance of RET. Reviewing such factors Devine-Wright [6] distinguishes three levels of analysis: *Contextual*, *personal* and *social-psychological*. Factors studied at a *contextual level of analysis* are directly related to the particular nature of a RET project. For wind farms two frequently identified factors at this level are noise and visual impact [30,25]. Community involvement and public consultation can also be highlighted as contextual factors that substantially contribute to social acceptance of wind farms [6,13,25,32–35], issues that are tightly interwoven with the question of dis-/trust among affected publics, which has been highlighted as another important aspect in building social acceptance of wind farm projects [36]. However, since this paper does not focus on an existing or projected power plant, contextual factors are not studied here.

The *personal level of analysis* is concerned with factors directly related to the person. Devine-Wright [14] highlights variables such as age, gender and class as the primary focus of studies at this level.

[1] It is important to note, that even though these three dimensions are separately defined they are all interlinked [6]. Thus, Devine-Wright et al. [50] criticise that literature to date has mostly focused on only one of these dimensions. Building on this framework by Wüstenhagen et al. [6], Sovacool and Ratan [78] further operationalized these three dimensions of social acceptance into nine factors that have been found to create conditions which are favourable for the diffusion of RET: (1) strong institutional capacity, (2) political commitment, (3) favourable legal and regulatory frameworks, (4) competitive installation and/or production costs, (5) mechanisms for information and feedback, (6) access to financing, (7) prolific community and/or individual ownership and use, (8) participatory project siting, and (9) recognition of externalities or positive public image.

Research on the effect of these socio-demographic variables has not yet yielded any consistent findings, which might be attributable to the fact that effects of these variables seem to be specific to the technology and various operationalisations of acceptance (e.g. community vs. market/consumer acceptance) and awareness. A tendency for older respondents to be less positive towards RET such as wind [37–39], biogas and solar energy [40] has been highlighted in some of the literature but higher consumer acceptance for renewable energy in older participants has also been reported [41]. Equally variable are findings on the effects of gender, with some research finding lower levels of support for wind power among women [42] and other studies finding no effect of acceptance for wind [37,39] and other forms of renewable energy deployment [40], or even higher levels of support for renewable energy development among women [14]. In the same vein results for income and education as indicators of class do not yield a consistent pattern. Studies found that individuals with higher incomes are more likely to accept renewable energy deployment [40] and support electricity production from RET [43–46], however contradicting results that individuals with higher income express a less positive stance towards wind power [37] have also been reported. With regards to education, scholars were able to show that support for electricity production from RET increases with the level of education [43,44,46].

Finally, analyses at the *social-psychological level* consider variables such as values, beliefs and motives. Previous literature has shown that the values individuals subscribe to are indicative of their attitudes towards wind power [47]. Similarly studies have found that greater environmental concern is predictive of greater support for and interest in RET [37,47–49].

More specific to the issue at hand are beliefs. Devine-Wright et al. [50] propose that belief systems held by various key actors in society such as policymakers and community leaders exert a high influence on social acceptance and the diffusion of RET. Building on theoretical work around the 'web of beliefs' [51]. Bell et al. [52] also posit that individuals will evaluate and understand information about RET siting decisions according to their individual beliefs. With regards to the association between beliefs and social acceptance some evidence exists that hints at a significant role of this type of constructs in pro-environmental decision making and behaviour. Liu et al. [40] in their study on public acceptance of renewable energy in rural China find that beliefs relating to the costs of RET (e.g. "high investment in RET would increase electricity prices") have a significant positive influence on the willingness to pay more for green electricity, while beliefs about the benefits of RET (e.g. improvement of energy supply of rural areas) have a positive but non-significant effect. Similarly, other authors find that the perception of wind energy as environmentally friendly or general disposition towards wind power is significantly associated with local approval and support for local wind energy developments [35,53]. Further, scholars have shown an impact of individual beliefs on energy savings [54] and the intention to engage in collective climate protection actions, such as local initiatives for energy autonomy [55].

In research on climate change perceptions, belief in climate change, or lack thereof, often labelled climate change scepticism, has been highlighted as a major predictor of various climate change related constructs including climate change concern, climate change policy support and individual intentions to mitigate [56–58]. In defining various forms of climate change scepticism Capstick and Pidgeon [59] highlight response scepticism and epistemic scepticism as two forms of climate change scepticism. Relevant to this paper is response scepticism, which the authors define as "relating to doubts about the efficacy of action taken to address climate change" [59]. This relates directly to beliefs regarding RET, as a lack of confidence regarding the efficacy of RET would most certainly translate into rejection of local RET projects [28].

Reaching a very concrete level of determinants of social acceptance, Wolsink [60] argues based on literature that people have different motives to resist a measure such as the siting of a wind power plant: "Some people are afraid of property value decline, while others are concerned about environmental aspects, such as damage to the countryside in general or to a valuable nature area, or the risk of a calamity of some kind". Motives to accept RET and motives to reject them can be further broken down into motives of different origins. Conducting a meta-analysis on social-psychological determinants of pro-environmental behaviour, Bamberg and Möser [61], for example, find that self-interest and pro-social motives are both connected to pro-environmental behaviour. While their valence is equal, they stem from different origins. This connects to the above-mentioned discussion of so-called NIMBY findings, for which some researchers had in fact suggested that the dichotomy between high public and low local support exists as a result of a conflict between wanting RET for pro-social and environmentalist motives but rejecting their installation at the local level for selfish motives [21]. These forms of motives are put to test here alongside beliefs in order to investigate their relative contribution to predicting social acceptance.

Summarizing the evidence on socio-demographic and social-psychological predictors of social acceptance we conclude that studies on the impact of socio-demographic variables on acceptance of RET and the support of green electricity generated from RET have not yet yielded any consistent findings. Some prior work even suggests that, compared to socio-demographic predictors, social-psychological characteristics have stronger explanatory power with respect to support for RET [43]. Further, considering the ambiguous evidence regarding the effect of socio-demographic variables we do not propose any specific hypotheses regarding these variables but include them as control variables in our study. Regarding the above-mentioned variables of belief and motives and building on existing literature we define the following hypotheses:

Hypothesis 1a. Belief in the future viability and benefits of RET is positively related to acceptance of RET.

Hypothesis 1b. Scepticism related to RET is negatively related to acceptance of RET.

Hypothesis 1c. Motives related to intrinsic qualities of RET, such as their environmental benefits, which are relevant for RET adoption are positively related to acceptance of RET.

Leading on from these factors, which have been highlighted in social acceptance research, the following section reviews literature on the effect of worldviews on RET acceptance. In doing so, we build on one of the most central theories in risk perception literature, cultural Theory of Risk [62].

2.3. Cultural theory of risk

Cultural theory of risk builds on two main premises: (1) Adherence to certain forms of how social relations are organized is related to so-called cultural biases or cultural worldviews as they have been alternatively referred to. (2) Four distinct cultural worldviews can be distinguished in a two-dimensional space composed by a group and a grid dimension: Hierarchism, Egalitarianism, Individualism and Fatalism [62,63].[2] Empirical work on cultural theory of risk has looked at how these specific worldviews affect the perception of specific risks in comparison to other predictors of risk perception. The general finding is that "however conceptualized – whether as political worldview or cultural biases – worldviews best account for patterns of risk perceptions" [64] outperforming variables such as knowledge, personality

[2] In work on *cultural cognition* by Kahan et al. [67,74] building on this theory the mentioned typologies were no longer used to describe the respective quadrant of the grid-group space but were partly adapted (omitting fatalism) as extreme points of the same two-dimensional space, juxtaposing hierarchy and equality and individualism and communitarianism. The work presented here in terms of nomenclature and measurements builds on this latter scholarly work.

traits and demographic characteristics. 'Patterns of risk' refers to the finding that risk perceptions emerge from an interplay of cultural biases and the type of hazard that is being evaluated. Particular risks are more salient to individuals from one group than they are to individuals from another.

Wildavsky and Dake [64] found that overall egalitarianism is positively related to the mean perceived risk, and negatively related to mean perceived benefit, of technologies. Further research building on cultural theory of risk found that, in particular, egalitarians are most concerned about technical and environmental risk. Specifically, egalitarianism is most strongly associated with concern for 'environmental pollution', 'dangers associated with nuclear energy' and the 'threat of nuclear war'. Egalitarianism correlates with high risk-estimates for environmental threats with potentially catastrophic outcomes, such as 'nuclear power' and the 'ozone depletion'; and unnatural risks, such as 'genetic engineering' and 'micro wave ovens' [65,66]. Hierarchism and individualism by contrast are positively associated with technological risk-taking and correlate with average ratings regarding technological benefits. Individualism correlates with low risk perceptions for environmental threats and personal risks, such as alcoholic drinks, car driving etc. Hierarchists are more preoccupied with forms of social deviance, insubordination and show high risk perceptions concerning social threats, such as terrorism and mugging [65,66].

Scholars applying and advancing this theory have proposed that these cultural biases are maintained through a biased form of information processing, referred to as cultural cognition, which is used by individuals to promote their "interests in forming and maintaining beliefs that signify their loyalty to important affinity groups" [67]. In other words, the cultural cognition approach posits that individuals process information in order to maintain and, ideally, promote their standing in the social group they adhere to. Integrating cultural theory and the psychometric paradigm, research in this line has shown that adherence to one or the other cultural worldview is predictive of support of and opposition to issues as varied as: national security, gun ownership, public health and climate change [68].

Pertinent to social acceptance of RET scholarship are studies confirming that people adjust their perceptions and opinions concerning climate change [67,69,70] and even climate change mitigation policies [71] to align with their cultural worldview and ideological commitments. However, little is known about whether cultural worldviews are linked to social acceptance of RET. A study that has looked at how hierarchical and individualist worldviews predict support for the deployment of and support for government-funded research on low carbon technologies (wind power and carbon capture and storage), only found a significant, albeit small, and negative correlation of both cultural worldviews[3] with support for government-funded research but none with support for the deployment [72].

Building on the above-reported work regarding the effect of cultural worldviews with respect to environmental concern, climate change perceptions and related issues and the first tentative findings reported by Cherry et al. [72] we expect to find that:

Hypothesis 2a. Individuals with stronger individualistic-hierarchical worldviews are less likely to accept the siting of RET in their neighbourhood.

Hypothesis 2b. Individuals with stronger communitarian-egalitarian worldviews are more likely to accept the siting of RET in their neighbourhood.

[3] The authors find that high hierarchism and equally, high individualism are associated with less support for government-funded research on low-carbon technologies.

3. Methods

3.1. Data and sample

Participant recruitment, remuneration and data collection were handled by *meinungsraum.at*.[4] An online questionnaire was administered to participants collecting a nationally representative sample of the Austrian population. Potential respondents are registered in an online panel curated by *meinungsraum.at* and were sent an invitation email and a maximum number of two reminder emails. Respondents are offered € 0.10 cents per completed survey minute as an incentive. In total 12,436 participants were invited by the market research company to participate in the survey that was set beforehand to achieve a sample size of approximately 1000 participants filling the necessary quotas for gender, age, educational level and income. With a final sample size of 1000 respondents excluding both incomplete records and records with questionable answer patterns (e.g. flat line responses, random inputs in open answer formats) a response rate of 9% was achieved, which is within the traditionally achieved response rate of *meinungsraum.at*. Data were collected from mid to end of October 2016. The final sample consisted of 1000 respondents of whom 51% were women. As can be seen in Table 1, the mean age was 45.03 and the reported mean income was € 2736, with approximately half of the sample indicating that they had completed higher education, which is above the national average.

3.2. Instrument

The questionnaire was intended to measure respondents' perceptions of various renewable energy-related issues, including perceptions of and attitudes towards electric vehicles and photovoltaic panels for private consumers but also RET in general and large-scale renewable energy production sites, such as wind farms and large-scale photovoltaic power plants, which are central to the research presented here. The survey instrument thus contained a variety of items and scale measurements. The statistical analysis presented here, however, only uses a selection of these measures and so the following more detailed description will focus on these only.

3.3. Variables and measurement

3.3.1. Dependent variables

Acceptance of RET was measured here by averaging two items that asked participants whether they would endorse the siting of a wind turbine and a photovoltaic power plant in their community; hereby explicitly quantifying and thus controlling for the important aspect of distance. Respondents were asked to indicate whether they endorsed the build of such a structure on a 5-point Likert-type scale (*strongly agree* to *strongly disagree*) for each RET separately. Respondents reported to be more favourable towards a photovoltaic power plant ($M = 3.25$, $SD = 0.75$) than a wind turbine ($M = 2.89$, $SD = 0.91$). The data however, clearly shows that respondents who indicate higher acceptance of a wind turbine in their residential surroundings, are also more likely to accept a photovoltaic power plant ($r = 0.42$, $p < 0.01$).

3.3.2. Independent variables

Details on the scales described in the following paragraphs can be found in Table A.1 in the Appendix A. *RET belief* ($\alpha = 0.60$) was measured using three items. Individuals were asked to indicate on a 5-point Likert-type scale (*strongly agree* to *strongly disagree*) whether they agreed or did not agree with a number of statements. *RET scepticism* was

[4] Meinungsraum.at is a full-service market research service provider with a focus on online market and opinion research. Meinungsraum.at curates an Austrian online-panel that includes around 30,000 participants using permanent multi-channel recruitment to replace drop outs and to ensure an optimal composition of the panel.

Table 1
Descriptive statistics of primary socio-demographic variables and representativeness.

Variables	Percentage/Mean Sample	Percentage/Mean Austrian Population[a]
Number of respondents	1000	
Gender		
Male	51%	49%
Female	49%	51%
Age (years)	45.03	42.50
Educational level		
Compulsory school	6%	20%
Vocational training	45%	49%
High school	26%	16%
College/university	24%	13%
Monthly income	€ 2736	€ 2909

[a] *Source:* Statistik Austria [73].

measured with two items using the same 5-point Likert-type scale. The *RET motives scale* ($\alpha = 0.85$) consisted of six items and the *RET extrinsic motives scale* ($\alpha = 0.71$) of four items, asking respondents to rate the strength of a number of arguments on a 5-point Likert-type scale (*very important* to *not important at all*). *Cultural worldview* was measured building on work by Kahan et al. [63,74] and Cherry et al. [72] using a shortened scale which included six items that were chosen based on their applicability to the cultural context of Austria. Answer options were presented on a 5-point Likert-type scale (*strongly agree* to *strongly disagree*). Exploratory factor analysis revealed two factors explaining 53% of variance. One factor consisted of the individualistic and hierarchical statements while the other was composed by the communitarian and egalitarian items. Reliability analysis indicated relatively low values for both scales (*communitarianism-egalitarianism*, $\alpha = 0.44$; *individualism-hierarchism*, $\alpha = 0.61$).[5] We also included the demographic variables *gender*, *age*, *education* and *income* as control variables in the regression model.

3.4. Data analysis

The data were analysed using multiple regression to investigate whether *acceptance of RET, wind power acceptance* and *photovoltaics acceptance* can be predicted based on *RET belief*, *RET scepticism*, *RET motives*, *RET extrinsic motives*, *communitarianism-egalitarianism*, *individualism-hierarchism*, *gender*, *age*, *education* and *income*.[6] Multiple regression allows for an analysis of the effect of an independent variable on a dependent variable, controlling for the effect of other predictors, i.e. other independent variables included in the analysis. Analyses were carried out using IBM SPSS Statistics version 24.

4. Results

The significant regression model accounts for 27% of total variance[7] ($F(10,897) = 34.54$, $p < 0.001$). As can be seen in Table 2 *RET belief* ($\beta = 0.37$, $p < 0.001$) yields the highest standardized regression weight. In line with Hypothesis 1a this indicates that the more positive individuals think about renewable energy, the more likely they are to accept the construction of renewable energy power plants in their community. *RET motives* ($\beta = 0.22$, $p < 0.001$) follow in second position and *RET scepticism* ($\beta = -0.10$, $p = 0.002$) in third, confirming Hypotheses 1b and 1c. This means that respondents who generally rate a variety of arguments for switching to renewable energies as important indicate to be more accepting with respect to RET deployments in their neighbourhood. Individuals instead, who are less convinced about the future viability of renewable energy have a lower likelihood of stating that they accept RET. Finally, *age* ($\beta = -0.08$, $p = 0.006$), *communitarianism-egalitarianism* ($\beta = 0.08$, $p = 0.014$) and gender ($\beta = -0.06$, $p = 0.046$) were significantly associated with RET acceptance, indicating that older and female participants are less likely to condone the building of wind turbines and photovoltaic power plants in their neighbourhood, while, more communitarian and egalitarian individuals are found to show higher acceptance, as was predicted by Hypothesis 2b. The analysis however, did not confirm Hypothesis 2a as *individualism-hierarchism* was not found to be significantly associated with the dependent variable ($\beta = -0.01$, $p = 0.794$).[8] Further, *income* ($\beta = 0.04$, $p = 0.201$) and *RET extrinsic motives* ($\beta = -0.03$, $p = 0.313$) also yielded non-significant contributions to the model.

Investigating acceptance of the two technologies separately, analyses showed a relatively weaker performance of the regression model for wind power acceptance with an adjusted R^2 of 0.14 ($F(10,897) = 15.53$, $p < 0.001$) as opposed to a slightly improved performance for the regression model for photovoltaics acceptance with an adjusted R^2 of 0.29 ($F(10,897) = 37.88$, $p < 0.001$). The technology-specific analyses confirm our findings that the social-psychological predictors *RET belief* ($\beta_{wind} = 0.29$, $p_{wind} = 0.001$ vs. $\beta_{pv} = 0.33$, $p_{pv} < 0.001$), *RET motives* ($\beta_{wind} = 0.11$, $p_{wind} = 0.001$ vs. $\beta_{pv} = 0.27$, $p_{pv} < 0.001$) have a significant positive effect on the acceptance of RET in general and the specific technologies. Interestingly however, *communitarianism-egalitarianism* only yielded a significant effect in the model for wind power ($\beta_{wind} = 0.07$, $p_{wind} = 0.037$). Another apparent difference in the two single item models concerns the socio-demographic variables *age* and *gender*, both of which are significant predictors for wind power acceptance only ($\beta_{wind.age} = -0.09$, $p_{wind.age} = 0.005$, $\beta_{wind.gender} = -0.07$, $p_{wind.gender} = 0.028$) (Table 2).

5. Discussion & conclusion

5.1. Discussion

In accordance with Hypothesis 1a and 1b the analysis here showed that general belief and scepticism with regards to RET are linked to the acceptance of RET. General belief in RET is in fact the strongest single predictor and positively associated with all three RET acceptance measures studied here. This result is notable as we find a positive association despite the acceptance questions placing the RET in the respondent's immediate living environment. As reported above previous studies in this domain have found that general support for RET, as we sought to operationalize through *RET belief* here, is contrasted by opposition at the local level. It thus follows that these constructs should be, if at all, negatively correlated [2,18,19]. We found however that social acceptance is significantly associated with a variety of constructs from the more abstract social-psychological dispositions and general belief in RET, to the more concrete individual motives regarding the specific issue. This finding is invigorated by the fact that our analysis offered an investigation of the predictive value of the various constructs in conjunction, as opposed to an abstracted look at isolated correlations for each parameter. Future studies, however will have to investigate this spatial component of acceptance in more detail. A related dimension that merits attention in this respect is time. Prospective studies would greatly benefit from investigating the effect of the various stages of a RET project in conjunction with the above mentioned spatial dimension, to then verify whether the impact of the general RET belief

[5] These reliability values are in line with results from other researchers that applied cultural worldview scales in their work in a non-US context [e.g. [51]. We discuss this potential limitation in more detail in the final section of this paper.

[6] A correlation matrix for all the variables included in the regression model is presented in Table A.2 in the Appendix A.

[7] Similar studies have reported R^2 values ranging from 0.13 to 0.37 [40,42,79].

[8] The non-significant contribution of individualism-hierarchism is addressed in more detail in the discussion section.

Table 2
Linear models of predictors of RET acceptance, wind power acceptance and photovoltaics acceptance.

	RET acceptance		Wind power acceptance		Photovoltaics acceptance	
Variables	β (SE)	*p*-value	β (SE)	*p*-value	β (SE)	*p*-value
Intercept	3.34 (0.13)	0.000	3.39 (0.19)	0.000	3.30 (0.14)	0.000
Control variables						
Gender	−0.06 (0.04)	0.046	−0.07 (0.06)	0.028	−0.02 (0.04)	0.407
Age	−0.08 (0.00)	0.006	−0.09 (0.00)	0.005	−0.04 (0.00)	0.135
Education	0.00 (0.02)	0.983	−0.03 (0.03)	0.415	0.04 (0.03)	0.252
Income	0.04 (0.00)	0.201	0.03 (0.00)	0.385	0.04 (0.00)	0.208
Explanatory variables						
RET belief	0.37 (0.02)	0.000	0.29 (0.03)	0.000	0.33 (0.02)	0.000
RET scepticism	−0.10 (0.02)	0.002	−0.04 (0.03)	0.219	−0.13 (0.02)	0.000
RET motives	0.22 (0.02)	0.000	0.11 (0.03)	0.001	0.27 (0.02)	0.000
RET extrinsic motives	−0.03 (0.02)	0.313	−0.01 (0.03)	0.860	−0.05 (0.02)	0.093
Communitarianism-egalitarianism	0.08 (0.02)	0.014	0.07 (0.03)	0.037	0.06 (0.02)	0.065
Individualism-hierarchism	−0.01 (0.02)	0.794	0.03 (0.03)	0.439	−0.05 (0.02)	0.122

Note: $N = 1000$. Standard errors in parentheses. RET acceptance: adj. $R^2 = 0.270$ ($F(10,897) = 34.54$, $p < 0.001$); Wind power acceptance: adj. $R^2 = 0.138$ ($F(10,897) = 15.53$, $p < 0.001$); Photovoltaics acceptance: adj. $R^2 = 0.289$ ($F(10,897) = 37.88$, $p < 0.001$).

measure presented here is truly independent of location or point in time.

Our results further show, that, after *RET belief*, *RET motives* have the second strongest impact on social acceptance of RET. As stated in Hypothesis 1c this finding indicates that people who strongly adhere to intrinsic qualities, such as environmental benefits, in their support for renewable energy have a higher propensity to accept the siting of a RET plant in their local community. This is in line with findings from literature on pro-environmental behaviour, which show that pro-social motives are the strongest predictors [61]. In accordance with this line of reasoning, the effect of the *RET extrinsic motives* is marginal and non-significant, suggesting that motives connected to self-interest (e.g. status symbols) and/or peer effects (e.g. experiences by friends and family) do not have a bearing on reported acceptance of RET. However, future studies might further investigate this relationship, also controlling for personality variables, such as self-interest to be included as potential moderating variables for the effects of the two motive sets used here. *RET belief* and *RET motives* yielded similar effects in the separate models for the technology-specific outcome variables, as well as the combined acceptance measure and can thus be accepted as relatively stable predictors of social acceptance of RET.

RET scepticism was not found to be a significant predictor of wind power acceptance, which might partly explain the relatively poorer performance of the related regression model. In this context is important to note that, as suggested by highest factor loadings for photovoltaic-related items in the *RET scepticism* scale, as well as the *RET belief* scale (see Table A.1), the two variables were slightly photovoltaic-centred. Against this background it is not overly surprising that out of these two variables, *RET scepticism* as the overall weaker predictor did not yield a significant contribution to the regression model for wind power acceptance. This particularity of the *RET belief* and *RET scepticism* scales further offers an explanation of why the contribution of *RET belief* in the wind power acceptance model is considerably smaller compared the other two regression models.

As regards the effect of worldviews, we were able to show that holding a communitarian-egalitarian worldview is positively associated with RET acceptance. As stated in Hypothesis 2b individuals who express stronger communitarian-egalitarian convictions are more likely to state they would accept the siting of a RET in their neighbourhood. Hypothesis 2a instead, focusing on a negative effect of holding an individualistic-hierarchical worldview was not confirmed by our analysis. This disparity in how the two worldview variables behaved in the model could point towards the idea that the issue of acceptance of RET does not polarize between individuals of different cultural orientations but is simply of a more positive connotation to communitarian-egalitarian persons. In this respect, it is important to point out that this predictor had no significant contribution in the regression model for photovoltaics acceptance but a significant one for wind power acceptance. This might indicate that photovoltaic power plants as opposed to wind turbines represent a much less contested issue in terms of differences between less and more committed communitarian-egalitarian individuals. Still, a slightly stronger coefficient was found for the combined outcome measure than the single outcome measure regarding wind turbines. Overall, the relatively small regression weight for *communitarianism-egalitarianism* sounds a note of caution but this should not be overly surprising as the construct of cultural worldviews is of a rather abstract nature when compared to the dependent variable.

Only two of the four included socio-demographic variables *age* and *gender* were found to be significant predictors of social acceptance of RET. Older and female[9] participants are less likely to accept a RET to be built in their immediate living environment. The finding regarding age is in line with most of the existing literature and should contribute to a clearer evidence base regarding the effect of age on social acceptance of RET [37–40]. The impact of age failed to reach significance for photovoltaics acceptance but was significant and slightly more pronounced with respect to wind power acceptance. A further socio-demographic predictor, *gender*, also reached significance in the wind power model, indicating that, in line with Klick and Smith [42] women are generally less likely to accept the siting of a wind turbine in the vicinity of their living environment. Again, this would point to the idea that wind turbines are somewhat more contested and as such are more correspondent to actual risk perception issues, which are characterised by female risk aversion [75,76].

Despite our efforts to design the study best possible, this research project does carry some shortcomings, one of which concerns the cultural worldview scales in particular. Due to restrictions to the overall length of the questionnaire we were forced to cut certain scale measurements in length. We need to acknowledge that factor and reliability analyses indicated that the measurement of cultural worldviews applied here, does not discriminate well between individuals in our sample. Following the cultural cognition theory [63] hierarchism and egalitarianism are conceptualized as two opposing poles, and so are individualism and communitarianism. Our findings from the factor analysis of the cultural worldview items did not reflect this logic however, we found that the individualism and hierarchism items formed one factor and the remaining communitarianism and egalitarianism items

[9] It is important to notice that the marginal *p*-value for gender ($p = 0.046$) calls for a cautious interpretation of this result.

formed the other, thus reducing the intended two-dimensional space to essentially two unrelated constructs. In light of this, finding a non-significant contribution to the model for individualism-hierarchism does not surprise much as this factor no longer represents an opposing pole, that by definition would have to be inversely related to the dependent variable.

There are various explanations for this finding. The short form used here potentially restricted the overall variance and thus would have led to a more condensed factor solution as was found here. It is however equally important to point out that the original work by Kahan et al. [e.g. [57,61] is heavily anchored in a US-American context. It would therefore follow that the items do not perform in the same fashion when used in a European context, as indicated here by the conflicting results of the factor analysis and the low reliability scores achieved. We did aim to choose items that to our judgement best suit an Austrian cultural context but it is probable that a dedicated approach to measuring cultural orientation in Europe might be necessary. This suspicion is supported by other non-US-American work that has run into the same issue of rather low reliability values [57].

Against the backdrop of these unfavourable conditions – the apparently problematic operationalization of worldviews and the analysis setup of joining a rather specific outcome variable and the rather abstract worldview construct – finding a significant association is in fact rather encouraging and underlines the importance of considering worldviews in future research on acceptance of RET. Cultural orientation has been shown to be a significant predictor in explaining individuals' engagement with a variety of issues. Given the strength of the effects shown for cultural orientation in predicting related issues such as environmental concern, risk perception of novel technologies and climate change it is interesting that this theory has not yet attracted more attention with regards to social acceptance of RET.

Beside the inclusion of worldviews, a further unique aspect of this study was, that it used an acceptance measure investigating what, relying on Wüstenhagen et al.'s [6] classification of social acceptance, could be deemed a hybrid of socio-political and community acceptance and what in direct translation might best be described as support. Our intention in this regard was to avoid the pitfall of the above-reported studies that found high acceptance at the general level, while concretized forms of acceptance or support appeared to be significantly lower, without having to rely on an existing or projected RET in the vicinity of our respondents. Additionally this type of measurement avoided the normative character of asking for acceptance rather than support. Despite this considerations, the above discussion of temporal and spatial aspects of acceptance and the various forms of engagement with RET, from acceptance to support, hint at other issues worth addressing in future research work. Still, for nationally representative measurements of RET acceptance, we would expect that our acceptance measure will yield a higher external validity when compared to other acceptance measures in this line of research.

5.2. Conclusion

Building on extant literature on social acceptance of RET and integrating insights from scholarly work on risk perception this paper conjointly examines social-psychological variables such as beliefs, motives and cultural worldviews and their relationship with social acceptance of RET. In summary, this research was able to show that belief and motives related to RET significantly predict the extent to which a person indicates to accept the siting of RET in the local community and that a communitarian-egalitarian worldview is associated with acceptance of RET in the neighbourhood. This latter finding however seems to be restricted to acceptance of wind power and the aggregate acceptance measure for wind power and photovoltaics. To our best knowledge this is the first research effort to look at the relationship of worldviews and acceptance of RET. As such, it offers a valuable first look at the effect of these variables to serve as a reference point for future research efforts, which aim at expanding this theoretical stock. For future studies, it is worthwhile considering cultural worldviews as a theoretical construct, relying on a more extensive measurement and, if necessary, on one that is adapted to the cultural context it is used in.

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Appendix A

Table A.1
Measurement scales and items with factor loadings.

Scales/Items	Factor loadings
RET belief (α = 0.60)	
In 20 years, electricity from solar energy (photovoltaic) will cost the same or less as conventional power (grid parity).[a]	0.756
In the year 2050, each object (e.g. electric devices) will produce the power it needs on its own.	0.738
Renewable energy technologies enable future economic growth without an increase of climate-damaging CO_2 emissions.	0.727
RET scepticism[a]	
I believe, that the production of solar cells consumes more energy than they later produce.	0.828
Austria will never get along without fossil fuels (gas, oil, coal).	0.781
RET motives[a] *(α = 0.85)*	
More independence from energy suppliers	0.790
Production of own energy	0.767
Increased security of supply	0.753

(*continued on next page*)

Table A.1 (*continued*)

Scales/Items	Factor loadings
Independence from imports of energy	0.745
Protection of the environment and the climate	0.708
Economic viability	0.701
RET extrinsic motives[a] *(α = 0.71)*	
Status symbol	0.810
Legal requirements	0.728
Attractiveness of new technology	0.723
Good experiences by friends and family	0.614
Communitarianism-egalitarianism (α = 0.44)	
Discrimination against minorities is still a very serious problem in our society.	0.790
Our society would be better off if the distribution of wealth was more equal.	0.748
The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals.	0.487
Individualism-hierarchism (α = 0.61)	
We have gone too far in pushing equal rights in this country.	0.766
The government interferes far too much in our everyday lives.	0.740
Free markets – not government programs – are the best way to supply people with the things they need.	0.731

[a] These items/scales were adapted from Ebers and Wüstenhagen [77].

Table A.2
Correlation matrix of variables in regression model.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. RET acceptance													
2. Wind power acceptance	0.88**												
3. Photovoltaics acceptance	0.81**	0.42**											
4. RET belief	0.47**	0.37**	0.43**										
5. RET scepticism	−0.13**	−0.04	−0.20**	0.00									
6. RET motives	0.36**	0.22**	0.41**	0.33**	−0.15**								
7. RET extrinsic motives	0.03	0.06	−0.01	0.19**	0.18**	0.00							
8. Communitarianism-egalitarianism	0.21**	0.17**	0.19**	0.27**	0.04	0.21**	0.22**						
9. Individualism-hierarchism	0.01	0.06	−0.06	0.12**	0.34**	0.06	0.27**	0.00					
10. Gender	−0.03	−0.03	−0.02	0.01	0.10**	0.03	0.03	0.11**	0.02				
11. Age	−0.00	−0.04	0.03	0.07*	−0.05	0.16**	−0.05	−0.03	0.04	−0.23**			
12. Education	0.05	−0.01	0.10**	−0.04	−0.19**	0.05	−0.18**	−0.04	−0.21**	0.01	−0.14**		
13. Income	0.07*	0.04	0.08*	0.04	−0.09*	0.06	−0.07*	−0.11**	−0.06	−0.16**	0.08*	0.21**	
Mean	3.07	2.89	3.25	2.73	2.46	4.13	3.03	2.83	2.87	–	45.03	–	2735.95
SD	0.70	0.91	0.75	0.66	0.70	0.66	0.77	0.60	0.60	–	14.12	–	1430.17

Note: $N = 1000$.
* Correlation significant at $p < 0.05$ (two sided).
** Correlation significant at $p < 0.01$ (two sided).

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