

# Acceptance of regenerative energies: the importance and the measurement of scepticism

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## Abstract:

In literature [1] acceptance plays a key role in projects that deal with renewable energies. Stakeholders have to implement responsible decisions about technological and sustainable issues, which depend on interest groups and other parts of the population. To ensure that the project (e.g. building a new wind craft system) is not condemned to failure, it is important to evaluate the acceptance of everyone involved in the project. A lot of publications have claimed the NIMBY (Not-In-My-Backyard) syndrome influences acceptance. The NIMBY describes the opinion of people who generally support renewable energies up until e.g. the biogas plant is to be built near their houses. New literature [2] points to the Place Identity effect as a replacement for the NIMBY. Place Identity describes the responsibility of a population in the way of connectedness of someone with his or her home. Recent publications [3], [4] also suggest that the handling of scepticism is an important factor for successful renewable energy projects. This is based on findings which show that pro-renewable energy subjects were less active in supporting the project than contra-renewable subjects were in block the project. A promising component for successful renewable energy projects could be the identification of those subjects and to gain their support. This study focuses on the issue of identifying personality factors and their relation to acceptance of renewable energies. In [5] a questionnaire to measure professional scepticism was presented. This questionnaire was translated into German and the predictive value of scepticism was tested in N=237 subjects from Switzerland in an online assessment. Factor analysis, item analysis and univariate regression were calculated. Results show an approximate fit to the suggested dimensions from [5]. It seems that scepticism is not or only a marginal significant predictor for attitudes towards renewable energies. Results are discussed in the framework of acceptance of renewable energy projects.

## Keywords:

Acceptance, Renewable Energy Projects (REPs), Scepticism, Measurement, Predictor, Attitude

## 1. Introduction

### 1.1. Why renewable energy projects fail

Projects in the field of renewable energies (REPs) are highly dependent on the support of various stakeholders, interest groups and parts of the population. According to literature [1], social acceptance plays a key role for the successful implementation of such projects. Although surveys on public acceptance generally show high levels of support for regenerative energy technologies, many such projects fail [1], [6]. In Switzerland for example, a planned wind craft project in Appenzell [7] failed because of local resident resistance. Reasons were concerns about negative impacts on the landscape and the system's insufficient power production due to its unfavourable position. A biogas

plant project in Reiden [8], [9] faced similar problems and was stopped because of resident's fear of increased traffic volume due to biomass transportation to the plant. In Basel [10] a project was cancelled after drilling for a geothermal power plant triggered an earthquake measuring 3.4 on the Richter scale.

In the literature different reasons for the above-mentioned resistance are discussed. Several publications have claimed that the so-called Not-In-My-Backyard (NIMBY) syndrome to influence public acceptance. The NIMBY phenomenon describes that people generally support wind power or other renewable energies, but show resistance when the plants are to be built near to the area where they live. According to [6], the phenomenon is conventionally considered a reason for people's opposition towards facility siting. In the past, the syndrome has been studied when infrastructure facilities (e.g. siting of hazardous waste facilities), as well as social facilities (e.g. aids nursing homes) were concerned. In the field of renewable energies, the phenomenon has mainly been used to explain resistance against wind power plants where NIMBY has been seen as a main factor for opposition towards turbine siting [6].

However, new research [11] has criticised the NIMBY approach claiming that it is too limited to explain opposition. Instead, the authors emphasise local issues like *place attachment* and *place identity* as being more influential with regard to the acceptance of REPs. According to them, the acceptance of such projects depends on how subjects perceive their own place of residence and how connected they feel to it; in other words, how strong their emotional attachment to the place is. Consequently, according to [2], social acceptance of specific REPs is lower as such projects pose a threat to people's place identity.

## **1.2. The role of scepticism**

In addition to the above-described theories, concepts of scepticism have been suggested to be an important factor for the success of REPs [3], [4]. A study conducted by the University of Zurich [4] analysed personal and project specific factors concerning their influence on the local acceptance of wind energy projects in five Swiss communities. One of the findings was the classification of respondents into three groups concerning their attitudes towards wind energy projects: supportive, sceptic and indecisive. Sceptical people rejected all wind energy projects presented in the study. Moreover, the study revealed that sceptical subjects showed a significant higher procedural willingness to participate in activities against wind energy projects (e.g. by participating in information events or voting), compared to supportive or indecisive subjects. Even though sceptics seldom represent a majority (only 12% of all respondents in the study from University of Zurich), there is the possibility that they dominate the planning process of wind energy projects or even block its implementation. They are therefore more likely to endanger a REP because of their higher active involvement, even though the majority of inhabitants support it. Furthermore, the authors find that sceptics may be hard to influence and convince since they reported to not be influenced by politics or relevant companies.

The above-described findings about scepticism clearly show the concept's importance in the context of REPs and policies. It becomes clear that sceptical subjects could pose a potential risk for REPs by dominating or hindering any stage of the process. On this basis the ability to identify such subjects is considered very valuable and a promising next step towards the successful implementation of REPs. A 'measurement' of scepticism would make it possible for project owners, communities or other stakeholders to identify sceptics in order to deal with them in an appropriate way. In this study, we set the focus on the identification of such groups.

## **1.3. A possible way towards the measurement of scepticism**

According to [12] scepticism is defined as doubtfulness, reluctance, concern or incredulity. A sceptic is therefore a rather distrustful person who tends to weigh facts and information. [13] defines the word 'sceptical' with 'not easily convinced, having doubts or reservations'. Some authors [5] generally define scepticism as the opposite of trust.

Different studies have dealt with different types of scepticism while all share the goal of developing scepticism assessment scales. Therefore, several scepticism scales exist in the field of market research [14], [15], Corporate Social Responsibility (CSR) [16] and climate change [17]. These scales all aim to assess scepticism towards one specific topic. Scales, which specifically assess scepticism towards renewable energies, do not exist yet. In the framework of her study, Hurtt [5] developed and validated a questionnaire to assess professional scepticism for auditing in the accounting profession. The scales of Hurtt's [5] instrument are based on a theoretical model on professional scepticism which was originally developed by Hurtt, Eining and Plumlee (cited by [5]). This model, in turn, is based on broad psychological and philosophical literature on scepticism and includes six individual characteristics: curiosity, self-confidence, interpersonal understanding, questioning, self-determining and deliberating. Curiosity is described as searching for knowledge and investigation. It differs from questioning, which has nothing to do with personal investigation but is characterised as a requirement for reasons, evidence, justification or proof. For people to dare to act on their curiosity and questioning self-confidence is necessary. Interpersonal understanding is described as a more specific type of curiosity, namely the curiosity regarding people. Self-determining characterizes the reluctance to accept other peoples' statements or claims. Deliberating is defined as reflective decision-making. The instrument consists of six scales (representing the above-mentioned elements), 30 items and has been validated with 200 business students and professional accountants.

Hurtt's [5] instrument has been proven to suitably measure professional scepticism and is, due to its broad scope, considered as a promising approach to assess scepticism in the field of renewable energies.

#### **1.4. Aim of the study & research questions**

This study aims to replicate and validate Hurtt's [5] questionnaire on scepticism in the German-speaking area of Switzerland with items translated into German. Furthermore, the study aims to test for the predictive value of scepticism with regard to attitudes towards five renewable energy forms: biomass power, geothermal energy, solar power, wind power and hydropower.

Based on this, the following two scientific research questions were derived:

- Is it possible to reproduce the factor structure and reliability of Hurtt's [5] scales measuring scepticism in the German-speaking area with German items?
- What influence does scepticism have on attitudes towards renewable energies?

## **2. Methodology**

### **2.1. Sample description**

The sample includes a total of  $N = 246$  subjects, of which 237 were included in the final statistical calculations. The average age was  $M = 35.1$  ( $SD = 13.05$ ) years ranging from 16 to 90. The sample is divided into 131 (55.27%) females and 106 males (44.73%). 230 people are Swiss residents and seven are German. The sample comprises subjects from all cantons in Switzerland, whereby the majority (53.6%) is from the cantons Zurich and Bern. Half of the sample (50.6%) is employed, one third (31.6%) are students and nearly half (48.5%) hold a Bachelor's degree or even higher qualifications. 50.6% reported that they are in the lowest income category.

### **2.2. Questionnaire**

The questionnaire, which was conducted within the framework of this study, consists of eight different parts and was created with the online tool Unipark from QuestBack. It starts with demographic questions, which are followed by Hurtt's [5] scepticism instrument (see description in section 1.3). As described above, Hurtt's scale was considered most suitable to assess scepticism in the field of renewable energies, due to its broad and holistic scope, and because the development of a new scale was not possible in the framework of this study. In order to apply Hurtt's [5] scales in

Switzerland a German-English bilingual English native speaker translated all 30 items into German. The items consist of statements which allow to express one's subjective level of agreement on a six-point Likert scale (1 = fully disagree, 6 = fully agree). The following sequence included a short video<sup>1</sup> where all five renewable energy forms (biomass power, geothermal energy, solar power, wind power and hydropower) were introduced. The aim of the video was to give a quick and neutral overview of the different technologies and how they work while at the same time creating a common knowledge base among the participants. The video was followed by a question about the general attitude towards renewable energies and a rating sequence where the five energy forms were to be ranked with regard to rejection (1 = most rejected energy form, 5 = least rejected energy form). After that, one question was asked about the attitude towards the energy form, which has been ranked as the most rejected energy form, as well as two questions, which assessed the respondent's subjective level of knowledge about this energy form. The last sequence presented a collection of possible concerns about the most rejected energy form by expressing agreement or disagreement on a five-point Likert scale. In this sequence, each subject was only questioned regarding the energy form which he or she had rejected the most.

The assessment and analysis of the above-mentioned rating and concerns about the most rejected energy form are not part of this paper and are dealt with in detail in [18]. This paper is specifically aimed at the replication and validation of the scepticism instrument developed by Hurtt [5] and the investigation of the influence of scepticism on attitudes towards renewable energies. This includes both the influence on the attitude towards renewable energies in general as well as the attitude towards the most rejected energy forms. In addition, the predictive value of particular scepticism characteristics was tested.

## 2.3. Data collection

The link to the questionnaire was distributed via mailing list to all students and staff from the institute Human in Complex Systems at the School of Applied Psychology. The link was also posted on social media platforms of the School and 'EnergieSchweiz' as well as the entire social network of the research team. The survey was accessible for two weeks and its completion took about 10 minutes. Participation was on a voluntary basis and the survey was completely anonymous. It was possible to stop filling out the questionnaire and resume at a later time.

## 2.4. Data analysis

### 2.4.1. Factor analysis & reliability analysis

Statistical analysis was performed using SPSS statistics software. In order to replicate Hurtt's [5] scepticism instrument an exploratory factor analysis (EFA) was conducted using oblique rotation (direct oblimin). Prior to this, prerequisites were tested by calculating the KMO (Kaiser-Meyer-Olkin) coefficient and applying the Bartlett test. The KMO tests for the regression model adequacy by calculating substantial correlations between the items. Since Hurtt [5] does not specify which method she applied when conducting the EFA, a theory driven decision for PCA (principal component analysis) according to [19] was made. Factor extraction was based on eigenvalue criterion (according to which factors with an eigenvalue > 1 are extracted), scree plot criterion and on the rotated pattern matrix. For a better clarity, factor loadings < 0.3 were suppressed. Following the factor analysis, a reliability analysis was conducted in order to check the internal consistency of all derived factors. For this purpose, Cronbach's alpha values and item-total correlations were calculated. One factor could not be tested for internal consistency since it consisted only of two items after factor analysis (questioning). In total, two Items with item-total correlations lower than  $r_{it} < 0.4$  were deleted. The elimination was carried out in accordance with respective literature [19-22] and by considering item content and higher predicted Cronbach's alpha values after the deletion.

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<sup>1</sup> Accessible under <http://www.youtube.com/watch?v=KWlh2EBbx8s>, minute 2:06 to 3:50.

## 2.4.2. Regression analysis

The subsequent univariate linear regression analysis aimed at examining the predictive value of scepticism on the attitude towards renewable energies. In order to operationalise scepticism two independent variables were created: a sum score (total of reached points in the scepticism questionnaire) and a scepticism dummy variable by which respondents were divided into groups of sceptics and non-sceptics (done by a median split). A test for normal distribution was conducted (Kolmogorov-Smirnov test), followed by a Mann-Whitney U test in order to check for significant differences between the two groups. Another three independent variables were created by calculating mean values of those scales from Hurtt [5] whose factor structure could be confirmed in the factor analysis (self-confidence, deliberating & interpersonal understanding). Dependent variables were the attitudes towards renewable energies in general and attitudes towards the five specific renewable energy forms (biomass power, geothermal energy, solar power, wind power and hydropower). Since each subject only answered questions regarding his or her most rejected energy form, another dependent variable was created which summarised the attitudes towards all specific energy forms. In total, 35 regressions were calculated and alpha-failure cumulation was corrected (Bonferroni correction). The regression analysis design is illustrated in Fig. 1.

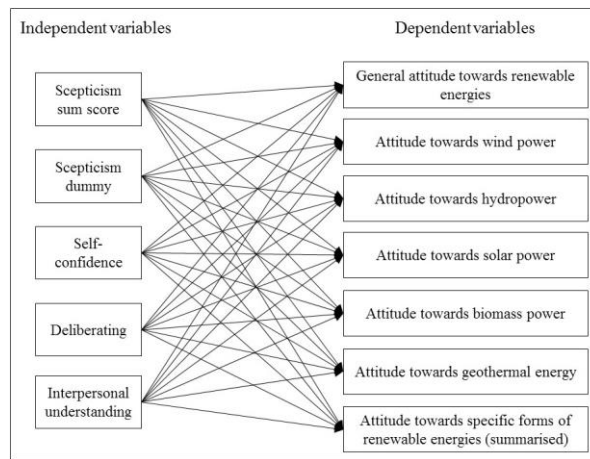


Fig. 1. Regression analysis design

## 3. Results

### 3.1. Factor structure

EFA gave a value of 0.821 for the Kaiser-Meyer-Olkin (KMO) measure of model adequacy indicating high substantial correlations between the items. The Bartlett test showed significance at  $p = 0.001$  significance level. Taken together this indicates that the 30 items are suitable for factor analysis. Both the eigenvalue criterion and the scree plot criterion indicate a seven-factor solution to be the most suitable for explaining the variability in the data. The seven factors extracted accounted for nearly 64% of the total variance. Factor loadings for the seven-factor solution are illustrated in Table 1. The factor structure revealed a full confirmation of three of Hurtt's [5] scepticism characteristics (self-confidence, deliberating & interpersonal understanding), whereas two could only be partially confirmed since one item of each factor loaded on another factor (self-determining & questioning). One characteristic could not be confirmed at all because it was split into two factors (curiosity 1 & curiosity 2).

### 3.2. Internal consistency

Reliability analysis revealed an overall Cronbach's alpha value of  $\alpha = 0.857$  for all factors deriving from the factor analysis. The values for single components range between  $\alpha = 0.633$  and  $\alpha = 0.885$  and show item-total correlations between  $r_{it} = 0.307$  and  $r_{it} = 0.808$  after deletion of two items (as

described above). All Cronbach's alpha values and item-total correlations are summarised in Table A.1 in Appendix A. The two deleted items are labelled with (D).

### 3.3. Regressions

The Kolmogorov-Smirnov test showed no normal distribution and the subsequent Mann-Whitney U test was significant at  $p = 0.05$  significance level. Consequently, the two groups created by median split (sceptics and non-sceptics) differed significantly from each other. The sum score's median lay at 139 (out of 180); therefore subjects with a value  $> 139$  were defined as sceptics and subjects with a value  $\leq$  as non-sceptics. Univariate linear regression analysis revealed several significant relationships between the scepticism sum score, respectively scepticism dummy variable, and the attitude towards renewable energies. There were marginal significances at  $p < .10$  significance level between scepticism sum score and attitude towards hydropower (.070), scepticism dummy variable and attitude towards hydropower (.092) and between deliberating and attitude towards biomass power (.080). Significances at  $p < .05$  significance level were found between interpersonal understanding and general attitude towards renewable energies (.016), interpersonal understanding and attitude towards geothermal energy (.049) and between self-confidence and attitude towards solar power (.020). Tables 2 and 3 give an overview over the results deriving from the regression analysis. Bonferroni correction revealed a new significance level of  $p < .001$ . When the results were adjusted accordingly, there were no significant relationships anymore.

*Table 1. Factor loadings for seven-factor solution with oblique rotation (direct oblimin)*

Factor	Loaded items	Loading
1	Ich finde Lernen aufregend.	.901
Curiosity 1	Ich lerne gerne.	.824
	Die Aussicht, etwas zu lernen, begeistert mich.	.785
	Neue Informationen zu entdecken macht Spass.	.611
2 Deliberating	Ich entscheide mich ungern, wenn ich noch nicht alle verfügbaren Informationen in Betracht gezogen habe.	.850
	Ich nehme mir Zeit beim Entscheiden	.794
	Bevor ich eine Entscheidung treffe, stelle ich gerne sicher, dass ich alle verfügbaren Informationen berücksichtigt habe.	.809
	Ich warte mit dem Treffen von Entscheidungen über Sachverhalte ab, bis ich mehr Informationen dazu habe.	.786
	Ich mag es nicht, wenn ich schnell Entscheidungen treffen muss.	.677
3 Interpersonal understanding	Das Verhalten von anderen Leuten interessiert mich nicht.	-.776
	Menschliches Verhalten, sowie die Gründe dafür, finde ich faszinierend.	-.677
	Ich frage mich selten, wieso sich Leute auf eine gewisse Art und Weise verhalten.	-.624
	Mich interessieren die Ursachen, die dazu führen, dass sich Menschen so verhalten wie sie sich verhalten	-.609
4 Self-determining	Ich versuche die Gründe für das Verhalten anderer Menschen zu verstehen.	-.558
	Ich akzeptiere oft Erklärungen von anderen Leuten, ohne weiter darüber nachzudenken	.719
	Es ist für andere Leute einfach, mich zu überzeugen.	.691
	Ich tendiere dazu, Sachen, die mir andere Leute sagen, sofort hinzunehmen.	.629
	Meistens stimme ich dem zu, was meine Gruppe denkt	.607

	Ich nehme Sachen, die ich sehe, lese oder höre üblicherweise „für bare Münzen“	.490
5 Self- confidence	Ich bin selbstbewusst	.889
	Ich habe viel Selbstvertrauen	.862
	Ich habe kein Vertrauen in mich.	.829
	Ich bin grundsätzlich zufrieden mit mir.	.792
6 Curiosity 2	Ich habe Vertrauen in meine Fähigkeiten.	.750
	Es macht mir Spass, herauszufinden, ob etwas Gelesenes oder Gehörtes wahr ist oder nicht.	-.684
	Ich recherchiere gerne nach neuen Information.	-.552
	Ich akzeptiere Aussagen nur, wenn ich Beweise dafür habe, dass diese stimmen	-.514
7 Questioning	Normalerweise merke ich, wenn eine Erklärung widersprüchlich ist.	-.329
	Ich hinterfrage oft Dinge, die ich gesehen oder gehört habe.	-.728
	Meine Freunde sagen mir, dass ich Gesehenes oder Gehörtes oft hinterfrage	-.682

Table 2. Univariate linear regressions between scepticism sum score & scepticism dummy variable and attitude

Dependent variable	Independent variable	R <sup>2</sup>	R <sup>2</sup> corr.	Beta	Sig.
General attitude towards RE	Sum score	.006	.002	.076	.242
	Scepticism dummy	.007	.003	-.083	.203
Attitude towards wind power	Sum score	.000	-.028	-.010	.955
	Scepticism dummy	.020	-.008	.143	.399
Attitude towards hydropower	Sum score	.135	.098	.368	.070†
	Scepticism dummy	.119	.080	-.344	.092†
Attitude towards solar power	Sum score	.000	-.050	.008	.972
	Scepticism dummy	.034	-.012	-.184	.400
Attitude towards biomass power	Sum score	.005	-.005	-.071	.477
	Scepticism dummy	.000	-.010	.003	.980
Attitude towards geothermal energy	Sum score	.006	-.014	.078	.580
	Scepticism dummy	.101	-.010	-.101	.475
Attitude towards specific forms of RE (summarised)	Sum score	.001	-.004	-.026	.689
	Scepticism dummy	.000	-.004	-.010	.881

RE, renewable energies. Significances at: †p < .10, \*p < .05, \*\*p < .01, \*\*\*p < .001.

Table 3. Univariate linear regressions between specific scepticism characteristics and attitude

Dependent variable	Independent variable	R <sup>2</sup>	R <sup>2</sup> corr.	Beta	Sig.
General attitude towards RE	Self-confidence	.001	-.003	.029	.653
	Deliberating	.000	-.004	-.020	.758
	Interpersonal underst.	.025	.020	.157	.016*
Attitude towards wind power	Self-confidence	.034	.006	-.184	.277
	Deliberating	.063	.036	.251	.134
	Interpersonal underst.	.042	.015	.205	.223
Attitude towards hydropower	Self-confidence	.007	-.036	-.085	.686

	Deliberating	.065	.025	.255	.218
	Interpersonal underst.	.000	-.043	.006	.978
Attitude towards solar power	Self-confidence	.231	.194	.480	.020*
	Deliberating	.121	.079	-.348	.103
	Interpersonal underst.	.001	-.047	.027	.903
Attitude towards biomass power	Self-confidence	.000	-.010	-.006	.951
	Deliberating	.030	.020	-.173	.080†
	Interpersonal underst.	.004	-.006	.061	.539
Attitude towards geothermal energy	Self-confidence	.000	-.020	-.016	.910
	Deliberating	.001	-.019	.033	.819
	Interpersonal underst.	.075	.057	.274	.049*
Attitude towards specific forms of RE (summarised)	Self-confidence	.001	-.003	-.032	.624
	Deliberating	.006	.002	-.076	.244
	Interpersonal underst.	.010	.006	.101	.122

RE, renewable energies. Interpersonal interest. Interpersonal understanding. Significances at: † $p < .10$ , \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

## 4. Discussion

The present study emphasises the importance of acceptance for renewable energy projects. It introduces examples for Swiss projects, which failed because of residents' resistance and provides literature based explanations (NIMBY, place attachment & place identity). In this context, the study particularly highlights the important role of scepticism and points out the benefit, which an identification of sceptics would bring. A possible way of measuring scepticism is introduced by presenting Hurtt's [5] questionnaire on professional scepticism which is considered a promising approach to assess scepticism in the field of renewable energies. Consequently, this study aimed to replicate and validate Hurtt's [5] questionnaire in the German speaking area of Switzerland with items translated into German. Furthermore, it aimed to test for the predictive value of scepticism with regard to attitudes towards renewable energies. This study represents one part of a research project and refers to data gathered in an online questionnaire, which was completed by 237 subjects. An exploratory factor analysis (EFA), a reliability analysis and univariate linear regression analyses were used to analyse the data and the results were presented.

### 4.1. Replication of the scepticism questionnaire

EFA and reliability analysis indicated a successful replication of Hurtt's [5] instrument in the German speaking area with German items by showing an approximate factor structure and similar Cronbach's alpha values. Nevertheless, some distinct differences were detected. In this study, three of Hurtt's [5] factors were confirmed completely: self-confidence, deliberating and interpersonal understanding. Two factors could be partly confirmed, whereby one item of each factor showed loadings on another factor (self-determining & questioning). One factor could not be confirmed since it split into two sub-factors (curiosity). Consequently, this study revealed a seven-factor solution compared to Hurtt's [5] six-factor solution. Reasons for this discrepancy in factor structure could lie in cultural differences between the USA and Switzerland and differences in language usage caused by item translation. The translation of the questionnaire from English into German, although carried out by a German-English bilingual English native speaker, could have caused changes in the semantic content of certain items, which in turn could have led to a different answering behaviour. Future conduction of the questionnaire in the German speaking area would require a more profound analysis of the item's exact semantic meaning after translation. Another reason for the discrepancy in factor structure could lie in the fact that Hurtt [5] used two different curiosity inventories (Melbourne Curiosity Inventory MCI & State-Trait Personality Inventory



STPI) for the development of her curiosity scale. This could explain the split of the curiosity factor into two sub-factors. From the authors' point of view the item content of factor 'curiosity 2' seems to reflect aspects of 'critical consideration' more than curiosity.

After the elimination of two items, reliability analysis revealed an overall Cronbach's alpha value of  $\alpha = 0.851$  which is nearly as high as Hurtt's [5] value ( $\alpha = 0.860$ ). The single factors reach slightly lower Cronbach's alpha values than Hurtt [5] (between  $\alpha = 0.696$  and  $\alpha = 0.885$ ), but are still seen as good values indicating high internal consistency according to [20]. Only one factor ( $\alpha = 0.633$ ) falls under the critical mark of  $\alpha = 0.650$  according to [21]. Item-total correlation values lie within the optimal range of  $r_{it} = .4$  and  $r_{it} = .7$  according to [22] or slightly higher. Two items with item-total correlations  $r_{it} < .4$  were deleted since Cronbach's alpha was predicted to be significantly higher after elimination and item content allowed for deletion. This finally resulted in a 28-item solution compared to Hurtt's [5] 30 items. In summary, it can be concluded that it was possible to replicate Hurtt's [5] scepticism instrument in the German speaking area. However, the described differences have to be noted.

## 4.2. Predictive value of scepticism

Univariate linear regression analysis revealed several significant relationships between scepticism and attitude towards renewable energies. A marginal influence at  $p < .10$  exists between scepticism sum score and attitude towards hydropower (.070), between scepticism dummy variable and attitude towards hydropower (.092) and between deliberating and attitude towards biomass power (.080). Significant influences at  $p < .05$  exist between interpersonal understanding and general attitude towards renewable energies (.016), between interpersonal understanding and attitude towards geothermal energy (.049) and between self-confidence and attitude towards solar power (.020). In summary, when scepticism is considered as a whole (operationalised by sum score and dummy variable) it only shows marginal influences on the attitude towards one specific renewable energy form: hydropower. The other detected significances involve particular sub-characteristics of Hurtt's [5] scepticism construct, such as self-confidence, deliberating and interpersonal understanding. These three relationships indicate that there is likelihood for some specific personal traits to play a role in the development of certain attitudes towards renewable energies. This could provide interesting information for project leaders or other stakeholders of renewable energy projects and could be worth to be pursued. However, at this point, it has to be mentioned that all significant results disappear after applying Bonferroni correction. It is therefore concluded that scepticism cannot be seen as a predictor for attitudes towards renewable energies in general and/or towards specific energy forms.

A possible reason for scepticism having no predictive value could lie in the applied scepticism instrument. Although it was possible to replicate the questionnaire in the German speaking area, Hurtt's [5] broad, six-dimensional construct of scepticism could be too generic for specifically measuring scepticism towards renewable energies. Another methodical approach might be necessary in order to capture this specific kind of scepticism. This could include the development of a particular scepticism instrument by antecedent qualitative research on scepticism characteristics with regard to renewable energies (e.g. by conducting interviews or focus groups) and subsequent item formulation. Equally possible, however, is that the scepticism construct may be unsuitable to be measured by a questionnaire at all and that completely other methods would be required for its assessment (e.g. implicit association test). On the other hand, it may also be that factors other than scepticism could have a much stronger predictive value on attitudes towards renewable energies (e.g. related constructs such as fear, worry or doubt). Or it might be possible that emergence deriving from different constructs is responsible for a certain influence on attitudes. All these considerations should be taken into account when conducting future research in this area.

Another reason for scepticism not to be a predictor can be seen in the fact that this study's sample consisted of only a few distinctive sceptics. As claimed in other studies [1], [6], social acceptance of renewable energies among population is generally very high. Consistent with these findings, this study revealed very similar results: respondents report to have a very positive general attitude

towards renewable energies. Moreover, they show high values in attitudes towards their most rejected energy form (for detailed results see [18]). Consequently, the sum score may not represent explicitly sceptic people and the median split may only be able to divide people into non-sceptics and slight sceptics on an absolute scale.

A third reason could lie in the small sample number ( $N = 237$ ), particularly among the specific renewable energy questions. Since each subject was limited to answer only his or her most rejected energy form with regard to attitude, this led to very small case numbers within these forms (e.g. attitude towards solar power  $N = 22$ ). It is a well-known phenomenon that the chance for significance is reduced the smaller  $N$  is.

The fact that scepticism cannot be seen as a predictor for attitudes towards renewable energies stands in contrast to [4], who clearly emphasises the important role of sceptics for the success of renewable energy projects. In addition to the above-described reasons, the focus on sceptics might not appear to be the right approach towards successful energy projects. Maybe it would be more reasonable to desist from sceptics and to focus on the potential of supportive and indecisive people instead. In this context, it could be interesting to explore how supporters could be won or indecisive people could be mobilised to show higher involvement in renewable energy projects.

## 5. Limitations and further research

As mentioned above, Hurtt's [5] scepticism scale might not be the right instrument to measure scepticism with regard to attitudes towards renewable energies. For future research, it would be interesting to investigate other methods to capture scepticism or even identify factors other than scepticism, which could have an influence on attitudes. In this context, the determination of discriminant and convergent validity might be helpful. On the one hand, this could show to which degree the instrument is able to differentiate between scepticism and other constructs (e.g. fear) and on the other hand, it could examine how well scepticism can be measured with different methods.

The fact that there were only a few sceptics in the sample limited the usefulness of the sum score and median split as real sceptics might show different patterns. Further research, which aims to test the predictive value of scepticism, should therefore take this factor into account when putting together the sample pool. The introduction of a defined scepticism reference value would further support this approach by providing orientation for the identification of sceptics.

When considering this study with regard to representativeness, sample size and sample composition must be claimed as limitations. A sample size of  $N = 237$  subjects cannot be considered representative for Switzerland. In addition, the sample composition was primarily composed of students and highly qualified people, as well as low-income subjects with the majority coming from the two cantons Bern and Zurich. Since this study is rather explorative in nature, a replication study with a much bigger sample size would be of high interest.

Most studies on acceptance of renewable energies exclusively consider one particular energy form for their analyses. The inclusion of several renewable energy forms can be considered a strength of this study. However, two things could have distorted the data: firstly, there was no distinction between different types of energy forms (e.g. no differentiation between hydraulic power stations and dams with regard to hydropower). As a consequence respondents might have answered the questions with one particular type in mind. Secondly, despite the short informational video, knowledge levels about specific renewable energy forms could have differed between respondents, which also could have influenced their attitude. For future research, it could therefore be helpful to specify the type of energy forms and creating a more equal knowledge base between all respondents.

## 5. Conclusion

This study replicated an existing scepticism questionnaire developed by Hurtt [5] in the German speaking area and tested the predictive value of scepticism with regard to attitudes towards

renewable energies. The replications revealed an approximate factor structure and slightly lower Cronbach's alpha values, for which cultural differences and translated items are presumed responsible. Regression analysis shows no significant relationships between scepticism and attitudes after Bonferroni correction indicate that scepticism is not a predictor. Reasons could lie in the scepticism instrument, the few sceptics in the sample and sample size in general. The findings therefore provide indications for a possible refutation of the assumption that sceptics play a central role for the success of renewable energy projects.

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## Appendix A. Supportive table for the factor analysis

*Table A.1 Item-total correlations and Cronbach's alpha for all factors*

Factor	Items	Item-total correlation $r_{it}$	Cronbach's alpha $\alpha$
1 Curiosity 1	Ich finde Lernen aufregend.	.717	.871
	Ich lerne gerne.	.805	
	Die Aussicht, etwas zu lernen, begeistert mich.	.608	
	Neue Informationen zu entdecken macht Spass.	.789	
2 Deliberating	Ich entscheide mich ungern, wenn ich noch nicht alle verfügbaren Informationen in Betracht gezogen habe.	.566	.850
	Ich nehme mir Zeit beim Entscheiden	.637	
	Bevor ich eine Entscheidung treffe, stelle ich gerne sicher, dass ich alle verfügbaren Informationen berücksichtigt habe.	.727	
	Ich warte mit dem Treffen von Entscheidungen über Sachverhalte ab, bis ich mehr Informationen dazu habe.	.741	
	Ich mag es nicht, wenn ich schnell Entscheidungen treffen muss.	.536	
3 Interpersonal understanding	Das Verhalten von anderen Leuten interessiert mich nicht.	.441	.804
	Menschliches Verhalten, sowie die Gründe dafür, finde ich faszinierend.	.663	
	Ich frage mich selten, wieso sich Leute auf eine gewisse Art und Weise verhalten. (D)	(.373)	
	Mich interessieren die Ursachen, die dazu führen, dass sich Menschen so verhalten wie sie sich verhalten	.744	
	Ich versuche die Gründe für das Verhalten anderer Menschen zu verstehen.	.665	
4 Self-determining	Ich akzeptiere oft Erklärungen von anderen Leuten, ohne weiter darüber nachzudenken	.456	.696
	Es ist für andere Leute einfach, mich zu überzeugen.	.507	

	Ich tendiere dazu, Sachen, die mir andere Leute sagen, sofort hinzunehmen.	.536	
	Meistens stimme ich dem zu, was meine Gruppe denkt	.343	
	Ich nehme Sachen, die ich sehe, lese oder höre üblicherweise „für bare Münzen“	.428	
5	Ich bin selbstbewusst	.808	.885
Self-confidence	Ich habe viel Selbstvertrauen	.761	
	Ich habe kein Vertrauen in mich.	.688	
	Ich bin grundsätzlich zufrieden mit mir.	.661	
	Ich habe Vertrauen in meine Fähigkeiten.	.703	
6	Es macht mir Spass, herauszufinden, ob etwas Gelesenes oder Gehörtes wahr ist oder nicht.	.528	.633
Curiosity 2	Ich recherchiere gerne nach neuen Information.	.510	
	Ich akzeptiere Aussagen nur, wenn ich Beweise dafür habe, dass diese stimmen	.307	
	Normalerweise merke ich, wenn eine Erklärung widersprüchlich ist. (D)	(.259)	
7	Ich hinterfrage oft Dinge, die ich gesehen oder gehört habe.	-	-
Questioning	Meine Freunde sagen mir, dass ich Gesehenes oder Gehörtes oft hinterfrage	-	-

(D), deleted.

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