Energy Policy 97 (2016) 310–320

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany

Sarah Salm*, Stefanie Lena Hille, Rolf Wüstenhagen

University of St.Gallen, Institute for Economy and the Environment, Tigerbergstrasse 2, CH-9000 St. Gallen, Switzerland

HIGHLIGHTS

- Out of 1,990 retail investors surveyed, 1,041 express interest to invest in renewables.
- Two target segments are identified, "local patriots" and "yield investors".
- "Local patriots" are willing to forgo return on investment in local projects.
- Solar photovoltaic is most popular technology, followed by wind and small hydro.
- Majority of investors use simple payback calculation or decide intuitively.

ARTICLE INFO

Article history:
Received 2 February 2016
Received in revised form
20 July 2016
Accepted 22 July 2016
Available online 30 July 2016

Keywords:
Community finance
Energy cooperative
Choice experiment
Social acceptance
Investment decision
Retail investor

ABSTRACT

Citizens own nearly half the renewable energy generation capacity in Germany and have been important drivers of the country's energy transition. In contrast to citizens' important role in financing renewable energies, the energy policy and economics literature has traditionally focused on other investors, such as incumbent energy firms. To close this gap, this paper reports on a large-scale survey of 1,990 German retail investors. Conducting a choice experiment with the subset of 1,041 respondents who expressed an interest in investing in community renewable energy projects, we present a unique dataset allowing for new insights in risk-return expectations of retail investors. We find that apart from return on investment, respondents are particularly sensitive to the minimum holding period and the issuer of community renewable energy investment offerings. A minimum holding period of 10 years implies a risk premium of 2.76% points. A subsequent segmentation analysis shows that two groups of potential community renewable energy investors with different risk-return expectations can be identified: "local patriots" and "yield investors". In contrast to professional investors, a majority of retail investors use simple decision rules such as calculating payback time or relying on their gut feeling when making investments.

1. Introduction

The European Union (EU) has agreed to reduce greenhouse gas emissions by 40% and increase the share of renewable energies to at least 27% by 2030 (European Commission, 2016). Some EU member states have higher ambitions, notably with regard to the share of renewables in the electricity sector. Germany, in particular, aims at 40–45% renewable energy by 2025 and 80% by 2050. Past growth of renewables in Germany, which rose from 3.4 to 27.8% between 1990 and 2014, has largely been driven by the country's feed-in tariff, which was first introduced in 1990 (Wüstenhagen and Bilharz, 2006). As incumbent energy firms have been relatively slow to pick up on renewable energy investment opportunities, large parts of the capacity is now owned by citizens or through investments in larger funds (Trend:research and Leuphana Universität Lüneburg, 2013; Walker et al., 2010). In contrast to the important role of citizens as drivers of the German energy transition, there is a scarcity of rigorous academic research on the risk-return preferences of retail investors[1] in community renewable energy projects. Community renewable energy projects or investments[2] enable retail investors, through a third party, to purchase shares in local or nationwide renewable energy projects with the expectation of social and/or economic gains (Aitken, 2010; Musall and Kuik, 2011; Rogers et al., 2008; Trend:research

* Corresponding author.
E-mail address: sarah.salm@unisg.ch (S. Salm).

http://dx.doi.org/10.1016/j.enpol.2016.07.042
0301-4215/

[1] Retail investors are individuals who invest in renewable energy projects for their personal account, and not on behalf of a third party.

[2] The terms "community renewable energy project" and "community renewable energy investment" are used as synonyms in this paper.

and Leuphana Universität Lüneburg, 2013; Walker and Devine-Wright, 2008; Walker et al., 2010; Yildiz, 2014).

The significant gap in research literature is even more surprising as citizens are often seen as a key bottleneck to social acceptance of energy infrastructure projects, and financial participation in such projects may potentially reap a double dividend for renewable energy project developers, both in terms of closing financing gaps and improving local acceptance (Aitken, 2010; Musall and Kuik, 2011; Rogers et al., 2008; Stigka et al., 2014; Walker et al., 2010). Furthermore, large investors such as electric utilities and institutional investors face high transaction costs for small-scale decentralised renewable energies, calling for new financing models at the local level (Unruh, 2000, 2002; Walker and Devine-Wright, 2008; Yildiz et al., 2015).

Based on a large-scale survey of 1,990 German retail investors, the current paper contributes to closing a gap in the academic literature on risk-return preferences of retail investors. Using a choice experiment with those respondents who express an interest in investing in community renewable energy projects, our research objective is to identify the most important financial and non-financial factors driving retail investors' decision-making. In particular, we are interested in calculating investors' willingness to accept certain features of community renewable energy investments, such as the minimum holding period, the choice of renewable energy technology or the proximity of the project location. Finally, our aim is to identify promising target segments of potential community renewable energy investors.

The remaining part of this paper is structured as follows: Section 2 provides a brief literature review. Section 3 explains the methodological approach. Section 4 presents the results of our survey and choice experiment, including willingness to accept calculations. Section 5 concludes the paper and discusses implications for policy makers and further research.

2. Background and literature review

Over the last decade, investor perceptions of risk and return have become an important stream of research in the energy policy and energy economics literature (Dinica, 2006; Wüstenhagen and Menichetti, 2012). While initially, traditional energy investors such as electric utilities have been the focus of analysis (Stenzel and Frenzel, 2008), the rise of renewables has brought about a significant diversity in the market for energy investment (Bergek et al., 2013). For large renewable energy projects, this has led to an emerging stream of research that investigates differences between utilities and institutional investors. For example, Helms et al. (2015) explored whether utilities' higher cost of capital compared to institutional investors may explain why the former have been slow to pick up on investment opportunities in lower-risk, lower-return renewable energy projects such as solar photovoltaics under the German feed-in tariff.

When it comes to retail investors, existing research is largely limited to the description and analysis of past observations, based on revealed preferences. Previous research includes descriptive accounts of their definition and share in overall renewable energy investment (Trend:research and Leuphana Universität Lüneburg, 2013; Walker and Devine-Wright, 2008; Yildiz, 2014) and the structure as well as development of energy cooperatives and community associations in general. The focus of analysis has primarily been the characteristics of previous community renewable energy investments (e.g. technology, size, finance structure, investment volume per capita, return on investment), including a demographic analysis of existing investors (DGRV, 2013; Holstenkamp and Ulbrich, 2010; Müller and Holstenkamp, 2015; Poppen, 2015; Rauschmayer et al., 2015; Yildiz, 2014; Yildiz et al., 2015). A smaller research stream addressed the overall motivation and perceived barriers of retail investors to participate in community renewable energy projects (Bauwens, 2016; Bomberg and McEwen, 2012; Kalkbrenner and Roosen, 2016; Rogers et al., 2008; Walker, 2008).

However, there is a lack of empirical research on retail investors' risk-return preferences. An interesting angle of community financing is its potentially positive influence on social acceptance (Aitken, 2010; Musall and Kuik, 2011; Nolden, 2013; Walker et al., 2010; Warren and McFadyen, 2010; Wüstenhagen et al., 2007; Yildiz et al., 2015). This link can occur in the case of "bottom-up" community energy projects as well as when large companies allow local residents to participate financially in a renewable energy project (Aitken, 2010; Walker et al., 2010).

Complementing previous research on past observations and revealed preferences, we see particular merit in conducting research based on stated preferences. Carrying out a choice experiment in a realistic setting allowed us to measure risk-return preferences of both existing and potential future investors, while at the same time mitigating the downsides of revealed preference approaches (see Section 3.1). Finding the right formula for community participation in financing renewable energy projects is a non-trivial task, but can contribute to building trust and hence increase the likelihood of project realisation (Walker et al., 2010).

3. Methodology

3.1. *Choice of methodological approach*

We applied a stated preference approach to complement existing research on past observations and revealed preferences. More specifically, to investigate retail investors' preferences for distinctive features of community renewable energy investments, we performed an adaptive choice-based conjoint analysis (ACBC) with German retail investors. In a conjoint analysis, respondents are confronted with hypothetical, but realistic choice situations in a real-time environment to derive their utility function. Conjoint measurement methods are particularly interesting to investigate preferences for product attributes in immature markets (Louviere et al., 2000). This characteristic supports the applied methodology in our research endeavour, where only limited market data is available. In contrast, revealed preferences that ask respondents to retrieve preferences from previous actions (Kroes and Sheldon, 1988) often have to deal with social desirability (Gustafsson et al., 2007), incomplete ability to reconstruct past actions, and the difficulty to explain all facets of previous decisions (Golden, 1992).

The success of conjoint analysis, first introduced by Kruskal (1965) and Luce and Tukey (1964) in mathematical psychology, derives from the mitigation of these pitfalls. Conjoint analysis has been applied in a variety of research fields including marketing (Green and Srinivasan, 1990; Orme, 2009) and entrepreneurship (Brundin et al., 2008; Zacharakis et al., 2007). Moreover, conjoint analysis has been applied in the general investment decision literature (Clark-Murphy and Soutar, 2004; Franke et al., 2006; Hampl, 2012; Shepherd, 1999; Shepherd et al., 2003) as well as in the renewable energy investment decision literature (Chassot et al., 2014; Goett et al., 2000; Kaenzig et al., 2013; Lüthi and Wüstenhagen, 2012; Masini and Menichetti, 2013; Roe et al., 2001; Tabi et al., 2014).

There are several conjoint measurement techniques in use, such as adaptive conjoint analysis (ACA), choice-based conjoint analysis (CBC) or the latest refinement, ACBC. The last two approaches are full profile methods that create a more realistic setting wherein decision-makers evaluate complete choice objects (Elrod et al., 1992; Louviere and Woodworth, 1983). The advantage of ACBC has led to a surge in its use over the past years (Boesch and Weber, 2012; Heinzle et al., 2013; Hinnen et al., 2015; Jervis et al., 2012). In contrast to other available techniques, the ACBC methodology captures more information at the individual level. This is due to its design that adapts to each individual respondent recognising non-compensatory decision-making rules. These rules apply when respondents take decisions by first eliminating unacceptable levels from the consideration set, and then choosing among the remaining options that are in line with such cut-off rules.

3.2. Selection of investment features relevant for renewable energy investments

A qualitative pre-study, based on literature review and eight semi-structured stakeholder interviews, identified relevant attributes and levels for the ACBC design. The interviewees included community cooperative board members, project developers working together with community financing initiatives, mayors and retail investors. The interviews were conducted between June and August 2015. Based on the pre-study, five attributes were selected for the ACBC experiment, namely “return on investment”, “holding period”, “technology”, “project location”, and “partner” (see Table 1).

For the attribute return on investment, we chose to treat it as a continuous pricing attribute. With such an approach, a large number of unique prices were shown to respondents, which allowed a better estimation of the price as a continuous function. For that, we specified a return of investment base level of 4%, and then varied that level by $\pm 50\%$. This led to an overall price variation between 2% and 6%. For the remaining attributes, we decided to integrate an equal number of attribute levels per attribute to avoid a number-of-levels effect. The holding period reflects the minimum time after a retail investor can withdraw from an initial investment. We included three levels ranging from 2 years to 10 years. This allowed assessing the preferred time horizon for community renewable energy investments. For the technology attribute, we included three types of renewable energy technologies, including solar photovoltaics, wind onshore and small hydropower, allowing us to identify whether and to what extent retail investors differentiated between different technology types. This should provide insights on what type of technology would be most popular to successfully drive future community renewable energy investments. The levels of the attribute project location reflect the range of distances between retail investors' residence and the community renewable energy project. The three attribute levels were operationalized as being a “project in my neighbourhood”, a “project within state” and a “project within Germany”. This attribute allowed us to assess whether and to what extent citizens have a preference for local power generation. Finally, the partner attribute describes the financial intermediary through which a retail investor participates in a community renewable energy investment. Three different types of partners were included: a municipal utility, an energy cooperative, and a financial investor.

Table 1
Attributes and attribute levels used in the ACBC analysis.

Attributes	Description	Attribute levels
Return on investment	Return that retail investor receives on investment/deposit	• Pricing attribute ranging between 2% and 6%
Holding period	Minimum time after which retail investor can withdraw initial investment	• 2 years • 5 years • 10 years
Technology	Type of renewable energy technology	• Solar photovoltaics • Wind onshore • Small hydropower
Project location	Location of renewable energy investment in relation to retail investors' residence	• Project in my neighbourhood • Project within state • Project within Germany
Partner	Partner through which retail investor invests in renewable energies	• Municipal utility • Energy cooperative • Financial investor

3.3. Design and structure of choice experiment

We used Sawtooth Software's module SSI web to administer the survey. The overall questionnaire consisted of three parts. In the first part, respondents were asked to provide relevant background information about their investment behaviour. The second part included the core choice experiment (ACBC). In the third part, respondents were asked a set of demographic and socio-economic characteristics, including gender, age, zip code, monthly net income of household, professional education and political party preference.

Within the middle part of the survey, the ACBC in turn consisted of three sub-sections. In the first step, participants were required to build their own preferred investment (“Build Your Own”, BYO). They were asked to describe the community renewable energy investment they would be most likely to choose in real life. Respondents were invited to indicate the preferred attribute levels for holding period, technology, project location and partner. For the attribute return on investment, an a-priori preference order was set, assuming that all else being equal, respondents had no reason to prefer low returns to higher returns.

Subsequently, the survey continued with a screening task section. In this part of the ACBC survey, respondents evaluated four investment options at the same time, each described by all five attributes as illustrated in Fig. 1.

Respondents were only required to indicate which of the options they considered as a suitable investment opportunity, but they did not have to take a choice between the different alternatives (i.e. it was possible to indicate that all, only a few or none of the options were considered as suitable). In total, 24 investment options were presented to the respondents over six rounds. The investment opportunities within the screening tasks followed the BYO closely with 1–2 variations in attribute levels (Orme and Johnson, 2008). The screening tasks were used to find out whether investors applied any non-compensatory decision rules, where one attribute level that is considered as unacceptable cannot be compensated for by the existence of other desired characteristics.

In the last part of the ACBC survey (i.e. the “choice tournament”), respondents were invited to compare and take a choice between competing investment options within a choice task tournament. These options were based on previously accepted knock-out rules (Johnson and Orme, 2007). This procedure allowed decision-makers to concentrate on the remaining differences of the investment opportunity, which led to a better estimation of zero-centred utilities for the attribute levels of lower-tier important attributes (Johnson and Orme, 2007).

3.4. Data collection and data sample

A total of 2,353 survey participants were recruited from a German data access panel in the period of October to November 2015. The German data access panel lists a large pool of active users and, as it is common practice in market research, incentivises survey participants by a reward scheme. The demographic structure of the survey sample is illustrated in Table 2. 1,990 survey participants completed the survey, which corresponds to a drop-out rate of 15.43%. Slightly over half of all survey

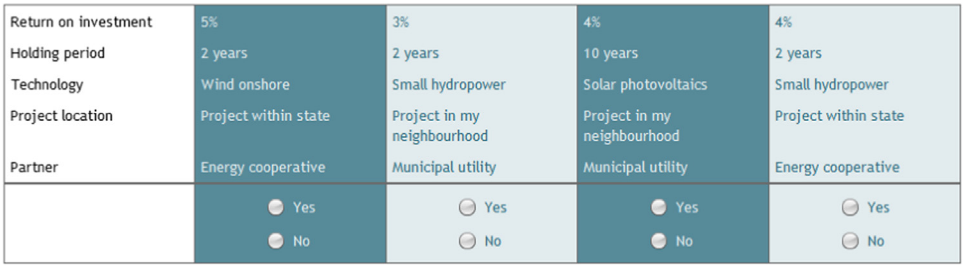

Fig. 1. Sample task from screening section of the ACBC.

participants (1,041) showed an interest in community renewable energy investments. The ACBC part of the questionnaire was only completed by those who indicated an interest to invest in community renewable energy projects, whereas the remaining survey participants received the first and third part of the questionnaire only. Survey participants were gradually invited until at least 1,000 respondents took part in the ACBC part of the survey. They were required to fulfil the pre-defined quotas for gender, age and state, given our goal to survey a sample of potential investors in community renewable energy projects that is representative for the German population. The quota was set in accordance with the latest German census survey; data for monthly net income and political preferences were based on more recent surveys or data of nationwide elections (Statistisches Bundesamt, 2011, 2013, 2014).

We applied a variety of Chi^2 analyses for demographic characteristics to test representativeness of the sample. The results indicated that the set quotas have all been met. We also tested whether the sample of respondents interested in community renewable energy investments significantly differed from the whole sample. Among the notable differences, the results presented in Table 2 suggest that potential community renewable energy investors were characterised by higher levels of income and education.

4. Results and discussion

In the following, we first report results from the additional survey questions contained in the questionnaire related to retail investors' risk-return perceptions. Subsequently, the results of the ACBC survey are described in detail. The results from the ACBC survey encompass (1) results on the average zero-centred utility of attribute levels as well as the importance of each attribute for the investment decision; (2) results on retail investors' implicit willingness to accept less desired investment features in exchange for a return premium; and (3) results of a segmentation analysis where two distinctive retail investor groups with similar preference structures were identified and subsequently analysed in terms of demographic variables.

4.1. Risk and return perception towards renewable energies

Below we provide an overview of survey participants' risk and return perceptions towards community renewable energy investments. First, respondents were asked to indicate what kind of renewable energy technology they would prefer to invest in. Fig. 2 clearly shows that both solar photovoltaics and wind onshore were preferred over competing technologies. Ranking third and fourth, after quite a gap, were small hydropower and biomass.

Second, respondents were asked about the amount of money they would be willing to invest in renewable energy projects. Fig. 3 shows that while 34% of the surveyed retail investors would only be willing to invest up to 1,000 Euros, 29% and 19% evaluated their potential investment volume much higher with 5,000 and 10,000 Euros, respectively. Further, 12% of the surveyed retail investors would consider investment volumes of up to 25,000 Euros, and 6% would even consider investing more than 25,000 Euros.

Third, we asked survey participants to provide an estimate on how risky they perceive different kinds of renewable energy investments. In order to facilitate the answers, we asked respondents to compare a specific renewable energy investment to a set of different alternatives. These alternatives included investment options from a start-up company to a private pension plan. Respondents were asked to select two alternative investments for this task. Interestingly, the majority of the surveyed retail investors regarded the risk profile of renewable energy investments similar to that of a high-risk start-up company or a direct investment into a small company (Fig. 4). In contrast, only a low number of surveyed retail investors perceived the risk profile of renewable energy investments similar to lower risk alternatives, such as a pension plan or a savings account.

Fourth, respondents were asked which financial decision criteria they use to assess investments in renewable energy projects (Fig. 5). The results suggest that retail investors differed significantly from what finance textbooks would describe as the state-of-the-art of professional investment analysis. While 35% of respondents relied on a simple assessment of the payback period, 27% frankly said that they trust their gut feeling when making investment decisions. 22% of the surveyed participants compared the return of the renewable energy project with the return of risk-equivalent benchmarks. Net present value calculation, representing a more sophisticated approach, was only applied by 16% of the respondents.

4.2. Average importances and part-worth utilities

As a first step, we measured the importance of the different characteristics of the investment options on retail investors' choices as illustrated in Table 3. Importance scores are calculated by examining how much difference each characteristic of the investment options contributes to the overall utility of an investment option. Importances are standardized to sum to 100% across all attributes (Orme, 2010). In our analysis, survey participants ranked return on investment (25.47%) as the most important attribute, followed by the type of partner (22.76%), duration of holding period (21.78%), type of technology (18.26%) and project location (11.74%). Standard deviation values were relatively high for all attributes, which points to the heterogeneity of survey participants.

4.3. Estimation of part-worth utilities of attribute levels

In a second step, we estimated the preference scores, or part-worth utilities, of attribute levels making use of a hierarchical

Please cite this article as: Salm, S., et al., What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. Energy Policy (2016), http://dx.doi.org/10.1016/j.enpol.2016.07.042

Table 2
Demographic structure of the survey sample.[a]

Variable (number of responses potential investors/our sample) 1) Chi² test: Potential investors/German average 2) Chi² test: Potential investors/Survey sample	Value	Potential investors (absolute numbers)	Potential investors (in %)	Survey sample (absolute numbers)	Survey sample (in %)	German average (in %)[b]
Gender (N=1,041/N=1,990)	Female	501	48.13	1,122	56.38	51.20
χ^2=3.439, d.f.=1, p=.064	Male	540	51.87	868	43.62	48.80
χ^2=18.725, d.f.=1, p<.001***						
Age (N=1,041/N=1,990)	18–29	186	17.87	287	14.42	16.98
χ^2=6.245, d.f.=3, p=.100	30–49	363	34.87	639	32.11	34.05
χ^2=14.235, d.f.=3, p=.003**	50–64	266	25.55	530	26.63	24.34
	65–99	226	21.71	534	26.83	24.62
German state (N=1,041/N=1,990)	Baden-Wurttemberg	135	12.97	233	11.71	13.07
χ^2=8.623, d.f.=15, p=.896	Bavaria	155	14.89	308	15.48	15.46
χ^2=19.270, d.f.=15, p=.202	Berlin	48	4.61	99	4.97	4.10
	Brandenburg	31	2.98	85	4.27	3.06
	Bremen	13	1.25	22	1.11	0.81
	Hamburg	28	2.69	42	2.11	2.13
	Hesse	79	7.59	121	6.08	7.45
	Lower Saxony	100	9.61	158	7.94	9.70
	Mecklenburg Western-Pomerania	22	2.11	39	1.96	2.01
	North Rhine-Westphalia	224	21.52	465	23.37	21.87
	Rhineland-Palatinate	50	4.80	81	4.07	4.97
	Saarland	13	1.25	23	1.16	1.25
	Saxony	52	5.00	140	7.04	5.06
	Saxony-Anhalt	31	2.98	58	2.91	2.85
	Schleswig Holstein	37	3.55	56	2.81	3.49
	Thuringia	23	2.21	60	3.02	2.73
Professional education (N=1,040/N=1,986)	No professional qualification	41	3.94	96	4.83	24.14
χ^2=1,184.597, d.f.=6, p<.001***	Apprenticeship, apprenticeship in a dual system	347	33.37	793	39.93	47.74
χ^2=18.359, d.f.=6, p=.005**	Technical college degree	117	11.25	215	10.83	10.99
	University of cooperative education degree in a dual system	127	12.21	233	11.73	1.55
	University of applied sciences and arts degree	145	13.94	247	12.44	5.99
	University degree	241	23.17	369	18.58	8.22
	Doctoral degree	22	2.12	33	1.66	1.37
Monthly net income of household (N=1,031/N=1,967)	Below 900 Euros	67	6.50	183	9.30	7.46
χ^2=95.558, d.f.=7, p<.001***	900–1,300 Euros	94	9.12	236	12.00	10.28
χ^2=22.210, d.f.=7, p=.002**	1,300–1,500 Euros	85	8.24	158	8.03	5.41
	1,500–2,000 Euros	139	13.48	304	15.46	13.41
	2,000–2,600 Euros	188	18.23	352	17.90	14.18
	2,600–3,600 Euros	223	21.63	368	18.71	17.61
	3,600–5,000 Euros	160	15.52	247	12.56	15.46
	5,000–18,000 Euros	75	7.27	119	6.05	16.19
Political preference (N=1,041/N=1,990)[c]	CDU/CSU (Christ democrats)	214	28.96	397	29.34	41.54
χ^2=144.340, d.f.=5, p<.001***	SPD (Social democrats)	151	20.43	277	20.47	25.73
χ^2=6.441, d.f.=5, p=.266	Die Linke (The Left)	113	15.29	213	15.74	8.59
	Bündnis 90/Die Grünen (The Greens)	111	15.02	166	12.27	8.45
	FDP (The Liberals)	39	5.28	57	4.21	4.76
	Other	111	15.02	243	17.96	10.92

[a] Due to rounding errors, cumulated percentages may differ from 100%.
[b] Data for gender, age, German state and professional education derive from Statistisches Bundesamt (2011), data for monthly net income of household from Statistisches Bundesamt (2013) and data for political preferences from Statistisches Bundesamt (2014).
[c] 302 of 1,041 and 637 of 1,990 respondents indicated not to have any political preference.
*** Significantly different at significance level of .001.
** Significantly different at significance level of .01.

Bayes (HB) model (Allenby et al., 2004; Orme, 2007; Wuebker et al., 2015). Part-worth utilities reflect the relative desirability of an attribute level compared to other levels within the same attribute. The higher a utility, the more positively the specific attribute level influences decision-makers to opt for a certain investment. In Table 4, these part-worth utilities are expressed as zero-centred utilities, and are presented together with the 95% interval of posterior distribution and corresponding standard deviations.

The quality of the overall HB model can be measured with the average root likelihood (RLH) parameter. The RLH parameter is the geometric mean of all predicted probabilities. As we show three

Please cite this article as: Salm, S., et al., What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. Energy Policy (2016), http://dx.doi.org/10.1016/j.enpol.2016.07.042

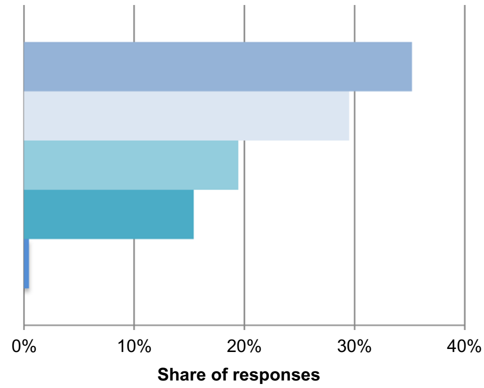

Fig. 2. Technology preference for community renewable energy projects (N = 1,041, multiple answers possible).

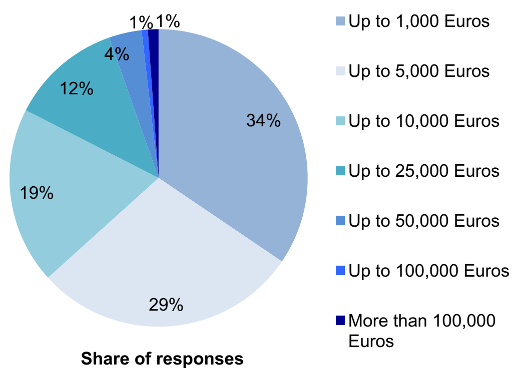

Fig. 3. Investment amount for community renewable energy projects (N = 1,041, only one answer possible).

choice tasks simultaneously, each task within the tournament should be selected with a probability of 33%. The RLH value is relatively high (RLH = .647) and thus indicates a good fit of the predicted model.

The results revealed that retail investors, as expected, mostly preferred higher levels to lower levels of return. Respondents seemed to make only little difference between investment options with a holding period of 2 and 5 years. However, they revealed a negative preference for investment options with a holding period of 10 years. Binary logistic regressions particularly confirmed the popularity of 10-year holding periods for respondents in their working age (26–64) whereas shorter holding periods are comparably less preferred ($p < .05$). Respondents in their younger (18–25) and retirement years (65–99) put particular emphasis on shorter holding periods. This is also reflected in the percentage of respondents that regarded the different levels of the holding period as unacceptable within the screening section of the ACBC. None of the potential community renewable energy investors regarded a minimum holding period of 2 years as unacceptable. In contrast, however, a minimum holding period of 5 years and 10 years were perceived as unacceptable by 3.17% and 24.50% of all respondents, respectively.

In addition, on average, most survey participants preferred solar photovoltaic installations to other technologies. Only 6.15% of respondents considered solar photovoltaics, 9.61% wind onshore and 7.59% small hydropower as unacceptable technologies.

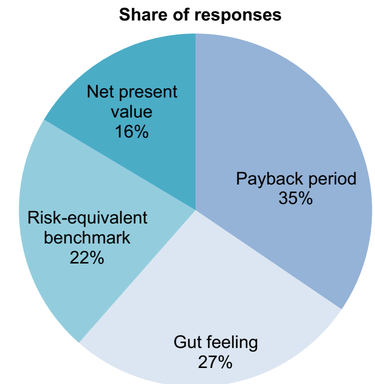

Fig. 5. Investment decision criteria (N = 1,041, only one answer possible).

Table 3
Average importances and standard deviations of attributes.[a]

Attribute	Average importances	Standard deviations
Return on investment	25.47%	16.24
Holding period	21.78%	13.20
Technology	18.26%	11.69
Project location	11.74%	8.46
Partner	22.76%	13.74

[a] Due to rounding errors, cumulated percentages may differ from 100%.

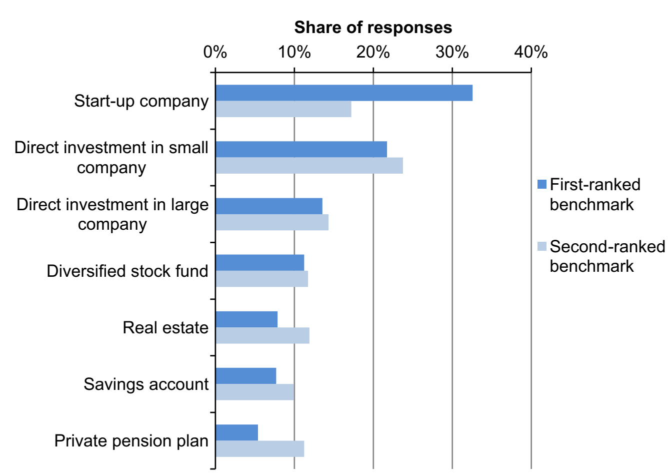

Fig. 4. Risk-equivalent benchmarks to community renewable energy projects (N = 1,041, only two answers possible).

Table 4
Zero-centred utilities, 95% interval of posterior distribution and standard deviations (Hierarchical Bayes model with normally distributed utilities).

Number of respondents (N = 1,041)		**Hierarchical Bayes model (HB)**		
Attribute	**Attribute levels**	**Zero-centred utilities**	**95% interval of posterior distribution**	**Standard deviations**
Return on investment	2%	−58.73	[−61.61: −55.85]	47.48
	6%	58.73	[55.85:61.61]	47.48
Holding period	2 years	23.55	[20.83:26.27]	44.73
	5 years	23.43	[22.01:24.85]	23.45
	10 years	−46.98	[−50.42: −43.54]	56.69
Technology	Solar photovoltaics	18.22	[15.50:20.94]	44.79
	Wind onshore	−6.90	[−9.68: −4.11]	45.81
	Small hydropower	−11.33	[−14.05: −8.61]	44.70
Project location	Project in my neighbourhood	12.90	[10.81:14.99]	34.42
	Project within state	1.73	[0.39:3.07]	21.98
	Project within Germany	−14.64	[−16.39.−12.89]	28.84
Partner	Municipal utility	27.47	[25.17:29.78]	40.53
	Energy cooperative	24.80	[22.34:27.26]	37.99
	Financial investor	−52.28	[−55.50: −49.06]	53.00

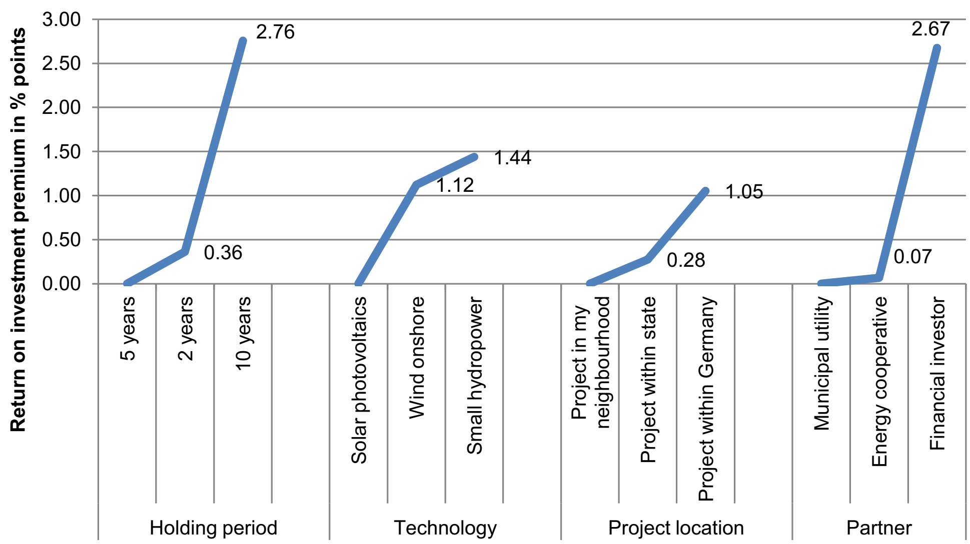

Fig. 6. Willingness to accept calculation for retail investors.

Moreover, although survey respondents preferred investment options close to their home, no clear difference between the project locations could be found. This is in line with the low number of respondents that considered the different project locations as unacceptable: only 4.51% of respondents considered a project in their neighbourhood as intolerable; a project within their state was also only rejected by 3.55% of the survey participants. In contrast, a higher share of respondents (9.41%) considered a project within Germany as unacceptable, suggesting a slight preference for more local investments.

Finally, the results show that the surveyed retail investors clearly preferred municipal utilities and energy cooperatives as partners for the community renewable energy investments in contrast to financial investors. This result is further reflected in the low number of respondents that considered energy cooperatives (4.42%) as well as municipal utilities (4.51%) as unacceptable. In contrast, more than a quarter of all surveyed retail investors (27.38%) considered financial investors unacceptable as issuers of community renewable energy investment offerings.

4.4. Willingness to accept calculation

As the third step, we converted median part-worth utilities into aggregated willingness to accept values. More precisely, the willingness to accept (WTA) calculation illustrates retail investors' willingness to accept less desired investment features in exchange for a return premium. In order to calculate the aggregated WTA (see Formula 1), the median part-worth utility (u_{ij}) of one attribute level (j) (e.g. wind onshore) is subtracted from the highest median part-worth utility ($u_{ij_{max}}$) within the same attribute (i) (e.g. technology). Then, the result is multiplied by the price (p) of one unit of utility. The price of one utility unit equals the difference of the highest and lowest possible price ($p_{max} - p_{min}$) divided by the difference between their median part-worth utilities ($u_{pj_{max}} - u_{pj_{min}}$).

$$WTA\left(u_{ij}\right) = \left(u_{ij_{max}} - u_{ij}\right) * \frac{p_{max} - p_{min}}{u_{pj_{max}} - u_{pj_{min}}} \tag{1}$$

The return premium is expressed in percentage points on top of the basis investment, which represents the lowest perceived risk profile with a 2% return. The result of the aggregated WTA calculation is displayed in Fig. 6.

The analysis shows that retail investors were largely indifferent between a 2 and a 5-year holding period. A possible explanation for this counter-intuitive result is that some retail investors might be searching for long-term investment opportunities. In contrast, a holding period of 10 years was clearly less preferred; retail investors would require an additional return premium of 2.76%. Concerning technology preferences, the results show that solar photovoltaics was the preferred option. A switch from solar photovoltaics to wind onshore or small hydropower would result in an increase of 1.12% or 1.44% return premium, respectively. Retail investors showed a relatively clear preference for renewable energy project locations close to their neighbourhood. In contrast, a project located within state or within Germany was considerably less attractive, implying a required compensation of 0.28% or 1.05% respectively. With regard to the choice of partner, retail investors expressed the highest trust towards municipal utilities. However, energy cooperatives as a partner were almost equally preferred, as expressed in a required premium of 0.07%. In contrast, retail investors would require an additional return premium of 2.67% if the intermediary is a financial investor, making this the least preferred partner for a community renewable energy investment.

4.5. Segmentation analysis

As previously indicated, the standard deviations of the part-worth utilities were relatively high which points to heterogeneity in retail investors' preferences. In the following, we conducted a segmentation analysis based on individual utilities. This allowed us to see whether we can detect more homogenous groups of survey respondents with similar preferences. The segmentation analysis was conducted with the module Convergent Cluster & Ensemble Analysis (CCEA) offered by Sawtooth. CCEA discover segments by grouping people into distinctive segments based on their individual part-worth utilities of all attributes levels. Within the “k-means” method, the CCEA starts from random points with an automatic 30-time replication. To determine its reproducibility, each replication was compared with previous replications (Orme and Johnson, 2008). After having identified distinctive segments, those segments were described in terms of demographic variables. This post-hoc segmentation differs from the more traditional a-priori segmentation where survey participants are divided into groups based on shared socio-demographic characteristics. We chose a two-segment solution with the level of reproducibility of 98%.

The two segments differed with regard to the part-worth utilities and importances of several attributes (Tables 5 and 6, Fig. 7). The first segment, which we called “local patriots” (N=557, representing 53.5% of respondents), was characterised by a higher importance of the attributes partner and project location. They clearly preferred community renewable energy investments that are led by municipal utilities or energy cooperatives over those that are led by financial investors, and they preferred projects in their neighbourhood to nationwide projects. Conversely, they put relatively less emphasis on return on investment. Solar photovoltaics was clearly their preferred technology.

The second segment, which we call “yield investors” (N=484, representing 46.5% of respondents), placed the highest importance on return on investment. While they also expressed preferences for municipal utilities or energy cooperatives and for projects located in their vicinity, these preferences are distinctly less pronounced than those of the local patriots, suggesting that for those investors, financial returns were the key to considering community renewable energy investments.

By applying several Chi^2 tests, we further analysed whether the two identified segments differ significantly in terms of demographic characteristics. The results of significance tests (Appendix 1) showed that the two segments did not differ significantly with respect to gender, German state, professional education, monthly net income of household and political preference ($p>.05$). However, they differed significantly with respect to age ($p<.001$). Thus, survey participants that belong to the local patriots segment were significantly older than those that belong to the yield investors segment.

Table 5
Segment-specific average importances and standard deviations of attributes.[a]

Attribute	Segment local patriots (N=557)		Segment yield investors (N=484)	
	Average importances	Standard deviations	Average importances	Standard deviations
Return on investment	16.27%[***]	10.57	36.06%[***]	15.14
Holding period	22.07%	13.55	21.45%	12.78
Technology	19.99%[***]	11.68	16.27%[***]	11.39
Project location	13.29%[***]	9.13	9.95%[***]	7.22
Partner	28.39%[***]	13.44	16.27%[***]	10.94

[a] Due to rounding errors, cumulated percentages may differ from 100%.
[***] Segment-specific average importances differ at significance level of .001.

Table 6
Segment-specific zero-centred utilities, 95% interval of posterior distribution and standard deviations (Hierarchical Bayes model with normally distributed utilities).

Number of respondents (N=1,041)		HB model segment local patriots (N=557)			HB model segment yield investors (N=484)		
Attribute	Attribute levels	Zero-centred utilities	95% interval of posterior distribution	Standard deviations	Zero-centred utilities	95% interval of posterior distribution	Standard deviations
Return on investment	2%	−33.02	[−35.98: −30.07]	35.55	−88.31	[−92.05: −84.57]	41.97
	6%	33.02	[30.07:35.98]	35.55	88.31	[84.57:92.05]	41.97
Holding period	2 years	23.54	[19.58:27.51]	47.69	23.55	[19.89:27.21]	41.11
	5 years	20.77	[18.79:22.74]	23.81	26.50	[24.48:28.52]	22.67
	10 years	−44.31	[−49.24: −39.38]	59.32	−50.05	[−54.81: −45.30]	53.39
Technology	Solar photovoltaics	20.33	[16.38:24.27]	47.55	15.80	[12.12:19.48]	41.29
	Wind onshore	−12.12	[−16.24: −7.99]	49.68	−0.88	[−4.46:2.69]	40.13
	Small hydropower	−8.21	[−12.12: −4.29]	47.11	−14.92	[−18.62: −11.22]	41.51
Project location	Project in my neighbourhood	19.55	[16.48:22.63]	37.05	5.25	[2.64:7.87]	29.35
	Project within state	0.36	[−1.55:2.28]	23.05	3.31	[1.47:5.14]	20.60
	Project within Germany	−19.92	[−22.40: −17.43]	29.94	−8.56	[−10.90: −6.22]	26.28
Partner	Municipal utility	39.91	[36.75:43.07]	38.07	13.16	[10.27:16.06]	32.51
	Energy cooperative	34.08	[30.60:37.56]	41.91	14.12	[10.91:17.34]	36.08
	Financial investor	−73.99	[−78.16: −69.82]	50.25	−27.29	[−31.24: −23.33]	44.40

Please cite this article as: Salm, S., et al., What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. Energy Policy (2016), http://dx.doi.org/10.1016/j.enpol.2016.07.042

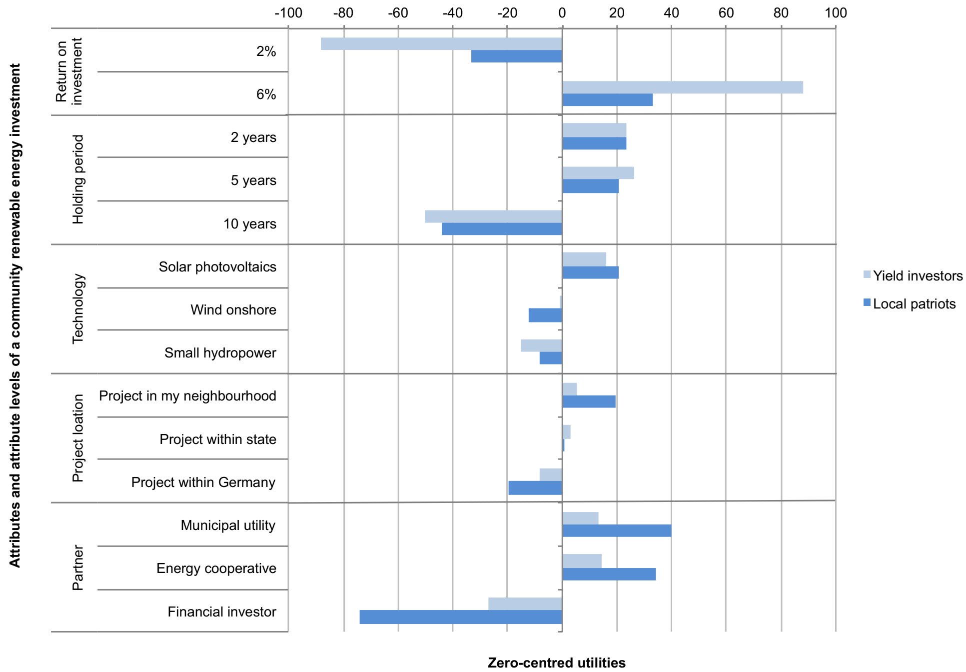

Fig. 7. Segment-specific part-worth utilities (zero-centred).

5. Conclusions and policy implications

This paper has analysed the risk-return expectations of potential German community renewable energy investors. Our study is, to the best of our knowledge, the first to quantify retail investors' preferences for community renewable energy project features with a choice experiment. Our findings confirm the important role that citizens could play as financiers of the energy transition. Nearly half of the 1,990 German retail investors we surveyed expressed an interest in community renewable energy investment. Our choice experiment with the subset of 1,041 potential renewable energy investors revealed that return on investment is a relevant, but not the only important factor. Other attributes, such as whether the investment is offered by a municipal utility or energy cooperative rather than a financial institution, also influence investor choices. In terms of holding period, the surveyed investors appeared to have a medium-term horizon, being almost indifferent between 2 and 5 years, but requiring a risk premium of 2.76% points in case of a 10-year holding period. As for technology, our study confirms prior research in that respondents prefer investment in solar photovoltaics to wind and small hydropower. As a noteworthy observation, many retail investors based their decision on intuition or simple payback period calculation rather than more sophisticated financial analysis. Finally, we identified two distinct segments, local patriots and yield investors, which differ with regard to their preferences. While the latter require higher rates of return and have less pronounced preferences for attributes such as partner or project location, the former have a strong aversion against financial investors and are willing to forego some returns for participating in local projects, mostly in solar photovoltaics.

Our findings have important policy implications. First of all, policymakers in many countries are currently faced with incumbent electric utilities that are increasingly cash-constrained and may have difficulties in financing the necessary investments in renewable energy infrastructure. In this situation, it will be helpful for policymakers to recognise that retail investors, through community financing of renewables, have significant potential to fill the gap. Rather than designing regulatory frameworks that provide generous support to incumbents, for example through capacity reserve payments for fossil power plants, or in some extreme cases engaging in government bailouts of ailing utilities, policymakers may wish to consider unlocking the potential of community investment. Our findings, however, show that retail investors are not just purely environmentally driven altruists, but they are looking for financial returns, too. This is particularly true for the sub-segment with 46.5% of potential community investors that we coined “yield investors”. The other sub-segment, the “local patriots” accounting for just over half of the potential investors, are somewhat less financially driven, but place particular emphasis on the local embedding of renewable energy projects. Facilitating the financial contribution of those actors requires framework conditions that are conducive for energy cooperatives, and for distributed solar photovoltaics. In light of these findings, recent trends in the German policy framework, such as the shift from feed-in tariffs to tenders, have to be carefully considered with regard to potentially crowding out local players.

As any piece of research, our study is subject to some limitations that can serve as starting points for further research. First, the survey has been limited to domestic investments of German retail investors. While Germany is one of the fastest-growing renewable energy markets in Europe and has seen significant investment from citizens, it would obviously be interesting to investigate other markets. It would be particularly interesting to see whether cultural factors contour the importance of community renewable energy investment across countries. This could be done by comparing countries with strong traditions in cooperative modes of financing and energy provision, such as Denmark or the Netherlands, to countries that lack such traditions, such as the UK and France.

A second limitation of our study owes to the fact that we are reporting on stated preferences. While we have used adaptive choice-based analysis as a sophisticated research method that creates a realistic choice setting and minimises social desirability bias, and we are reporting on a large sample of potential investors, it would be valuable to replicate our research based on revealed preferences. While we believe that the relative preferences expressed in the choice experiments provide a robust account of

Please cite this article as: Salm, S., et al., What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. Energy Policy (2016), http://dx.doi.org/10.1016/j.enpol.2016.07.042

underlying utilities, the magnitude of the effects should be interpreted with caution. In particular, our finding that about half of respondents are interested in community renewable energy investment, while giving an indication for which market potential exist, does not imply that all of these potential investors are going to act on their preferences tomorrow.

Finally, an interesting avenue for further research might be to combine survey methods with test markets. For example, varying the features of community renewable energy investment offerings on crowdfunding websites and then observing actual investor behaviour has a high potential to generate new insights.

Acknowledgment

The authors wish to acknowledge financial support from the Commission for Technology and Innovation (CTI) under the Swiss Competence Center for Energy Research (SCCER CREST), as well as helpful comments from three anonymous reviewers. Any remaining errors are our own.

Appendix

See Appendix Table A1.

Table A1
Demographic structure of local patriots segment and yield investors segment[a].

Variable (number of responses local patriots/yield investors)	Value	Local patriots (absolute numbers)	Local patriots (in %)	Yield investors (absolute numbers)	Yield investors (in %)
Gender (N=557/N=484)	Female	275	49.37	226	46.69
χ^2=0.744, d.f.=1, p=.389	Male	282	50.63	258	53.31
Age (N=557/N=484)	18–29	78	14.00	108	22.31
χ^2=23.745, d.f.=3, p<.001[***]	30–49	180	32.32	183	37.81
	50–64	156	28.01	110	22.73
	65–99	143	25.67	83	17.15
German state (N=557/N=484)	Baden-Wurttemberg	80	14.36	55	11.36
χ^2=14.901, d.f.=15, p=.459	Bavaria	84	15.08	71	14.67
	Berlin	23	4.13	25	5.17
	Brandenburg	15	2.69	16	3.31
	Bremen	9	1.62	4	0.83
	Hamburg	16	2.87	12	2.48
	Hesse	43	7.72	36	7.44
	Lower Saxony	48	8.62	52	10.74
	Mecklenburg Western-Pomerania	16	2.87	6	1.24
	North Rhine-Westphalia	121	21.72	103	21.28
	Rhineland-Palatinate	25	4.49	25	5.17
	Saarland	6	1.08	7	1.45
	Saxony	20	3.59	32	6.61
	Saxony-Anhalt	19	3.41	12	2.48
	Schleswig Holstein	19	3.41	18	3.72
	Thuringia	13	2.33	10	2.07
Professional education (N=556/N=484)	No professional qualification	19	3.42	22	4.55
χ^2=5.741, d.f.=6, p=.453	Apprenticeship, apprenticeship in a dual system	188	33.81	159	32.85
	Technical college degree	67	12.05	50	10.33
	University of cooperative education degree in a dual system	61	10.97	66	13.64
	University of applied sciences and arts degree	84	15.11	61	12.60
	University degree	123	22.12	118	24.38
	Doctoral degree	14	2.52	8	1.65
Monthly net income of household (N=551/N=480)	Below 900 Euros	42	7.62	25	5.21
χ^2=10.840, d.f.=7, p=.146	900–1,300 Euros	58	10.53	36	7.50
	1,300–1,500 Euros	46	8.35	39	8.13
	1,500–2,000 Euros	74	13.43	65	13.54
	2,000–2,600 Euros	97	17.60	91	18.96
	2,600–3,600 Euros	114	20.69	109	22.71
	3,600–5,000 Euros	74	13.43	86	17.92
	Above 5,000 Euros	46	8.35	29	6.04
Political party preference (N=557/N=484)[b]	CDU/CSU (Christ democrats)	104	26.60	110	31.61
χ^2=5.427, d.f.=5, p=.366	SPD (Social democrats)	83	21.23	68	19.54
	Die Linke (The Left)	59	15.09	54	15.52
	Bündnis 90/Die Grünen (The Greens)	67	17.14	44	12.64
	FDP (The Liberals)	23	5.88	16	4.60
	Other	55	14.07	56	16.09

[a] Due to rounding errors, cumulated percentages may differ from 100%.
[b] 166 of 557 and 136 of 484 respondents indicated not to have any political preference.
[***] Local patriots and yield investors significantly differ at significance level of .001.

References

Aitken, M., 2010. Wind power and community benefits: challenges and opportunities. Energy Policy 38 (10), 6066–6075.
Allenby, G.M., Bakken, D.G., Rossi, P.E., 2004. The HB revolution how Bayesian methods have changed the face of marketing research. Mark. Res. 16, 20–25.
Bauwens, T., 2016. Explaining the diversity of motivations behind community renewable energy. Energy Policy 93, 278–290.
Bergek, A., Mignon, I., Sundberg, G., 2013. Who invests in renewable electricity production? Empirical evidence and suggestions for further research. Energy Policy 56 (0), 568–581.
Boesch, I., Weber, M., 2012. Processor's preferences and basic differentiation strategies for potatoes, milk, and wheat in Switzerland. J. Agric. Food Ind. Organ. 10, 1.
Bomberg, E., McEwen, N., 2012. Mobilizing community energy. Energy Policy 51, 435–444.
Brundin, E., Patzelt, H., Shepherd, D.A., 2008. Managers' emotional displays and employees' willingness to act entrepreneurially. J. Bus. Ventur. 23 (2), 221–243.
Chassot, S., Hampl, N., Wüstenhagen, R., 2014. When energy policy meets free-market capitalists: the moderating influence of worldviews on risk perception and renewable energy investment decisions. Energy Res. Soc. Sci. 3 (0), 143–151.
Clark-Murphy, M., Soutar, G.N., 2004. What individual investors value: Some Australian evidence. J. Econ. Psychol. 25 (4), 539–555.
DGRV, 2013. Energiegenossenschaften–Ergebnisse der Umfrage des DGRV und seiner Mitgliedsverbände. Berlin.
Dinica, V., 2006. Support systems for the diffusion of renewable energy technologies – an investor perspective. Energy Policy 34 (4), 461–480.
Elrod, T., Louviere, J.J., Davey, K.S., 1992. An empirical comparison of ratings-based and choice-based conjoint models. J. Mark. Res. 29 (3), 368–377.
European Commission, 2016. Climate Action: 2030 Climate & Energy Framework. Retrieved 08.01.2016, from ⟨http://ec.europa.eu/clima/policies/strategies/2030/⟩.
Franke, N., Gruber, M., Harhoff, D., Henkel, J., 2006. What you are is what you like—similarity biases in venture capitalists' evaluations of start-up teams. J. Bus. Ventur. 21 (6), 802–826.
Goett, A.A., Hudson, K., Train, K.E., 2000. Customers' choice among retail energy suppliers: the willingness-to-pay for service attributes. Energy J. 21 (4), 1–28.
Golden, B.R., 1992. The past is the past – or is it? The use of retrospective accounts as indicators of past strategy. Acad. Manag. J. 35 (4), 848–860.
Green, P.E., Srinivasan, V., 1990. Conjoint analysis in marketing: new developments with implications for research and practice. J. Mark. 54 (4), 3–19.
Gustafsson, A., Herrmann, A., Huber, F., 2007. Conjoint Measurement: Methods and Applications. Springer Science & Business Media, Berlin Heidelberg.
Hampl, N., 2012. Energy Investment Decision-Making Under Uncertainty: The Influence of Behavioral and Social Effects, St. Gallen.
Heinzle, S.L., Yip, A.B.Y., Xing, M.L.Y., 2013. The influence of green building certification schemes on real estate investor behaviour: evidence from Singapore. Urban Stud. 50 (4), 1–18.
Helms, T., Salm, S., Wüstenhagen, R., 2015. Investor-specific cost of capital and renewable energy investment decisions. In: Donovan, C. (Ed.), Renewable Energy Finance. Imperial College Press, London, pp. 77–101.
Hinnen, G., Hille, S.L., Wittmer, A., 2015. Willingness to pay for green products in air travel: ready for take-off? Bus. Strategy Environ.
Holstenkamp, L., Ulbric, S., 2010. Bürgerbeteiligung mittels Fotovoltaikgenossenschaften. Marktüberblick und Analyse der Finanzierungsstruktur. Arbeitspapierreihe Wirtschaft & Recht, 8, Lüneburg.
Jervis, S., Ennis, J., Drake, M., 2012. A comparison of adaptive choice-based conjoint and choice-based conjoint to determine key choice attributes of sour cream with limited sample size. J. Sens. Stud. 27 (6), 451–462.
Johnson, R., Orme, B., 2007. A New Approach to Adaptive CBC. In: Proceedings of Paper presented at the Sawtooth Software Conference. Sequim (WA).
Kaenzig, J., Heinzle, S.L., Wüstenhagen, R., 2013. Whatever the customer wants, the customer gets? Exploring the gap between consumer preferences and default electricity products in Germany. Energy Policy 53, 311–322.
Kalkbrenner, B.J., Roosen, J., 2016. Citizens' willingness to participate in local renewable energy projects: the role of community and trust in Germany. Energy Res. Soc. Sci. 13, 60–70.
Kroes, E.P., Sheldon, R.J., 1988. Stated preference methods: an introduction. J. Transp. Econ. Policy, 11–25.
Kruskal, J.B., 1965. Analysis of factorial experiments by estimating monotone transformations of the data. J. R. Stat. Soc. Ser. B (Methodol.) 27 (2), 251–263.
Louviere, J., Hensher, D., Swait, J., 2000. Stated Choice Methods: Analysis and Applications. Cambridge University Press, Cambridge.
Louviere, J., Woodworth, G., 1983. Design and analysis of simulated consumer choice or allocation experiments: an approach based on aggregate data. J. Mark. Res. 20 (4), 350–367.
Luce, R.D., Tukey, J.W., 1964. Simultaneous conjoint measurement: a new type of fundamental measurement. J. Math. Psychol. 1 (1), 1–27.
Lüthi, S., Wüstenhagen, R., 2012. The price of policy risk—empirical insights from choice experiments with European photovoltaic project developers. Energy Econ. 34 (4), 1001–1011.
Masini, A., Menichetti, E., 2013. Investment decisions in the renewable energy sector: an analysis of non-financial drivers. Technol. Forecast. Soc. Change 80 (3), 510–524.
Müller, J.R., Holstenkamp, L., 2015. Zum Stand von Energiegenossenschaften in Deutschland.
Musall, F.D., Kuik, O., 2011. Local acceptance of renewable energy—a case study from southeast Germany. Energy Policy 39 (6), 3252–3260.
Nolden, C., 2013. Governing community energy—feed-in tariffs and the development of community wind energy schemes in the United Kingdom and Germany. Energy Policy 63 (0), 543–552.
Orme, B., 2007. Software for Hierarchical Bayes Estimation for CBC data, CBC/HB v4. Sawtooth Software Research Paper Series, Sequim (WA).
Orme, B., 2009. Which Conjoint Method Should I Use. Sawtooth Software Research Paper Series, Sequim (WA).
Orme, B., 2010. Getting Started With Conjoint Analysis: Strategies for Product Design and Pricing Research. Sawtooth Software Research Paper Series, Madison (WI).
Orme, B., Johnson, R., 2008. Improving K-means Cluster Analysis: Ensemble Analysis Instead of Highest Reproducibility Replicates. Sawtooth Software Research Paper Series, Sequim (WA).
Poppen, S., 2015. Energiegenossenschaften und deren Mitglieder: Erste Ergebnisse einer empirischen Untersuchung: Arbeitspapiere des Instituts für Genossenschaftswesen der Westfälischen Wilhelms-Universität Münster, Münster.
Rauschmayer, F., Centgraf, S., Masson, T., 2015. Ergebnisse der EnGeno Mitgliederbefragung von Energiegenossenschaften. Helmholtz-Zentrum für Umweltforschung UFZ, Leipzig.
Roe, B., Teisl, M.F., Levy, A., Russell, M., 2001. US consumers' willingness to pay for green electricity. Energy Policy 29 (11), 917–925.
Rogers, J., Simmons, E., Convery, I., Weatherall, A., 2008. Public perceptions of opportunities for community-based renewable energy projects. Energy Policy 36 (11), 4217–4226.
Shepherd, D.A., 1999. Venture capitalists' assessment of new venture survival. Manag. Sci. 45 (5), 621–632.
Shepherd, D.A., Zacharakis, A., Baron, R.A., 2003. VCs' decision processes: evidence suggesting more experience may not always be better. J. Bus. Ventur. 18 (3), 381–401.
Statistisches Bundesamt, 2011. Zensus Kompakt – Endgültige Ergebnisse des Zensus 2011. Retrieved 15.12.2015, from ⟨https://www.zensus2011.de/SharedDocs/Downloads/DE/Publikationen/Aufsaetze_Archiv/2015_01_Zensus_Kompakt_endgueltig.pdf?__blob=publicationFile&v=3⟩.
Statistisches Bundesamt, 2013. Wirtschaftsrechnungen, Einkommen- und Verbrauchsstichproben, Einlagen und Auslagen privater Haushalte. Retrieved 15.12.2015, from ⟨https://www.destatis.de/DE/Publikationen/Thematisch/EinkommenKonsumLebensbedingungen/EinkommenVerbrauch/EVS_EinnahmenAusgabenprivaterHaushalte2152604139004.pdf?__blob=publicationFile⟩.
Statistisches Bundesamt, 2014. Statistisches Jahrbuch 2014 für die Bundesrepublik Deutschland. Retrieved 15.12.2015, from ⟨https://www.destatis.de/DE/Publikationen/StatistischesJahrbuch/StatistischesJahrbuch2014.pdf?__blob=publicationFile⟩.
Stenzel, T., Frenzel, A., 2008. Regulating technological change—the strategic reactions of utility companies towards subsidy policies in the German, Spanish and UK electricity markets. Energy Policy 36 (7), 2645–2657.
Stigka, E.K., Paravantis, J.A., Mihalakakou, G.K., 2014. Social acceptance of renewable energy sources: a review of contingent valuation applications. Renew. Sustain. Energy Rev. 32, 100–106.
Tabi, A., Hille, S.L., Wüstenhagen, R., 2014. What makes people seal the green power deal? — Customer segmentation based on choice experiment in Germany. Ecol. Econ. 107 (0), 206–215.
Trend:research, Leuphana Universität Lüneburg, 2013. Definition und Marktanalyse von Bürgerenergie in Deutschland. Retrieved 02.02.2015, from ⟨http://100-prozent-erneuerbar.de/wp-content/uploads/2013/10/Definition-und-Marktanalyse-von-B%C3%BCrgerenergie-in-Deutschland.pdf⟩.
Unruh, G.C., 2000. Understanding carbon lock-in. Energy Policy 28 (12), 817–830.
Unruh, G.C., 2002. Escaping carbon lock-in. Energy Policy 30 (4), 317–325.
Walker, G., 2008. What are the barriers and incentives for community-owned means of energy production and use? Energy Policy 36 (12), 4401–4405.
Walker, G., Devine-Wright, P., 2008. Community renewable energy: what should it mean? Energy Policy 36 (2), 497–500.
Walker, G., Devine-Wright, P., Hunter, S., High, H., Evans, B., 2010. Trust and community: exploring the meanings, contexts and dynamics of community renewable energy. Energy Policy 38 (6), 2655–2663.
Warren, C.R., McFadyen, M., 2010. Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland. Land Use Policy 27 (2), 204–213.
Wuebker, R., Hampl, N., Wüstenhagen, R., 2015. The strength of strong ties in an emerging industry: experimental evidence of the effects of status hierarchies and personal ties in venture capitalist decision making. Strateg. Entrep. J. 9 (2), 167–187.
Wüstenhagen, R., Bilharz, M., 2006. Green energy market development in Germany: effective public policy and emerging customer demand. Energy Policy 34 (13), 1681–1696.
Wüstenhagen, R., Menichetti, E., 2012. Strategic choices for renewable energy investment: conceptual framework and opportunities for further research. Energy Policy 40 (0), 1–10.
Wüstenhagen, R., Wolsink, M., Bürer, M.J., 2007. Social acceptance of renewable energy innovation: an introduction to the concept. Energy Policy 35 (5), 2683–2691.
Yildiz, Ö., 2014. Financing renewable energy infrastructures via financial citizen participation – the case of Germany. Renew. Energy 68, 677–685.
Yildiz, Ö., Rommel, J., Debor, S., Holstenkamp, L., Mey, F., Müller, J.R., Rognli, J., 2015. Renewable energy cooperatives as gatekeepers or facilitators? Recent developments in Germany and a multidisciplinary research agenda. Energy Res. Soc. Sci. 6, 59–73.
Zacharakis, A.L., McMullen, J.S., Shepherd, D.A., 2007. Venture capitalists' decision policies across three countries: an institutional theory perspective. J. Int. Bus. Stud. 38 (5), 691–708.

Please cite this article as: Salm, S., et al., What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. Energy Policy (2016), http://dx.doi.org/10.1016/j.enpol.2016.07.042