Community financing of renewable energy projects in Austria and Switzerland: profiles of potential investors

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Abstract

Small-scale investors are gaining recognition as a valuable source of private funding necessary for a successful energy transition. Still, there is limited knowledge about the characteristics of potential investors, especially in community renewable energy projects. This study intends to address this gap and investigates the impact of socio-demographic and socio-psychological characteristics on individuals' willingness to invest in community renewable energy projects. Our investigation is based on two large-scale representative surveys of 2,260 respondents in Austria and Switzerland. The majority of respondents would be willing to invest 1,000 to 10,000 CHF/EUR in such a project, with higher amounts in the Swiss sample. Potential investors in Austria tend to be male homeowners with higher incomes, while Swiss investors are more educated. Generally, positive attitudes and beliefs related to renewable energy have a significant impact on investment intention. The largest group of potential investors in both countries can be described as 'urban energy enthusiasts', who show high acceptance of wind energy installations near their communities. Surprisingly, a significant segment of potential investors is skeptical of a nearby wind installation. Study results can be used by decision-makers to tailor appropriate policy measures and by project developers for communication of the project aims and benefits.

Keywords

social acceptance, community finance, beliefs, willingness-to-invest, wind energy, cluster analysis

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Highlights

1. Majority of respondents interested in investing in community energy projects.
2. Attitudes and beliefs impact intentions to invest in community renewable energy.
3. Largest group of potential investors characterized as ‘urban energy enthusiasts’.
4. Unexpectedly high share of potential investors shows low acceptance of wind power.
5. In Austria and Switzerland, preferred technologies are solar PV and wind power.

1. Introduction

In order to meet national emission and clean energy installation targets, an estimated \$16.5 trillion of private investment in renewable energy (RE) and energy efficiency projects is needed over the coming 15 years and a large investment gap still exists (Buchner et al., 2015). Given this huge unmet need for private investment, public attention has recently turned towards community renewable energy (CRE) projects, which involve small-scale private (aka ‘retail’ or ‘individual’) investors and provide an important alternative to large public and private investors, such as funds and electric utilities (e.g. Bauwens, 2016; Bergek et al., 2013). While regional utilities and banks are often favored for CRE development (Gamel et al., 2016), the communities remain closely involved in different aspects of the projects, ranging from planning, installation, financing, and operations (Walker and Devine-Wright, 2008). Thus, CRE increases investor diversity in the sector. There are multiple other benefits of CRE: in addition to financial returns (Salm et al. 2016) and the development of the local economic base, CRE projects foster communal values (solidarity, self-sufficiency, self-determination, and empowerment through local engagement), stimulate job creation, and have a positive environmental impact (Walker, 2008). CRE projects also help increase local acceptance of RE installations, which is often critical for wind power projects (e.g. Musall and Kuik, 2011; Walker et al., 2010).

Despite these positive aspects of CRE, there are considerable knowledge gaps about this relatively new investment vehicle. Limited data are available on the potential for capital inflows in this sector, but also on profiles of potential investors and their investment. These aspects are of crucial importance for a sound CRE policy that would target the most interested segments in the population. Perhaps the most-studied aspect of CRE finance is the motivation to invest, which includes environmental, social, financial, ethical, altruistic or emotional considerations, with multiple motivations often present simultaneously (Bauwens, 2016). It has been established that environmental concerns, peer effects and social norms (e.g.

interpersonal trust and social identification) have a positive effect on the willingness to participate in a CRE project (Bamberg et al., 2015; Dóci and Vasileiadou, 2015; Kalkbrenner and Roosen, 2016; Mignon and Bergek, 2016). Moreover, place of residence plays a role: countryside dwellers in Germany were more likely to participate in CRE projects than urban dwellers (Kalkbrenner and Roosen, 2016). Rural dwellers seem to be motivated by the increase in self-reliance and independence, while urban inhabitants appreciated their interdependence and being connected to other people in the city (Dóci and Vasileiadou 2015). Investors into CRE projects tended to be older males with higher incomes, higher education and higher electricity usage (Bauwens and Eyre, 2017; Dóci and Vasileiadou, 2015; Yildiz et al., 2015). It remains to be shown whether these investor characteristics hold for two other German-speaking countries of Austria and Switzerland.

The paper seeks to accomplish a number of research objectives, including cross-country comparison of the results. We seek to address the following research questions:

- What are socio-demographic and socio-psychological characteristics of potential investors (and non-investors) in CRE in Austria and Switzerland?
- What are the preferences of different types of potential investors with respect to CRE (e.g. investment amount, preferred technology) and what are perceived drivers and barriers to investments into CRE?

The study's focus on Austria and Switzerland is not accidental. Austrian and Swiss CRE projects have not been subject to much academic attention, unlike those in Germany (cf. Yildiz et al., 2015), the Netherlands (cf. Dóci and Gotchev, 2016), the United Kingdom (cf. Walker et al., 2010), and to a lesser extent in France and Sweden (cf. Mignon and Rüdinger, 2016) or Belgium (cf. Bauwens et al., 2016). In both Austria and Switzerland, there are traditional concerns about the pristine Alpine scenery and tourism, which impact socio-political acceptance of large-scale renewable energy installations. Direct citizen involvement might alleviate the tension between RE development and the willingness to protect unique

natural environments. Still, there are reasons to believe that CRE projects might have a large potential in Austria and Switzerland, as both countries have a long tradition of citizen participation in different types of community-based initiatives (ranging from banking services to dairy farms). In Switzerland, 292 energy cooperatives were involved in both energy production and distribution in 2015 (Schmid and Seidl, 2016). Austria hosted a total of about 400 community RE projects in 2014 (Bauwens et al., 2016). Purtschert (2005) and Madlener (2007) provide further examples of community energy projects in Switzerland and Austria respectively.

Complementing previous research efforts that looked at potential investors and their characteristics (Kalkbrenner and Roosen, 2016; Salm et al., 2016), this study describes and compares potential CRE investors in Austria and Switzerland by the means of two large-scale representative surveys. Note that actual investors provide current investment flows into CRE projects, while presence of potential investors is indicative of future capital flows and growth opportunities for the sector.

One of the contributions of this study is connecting personal beliefs to the willingness to invest (WTI) in CRE projects. While various scholars have shown the impact of beliefs on pro-environmental behavior, such as energy savings (cf. Gadenne et al., 2011), willingness to engage in climate change mitigation (cf. Ferguson and Branscombe, 2010), and willingness to pay for green electricity (cf. Liu et al., 2013), surprisingly little is known to date on how personal beliefs are connected to actual or potential engagement in CRE projects. A study by Bamberg et al. (2015) investigated the influence of participative efficacy beliefs on the intention to engage in collective climate protection actions, while Fleiß et al. (2017) looked at the impact of beliefs on investment into communal solar energy projects. Our research further addresses the connection between individual beliefs and investment intentions, establishing that potential investors in both countries are on average more optimistic about solar power achieving grid parity and the possibility of future without fossil fuels. Yet, there is a

significant investor heterogeneity with respect to welcoming wind power in the back yard.

The study has several other important contributions, such as the estimation of the potential market size for CRE projects. The market size can be inferred by knowing that nearly half of Austrian respondents and 60% of Swiss respondents would be interested in investing into a CRE project and that the majority of the investment would lie in the range of 1,000-10,000 EUR/CHF⁴. The study also identified the most two promising technologies for CRE projects: solar photovoltaic and wind power. Moreover, our analysis provides new insights into the profiles of potential investors and non-investors, illustrating socio-demographic differences between them. Based on explorative cluster analysis, this study identifies the largest group of potential investors in both countries as ‘wind energy enthusiasts’. In contrast to Germany (Kalkbrenner and Roosen, 2016), where living in a rural community increased the likelihood of investment, the residence variable did not significantly impact the odds of investment in Switzerland and Austria.

Another important insight is that there is a significant sector of potential investors (about a quarter of the sample) who report lower levels of acceptance of wind energy installations near their domicile. This is a somewhat surprising result, given that prior research often links CRE projects with increased social acceptance (e.g. Musall and Kuik, 2011). In spite of the wind energy skeptics’ resistance to wind power near their communities, roughly every fifth of them in Austria and sixth in Switzerland would invest into wind power. The segmentation findings are especially relevant to policy makers, who intend to create a tailored mix of policy measures, as well as community project developers, who wish to target their communication strategies towards the most receptive groups of potential investors. Additional policy implications can be derived with the knowledge of drivers and barriers for CRE investment investigated by this paper. Tellingly, the most significant barrier in Austria were lacking financing means (hence, the need to communicate about incremental investment opportunities

⁴ For simplicity, we assumed a 1:1 exchange rate between the currencies. When the surveys were fielded, the Euro and the Swiss franc fluctuated around 1.12-1.13 and 0.93-0.98 per US dollar respectively (IMF, 2017).

in CRE), while the Swiss respondents were struggling with the perceived riskiness of investment and indicated the lack of knowledge about CRE (hence, a recommendation for consumer education with respect to risk and return profiles of CRE investments).

This paper proceeds as follows: we describe the data collection and methodological approach, followed by the results. The paper ends with a discussion of policy implications, as well as the study's limitations and suggestions for further research.

2. Data and Methods

a. Data collection and survey setup

The analysis is based on a pooled dataset (N=2,260) from two surveys, which provide one of the most in-depth insights into household and individual preferences with respect to RE in Austria and Switzerland. The survey in Austria has been completed in October 2015 with 1,014 respondents (for project report, see Hampl et al., 2016). The Swiss survey was conducted in February-March 2015 and included 1,246 respondents (for project report, see Ebers and Wüstenhagen, 2015). Both samples are representative of the populations in the two countries with respect to region, gender, age, and education. Note that the Swiss sample excludes the Italian-speaking region of Ticino, as the survey was conducted in German and French. Since only 4% of Swiss population lives in this area (Swiss Federal Statistical Office, 2017b), it did not have a significant impact on the representativeness of the survey.

It was possible to pool the data because the surveys included the same set of questions on:

(1) Respondents' WTI into community energy projects (Figure 1), specific investment amounts (Figure 2) and preferred RE technologies among potential investors (Figure 3).

Potential investors⁵ answered 'yes' or 'rather yes' to the question 'I could imagine participating in a community finance project that develops renewable energy'⁶, and subsequently named the amount they would be willing to invest in EUR or CHF (Figure 2)

⁵ For Austria, this group of potential investors also includes a small fraction of actual investors (7%) that were asked whether they could imagine participating in *another* CRE project.

⁶ A description of CRE projects was provided to the respondents in a pop-up window of the survey.

and the preferred technologies (Figure 3). The non-investors responded ‘no’ or ‘rather no’ to this question.

Figure 1: Willingness to invest into community renewable energy projects

Figure 2: Potential investor's willingness to commit funds to community renewable energy projects

Figure 3: Potential investor's preference of renewable energy technologies

(2) *Socio-demographic characteristics, such as gender, age, educational level, residence (urban vs. rural), net household income per month, and home ownership (renter vs. homeowner) (Table 1).*

These variables were added as they have been determined as important by prior research like Bauwens and Eyre (2017), Brounen et al. (2012) and Ohler and Billger (2014). With respect to residence, the respondents were manually assigned to either category ‘rural’ or ‘urban’, based on the zip codes. In Austria, the European Commission’s Degree of Urbanization typology is used and we assigned ‘rural’ to zip codes that were classified as ‘thinly-populated (rural areas)’, while ‘urban’ was assigned to ‘densely populated areas (cities/urban centers/urban areas)’ and ‘intermediate density areas (towns, suburbs)’ (Eurostat, 2017; Statistik Austria, 2016c). Switzerland uses a comparative, but slightly different classification typology. We classified Swiss respondents as ‘urban’ if they lived in zip codes with the typologies: ‘nucleated town of an agglomeration’, ‘other municipality of an

agglomeration’, ‘isolated town’, and ‘urban’ (Swiss Federal Statistical Office, 2016a). The ‘rural’ category was assigned to respondents with zip codes tagged as ‘rural municipalities’. The variable ‘net household income per month’ has been assigned to the category ‘low income’ for incomes below 5,000 CHF (in CH) and 1,700 EUR (in AT) per month, ‘middle income’ for incomes between 5,000-11,000 CHF (in CH) and 1,700-3,500 EUR (in AT) per month, and ‘high income’ for incomes equal or above 11,000 CHF (in CH) and 3,500 EUR (in AT) per month, corresponding to the respective national income level (Statistik Austria, 2016b; Swiss Federal Statistical Office, 2015a).

<<Table 1: Characteristics of potential investors and non-investors in CRE projects >>

Variable	Question and coding	Potential investors		Non-investors		Country average ^a	
		AT	CH	AT	CH	AT ^b	CH ^c
<i>Socio-demographic variables</i>							
Gender	0=female	38.2%	51.3%	57.0%	50.0%	51.1%	50.5%
	1=male	61.8%	48.7%	43.0%	50.0%	48.9%	49.5%
Age	Under 15 years	0%	0%	0%	0%	14.3%	14.9%
	15-24 years	9.2%	12.6%	8.6%	7.5%	11.7%	11.2%
	25-54 years	65.7%	63.2%	60.0%	60.7%	43.0%	43.6%
	55 years and over	25.1%	24.2%	31.4%	31.8%	30.9%	30.3%
Education	0=compulsory school	3.2%	3.3%	4.3%	3.7%		25.6%
	1=vocational training	37.5%	43.0%	48.2%	54.2%	26.9%	35.5%
	2=high school	33.3%	10.1%	26.4%	8.3%	45.8%	
	3=college, university, other advanced degree	26.1%	43.5%	21.1%	33.9%	14.0%	11.3%
						13.3%	12.1%
Residence	0=rural	34.7%	29.1%	32.4%	33.8%	39.4%	26.3%
	1=urban	65.3%	70.9%	67.6%	66.2%	60.6%	73.7%
Income	0=low	19.3%	19.1%	27.3%	17.5%	13.9%	22.4%
	1=middle	44.3%	61.4%	50.1%	61.5%	77.3%	58.1%
	2=high	36.4%	19.6%	22.6%	21.0%	8.8%	19.5%
Home ownership	0=renter	39.2%	50.8%	51.4%	42.7%	50.4%	62.5%
	1=owner	60.8%	49.2%	48.6%	57.3%	49.6%	37.5%
<i>Socio-psychological variables</i>							
Solar myth	‘I believe that solar cells use more energy during their manufacturing than they later produce.’						
	1=agree	10.6%	6.3%	10.2%	10.9%		
	2=rather agree	26.3%	25.1%	33.4%	36.1%		
	3=rather disagree	46.2%	51.0%	44.3%	36.7%		
	4=disagree	16.9%	17.5%	12.1%	16.3%		

Grid parity optimism	‘I believe that solar electricity will reach grid parity in 20 years.’				
	1=disagree	3.5%	2.6%	5.9%	8.1%
	2=rather disagree	18.3%	19.2%	26.2%	30.2%
	3=rather agree	48.2%	57.5%	48.0%	49.4%
	4=agree	30.5%	20.5%	19.9%	12.4%
Future without fossil fuels	‘I do not believe that one day we will be able to live without fossil fuels.’				
	1=agree	14.7%	13.2%	20.1%	27.0%
	2=rather agree	33.9%	33.9%	40.6%	35.7%
	3=rather disagree	32.3%	31.7%	27.3%	25.4%
	4=disagree	19.1%	21.2%	11.9%	11.9%
Wind energy acceptance	‘I would approve of building a wind turbine slightly outside my community.’				
	1=disagree	8.7%	9.9%	15.8%	19.6%
	2=rather disagree	16.7%	12.0%	21.7%	19.4%
	3=rather agree	39.4%	38.4%	37.3%	36.1%
	4=agree	35.5%	39.7%	25.2%	24.9%
	N	502	752	512	494
	% of sample	49.5%	60.4%	51.5%	39.6%

^a Values refer to year 2015, with exception of ‘home ownership’ (AT) refers to 2014, ‘education’, ‘residence’, and ‘income’ (CH) refers to 2000, 2014, and 2013 respectively.

^b Statistik Austria, 2015, 2016a, 2017a,b,c; Ministry of Labor, Social Affairs and Consumer Protection, 2017

^c Swiss Federal Statistical Office, 2014, 2015b, 2015c, 2016b, 2017a; Swiss Federal Housing Office, 2016

(3) Socio-psychological characteristics such as attitudes and beliefs related to specific RE technology and the prospects of RE in general (Table 1).

To investigate the relationship between attitudes and beliefs and WTI, this study includes four variables that provided an indication of the respondents’ knowledge about solar power (variable ‘solar myth’), their optimism with respect to cost reductions of RE (variable ‘grid parity optimism’) and substitution of fossil fuels with RE (variable ‘future without fossil fuels’), and finally, their acceptance of wind energy in the back yard (variable ‘wind energy acceptance’). The variable ‘solar myth’ investigated whether the respondents’ believe an often repeated, yet erroneous statement that solar cells require more energy during manufacturing than they later produce. In reality, the energy payback time of solar photovoltaic systems in Europe is between 1.5 and 2.5 years, depending on the geographical location and technology (Fraunhofer, 2016). The energy balance of solar cells is thus positive after several years of use.

‘Grid parity optimism’ evaluated the respondents’ belief about whether solar power will achieve grid parity in the coming two decades. The results from the European PV Parity project (2013) show that solar power has already reached grid parity in several European countries in 2012 (Germany, Italy, Netherlands and Spain) and will achieve grid parity in most of the European countries by 2020, so disagreeing with this statement signals pessimism.

The last two socio-psychological questions solicited the respondents’ beliefs about a future without fossil fuels and acceptance of a wind energy project near their communities. We expected that respondents with more favorable views on RE would be more likely to express willingness to participate in CRE projects. For the socio-psychological questions higher values in the responses indicate more support of RE. This makes the interpretation of the logistic regression results, discussed below, more intuitive.

(4) Perceived drivers and barriers to investment in community finance in Austria (Figures 4 and 5) and Switzerland (Figure 6).

For this category of variables, Austrian and Swiss surveys used slightly varying methodologies. In Switzerland, the respondents answered whether the presented driver was ‘important’ or ‘not important’. The Austrian study, which was conducted later, gave the respondents a more refined way to express their opinion by evaluating a specific driver or barrier on a 5-point Likert scale ranging from ‘very important’ to ‘not important’. The question on investment drivers was absent from the Swiss study.

Figure 4: Drivers to investment in community renewable energy projects in Austria

Figure 5: Barriers to investment in community renewable energy projects in Austria

Figure 6: Barriers to investment in community renewable energy projects in Switzerland

b. Methodology

In a first step, we compared the socio-demographic and socio-psychological characteristics of the Swiss and Austrian potential investors and non-investors. Then, we utilized logistic regression to test the difference between potential investors and non-investors. This is a standard method when the dependent variable is binary, which has been used in studies ranging from chemistry to social sciences and engineering (some recent studies that apply to energy include Calì et al. (2016) and Hansen et al. (2017)). For the analysis, we defined willingness-to-invest as the dependent variable (1=potential investors, 0=non-investors) and the socio-demographic and socio-psychological categorical variables were covariates. Respondents' age was the only continuous variable in the regression. The exponential beta coefficients show the odds of investment in community finance, while Nagelkerke R² and log likelihood provide information about the goodness of fit.

Subsequently, we investigated and described different investor groups, who will be at the

focus of policy and marketing efforts. To achieve it, we conducted an explorative two-step cluster analysis, which incorporates the principles of both hierarchical and partitioning clustering methods (Mooi and Sarstedt, 2011). This approach has been widely used in market and policy research, for example for segmenting mobile Internet adopters in Japan (Okazaki, 2006), describing profiles of cyclists at an event in Australia (Lamont and Jenkins, 2013), or characterizing different bioenergy policy approaches in the US (Ebers et al., 2016). The method ensures the highest homogeneity within and maximal heterogeneity between the clusters and can be used for categorical variables present in our data (Kaufman and Rousseeuw, 2005). It was tested whether the categorical variables are independent (chi-squared tests) and have a multinomial distribution. Some degree of interdependency between socio-demographic and socio-psychological variables in the sample was expected, but these interdependencies do not negate the clustering results.

Two-step clustering is appropriate for large samples where the number of clusters is not fixed a-priori (Chiu et al., 2001). To identify the appropriate number of clusters, we explored the solutions for two to five clusters with different clustering variables. Even though the clustering cannot identify true groups of investors, the segments allow the creation of more tailored policy and marketing approaches, which is superior to pursuing a mass marketing strategy (Dolnicar and Leisch, 2010). Segmentation results were evaluated based on the quality of fit (smaller BIC), stability (comparing with results of other clustering techniques like k-means), validity (ease and meaningfulness of interpretation), and comparability between countries (Mooi and Sarstedt, 2011). In the final segmentation, the potential investors were separated into four clusters according to their residence (urban vs. rural) and acceptance of wind energy, contrasting the respondents who (rather) agreed to accept a wind energy project near their domicile with the respondents who (rather) disagreed. To investigate between-cluster differences, we decided against using the independent t-tests (ANOVAs), due to their inadequate treatment of categorical outcomes (Jaeger, 2008). Instead, we conducted

chi-squared tests with the null hypothesis: ‘Cluster membership is not associated with socio-demographic or socio-psychological characteristics of the respondent’. We reported the cases where the null hypothesis was rejected (see Appendix 1). Each cluster was labeled with a meaningful name that described the potential investors in this group as either rural or urban wind energy enthusiast or skeptic.

3. Results and Discussion

a. Comparison of potential investors and non-investors

The results suggest positive prospects for CRE projects in both countries. In Austria, about half (49.5%) of the respondents are ‘potential investors’, which is a high rate for this relatively new investment vehicle. In Switzerland, the share of the potential investors is even higher, reaching 60.4% of the sample. Austrian and Swiss respondents most often mention solar photovoltaic as the preferred technology for investment, which is similar to the preferences of potential investors in Germany described by Salm et al. (2016). Wind power is the second most preferred technology in both countries. This result suggests a particularly high potential for community projects in solar photovoltaic and further expansion of the so-called citizen wind energy parks (‘Bürgerwindenergiepark’ in German).

The results of the logistic regression show how different socio-demographic and socio-psychological variables impact the odds of investment in CRE projects (Table 2). Similar to Germany (Fraune, 2015), Austrian and Swiss community finance investors are on average more likely to be male. This effect is especially pronounced in Austria, where male respondents are more than twice (2.27) as likely to invest into community RE projects than female respondents. Switzerland seems to have a better gender balance among potential investors (see Table 1).

Table 2: Impact of socio-demographic and socio-psychological variables on willingness to invest in community renewable energy projects

Dependent variable=WTI	Exp(B) Austria	Exp(B) Switzerland
<i>Socio-demographic variables</i>		
Gender	2.27***	0.90
Age	0.98***	0.99
Education	1.10	1.31***
Residence	1.21	1.02
Income	1.24**	0.78*
Home ownership	1.75***	0.91
<i>Socio-psychological variables</i>		
Solar myth	1.13	1.13
Grid parity optimism	1.47***	1.33***
Future without fossil fuels	1.24***	1.52***
Wind energy acceptance	1.31***	1.35**
Constant	0.04	0.10***
Nagelkerke R Square	0.17	0.15
-2 Log likelihood	1127.6	936.8
Correct predictions for potential investors	66.0%	84.1%

*** Statistically significant at the 0.01 level.

** Statistically significant at the 0.05 level.

* Statistically significant at the 0.1 level.

With respect to age, we identified a statistically significant, albeit small difference between investors and non-investors in Austria. No effect was found for the Swiss sample. An average potential investor is slightly younger than 44, while non-investors are on average 2 years older. We identified a significant segment of urban investors (nearly two thirds) in our sample. Yet, the residence variable was not a significant predictor of investment, while in Germany rural residents were more likely to participate in community finance (Kalkbrenner and Roosen, 2016).

We find evidence that in Austria home ownership increases the likelihood of being a potential investor by 75%, in spite of the fact that CRE projects allow participation of both home-owners and renters, regardless of whether they own the property that is suitable for RE installation. Having a higher income increased the odds of investment into CRE by 24% in Austria, which agrees with our findings that lacking financial means are the largest barrier for investment. Prior study of wind power investments in Germany also showed that investors tend to be younger and have more financial means (Gamel et al., 2016). For the Swiss sample,

the education variable is highly significant, suggesting that more years of schooling increases the WTI. Further, our results highlight the importance of attitudes and beliefs in investment decision-making. Specifically, potential investors in our sample tend to disagree with an often-repeated but erroneous statement that solar cells use more energy during their manufacturing than they later produce. They demonstrate significantly higher acceptance of wind power than non-investors, as measured through individual acceptance of wind installations in the respondent's vicinity. In addition, the potential investors in both countries tend to be more optimistic about the economic competitiveness (grid parity) of solar photovoltaic and about the possibility of substitution of fossil fuels with RE in the future.

b. Characteristics of potential investors

Given that the marketing and policy efforts will be tailored towards potential investors, we provide a more in-depth description of their characteristics. Cluster analysis allowed us to identify four clusters of potential investors according to their residence (urban vs. rural) and their acceptance of wind energy near their community. The chi-squared tests confirm that the cluster members differ with respect to socio-demographic and socio-psychological characteristics, summarized in Tables 3 and 4.

The largest group of potential investors in Austria and Switzerland can be described as 'urban energy enthusiasts' (49.8% and 55.8% respectively), who are mostly renters and show high acceptance of wind energy installations near their communities. These potential investors are informed about solar technologies, are rather optimistic about the achievement of grid parity and the possibility to live without fossil fuels in the future. In Austria, the members of this cluster are most highly educated, but have lower than average incomes compared to other clusters. This stands in contrast to Swiss potential investors in this cluster, who are middle income. 'Urban energy enthusiasts' are also most likely to disagree with the 'solar myth' than members of other clusters (confirmed by the Chi-squared tests).

Table 3: Characteristics of potential investors into community renewable energy projects in Austria

Variable	Question and coding	Urban wind energy		Rural wind energy	
<i>Socio-demographic variables</i>		enthusiasts	skeptics	enthusiasts	skeptics
**a Gender	0=female	38.4%	34.6%	46.8%	20.8%
	1=male	61.6%	65.4%	53.2%	79.2%
Age	Young: 16-24 years	8.0%	11.5%	9.5%	10.4%
	*Middle: 25-54 years	67.6%	74.4%	58.7%	60.4%
	**55 years and older	24.4%	14.1%	31.7%	29.2%
** Education	0=compulsory school	2.8%	2.6%	2.4%	8.3%
	1=vocational training	31.2%	38.5%	45.2%	47.9%
	2=high school	36.4%	28.2%	31.0%	31.3%
	3=college, university etc.	29.6%	30.8%	21.4%	12.5%
** Income	0=low	25.7%	12.7%	14.2%	9.5%
	1=middle	42.6%	52.1%	40.7%	50.0%
	2=high	31.7%	35.2%	45.1%	40.5%
*** Home ownership	0=renter	55.2%	39.7%	13.5%	22.9%
	1=owner	44.8%	60.3%	86.5%	77.1%
<i>Socio-psychological variables</i>					
Solar myth	'I believe that solar cells use more energy during their manufacturing than they later produce.'				
	1=agree	10.80%	7.70%	13.50%	6.30%
	2=rather agree	25.20%	19.20%	27.80%	39.60%
	3=rather disagree	42.80%	59.00%	42.90%	52.10%
	4=disagree	21.20%	14.10%	15.90%	2.10%
^b Grid parity optimism	'I believe that solar electricity will reach grid parity in 20 years.'				
	1=disagree	2.8%	5.1%	2.4%	2.1%
	2=rather disagree	18.0%	28.2%	12.7%	18.8%
	3=rather agree	51.6%	35.9%	47.6%	52.1%
	4=agree	27.6%	30.8%	37.3%	27.1%
Future without fossil fuels	'I do not believe that one day we will be able to live without fossil fuels.'				
	1=agree	16.0%	11.5%	14.3%	14.6%
	2=rather agree	33.6%	35.9%	32.5%	35.4%
	3=rather disagree	29.6%	37.2%	34.9%	31.3%
	4=disagree	20.8%	15.4%	18.3%	18.8%
<i>Investment-related variables</i>					
WTI	Up to 100 EUR	22.8%	29.5%	14.3%	8.3%
	Up to 1,000 EUR	51.2%	51.3%	60.3%	79.2%
	Up to 10,000 EUR	9.6%	7.7%	13.5%	6.3%
	More than 10,000 EUR	2.4%	0.0%	0.8%	2.1%
	Missing	14.0%	11.5%	11.1%	4.2%
Preferred technology	Solar photovoltaic	70.0%	76.9%	81.0%	85.4%
	Wind power	52.0%	14.1%	50.8%	27.1%
	Hydropower	36.8%	28.2%	25.4%	33.3%
Investment drivers ^c	Biomass	25.6%	14.1%	17.5%	8.3%
	Support for renewable energy	1.76	1.87	1.70	1.98
	Protection of climate and natural resources	1.79	2.08	1.68	1.98
	Independence from energy imports	1.92	2.15	1.73	1.88
	Personally help energy transition	1.95	2.26	1.87	2.08
	Support of local or regional initiative	2.05	2.14	1.91	2.10
	Development of local economy (new jobs, tax base)	2.10	2.18	1.97	2.48
	Secure investment	2.15	2.14	2.00	2.21
	High return on investment	2.36	2.31	2.24	2.58
	Lacking financial means	2.19	2.60	2.27	2.42
Investment barriers ^c	Immaturity of RE technologies	2.43	2.74	2.49	2.83
	Investment risk too high	2.49	2.69	2.60	2.88
	Investment too long-term	2.60	2.59	2.65	2.77
	Return on investment is too low	2.66	2.63	2.57	2.88
	Political uncertainty	2.81	2.64	2.82	2.71
	Don't know enough to decide	2.82	3.06	3.00	3.33
	High complexity	2.82	2.97	2.76	2.96
	Cluster share	49.8%	15.5%	25.1%	9.6%

^a Significant Pearson Chi-squared statistic that rejects the null hypothesis of no difference between clusters of potential investors in Austria.

^b Significant Pearson Chi-squared statistic that rejects the null hypothesis of no differences between rural enthusiasts vs. urban skeptics, and urban enthusiasts vs. urban skeptics.

^c Values are average ratings (1=very important, 5=not important).

*** Chi-squared test significant at the 0.01 level (2-tailed).

** Chi-squared test is significant at the 0.05 level (2-tailed).

* Chi-squared test is significant at the 0.1 level (2-tailed).

Table 4: Characteristics of potential investors into community renewable energy projects in Switzerland

Variable	Question and coding	Urban wind energy		Rural wind energy	
<i>Socio-demographic variables</i>		enthusiasts	skeptics	enthusiasts	skeptics
^a Gender	0=female	51.6%	53.1%	49.7%	51.0%
	1=male	48.4%	46.9%	50.3%	49.0%
Age	Young: 16-24 years	13.1%	12.4%	12.7%	10.2%
	Middle: 25-54 years	62.2%	63.7%	67.3%	61.2%
	55 years and older	24.7%	23.9%	20.0%	28.6%
^{***} Education	0=compulsory school	2.7%	5.3%	3.6%	2.0%
	1=vocational training	39.6%	33.6%	57.0%	44.9%
	2=high school	11.4%	12.4%	8.5%	2.0%
	3=college, university	46.4%	48.7%	30.9%	51.0%
Income	0=low	16.5%	26.4%	19.5%	20.0%
	1=middle	65.0%	52.8%	58.4%	64.0%
	2=high	18.4%	20.8%	22.1%	16.0%
^{***} Home ownership	0=renter	56.4%	51.3%	41.2%	34.7%
	1=owner	43.6%	48.7%	58.8%	65.3%
<i>Psychological variables</i>					
^a Solar myth	'I believe that solar cells use more energy during their manufacturing than they later produce.'				
	1=agree	6.1%	6.2%	6.7%	8.3%
	2=rather agree	19.7%	42.5%	29.1%	18.8%
	3=rather disagree	52.1%	46.9%	47.3%	62.5%
	4=disagree	22.1%	4.4%	17.0%	10.4%
^{**} Grid parity optimism	'I believe that solar electricity will reach grid parity in 20 years.'				
	1=disagree	2.2%	5.4%	1.2%	4.1%
	2=rather disagree	15.9%	23.4%	20.9%	34.7%
	3=rather agree	58.7%	53.2%	58.9%	51.0%
	4=agree	23.2%	18.0%	19.0%	10.2%
Future without fossil fuels	'I do not believe that one day we will be able to live without fossil fuels.'				
	1=agree	11.1%	17.0%	13.9%	18.8%
	2=rather agree	31.2%	39.3%	36.4%	35.4%
	3=rather disagree	33.7%	27.7%	30.9%	27.1%
	4=disagree	24.0%	16.1%	18.8%	18.8%
<i>Investment-related variables</i>					
WTI	Up to 100 CHF	15.7%	24.8%	14.5%	12.2%
	Up to 1,000 CHF	44.1%	43.4%	45.5%	49.0%
	Up to 10,000 CHF	36.3%	31.0%	34.5%	38.8%
	More than 10,000 CHF	3.9%	0.9%	4.8%	0.0%
	Missing	0.0%	0.0%	0.6%	0.0%
Preferred technology	Solar photovoltaic	80.1%	75.2%	78.8%	85.7%
	Wind power	51.1%	15.0%	55.2%	16.3%
	Hydropower	39.2%	36.3%	40.6%	38.8%
	Biomass	32.9%	26.5%	33.3%	32.7%
Investment barriers	Don't know enough to decide	43.1%	46.9%	41.2%	42.9%
	Investment risk too high	42.1%	41.6%	40.6%	40.8%
	High complexity	26.9%	24.8%	24.2%	24.5%
	Political uncertainty	26.9%	24.8%	24.2%	36.7%
	Return on investment is too low	25.2%	26.5%	19.4%	28.6%
	Investment too long-term	22.8%	22.1%	24.2%	34.7%
	Immaturity of RE technologies	18.9%	18.6%	24.2%	20.4%
	Prefer traditional investment instruments	8.7%	10.6%	6.1%	10.2%
	Lacking financial means	1.7%	1.8%	2.4%	0.0%
Cluster share:		55.8%	15.3%	22.3%	6.6%

^a Significant Pearson Chi-squared statistic that rejects the null hypothesis of no difference between clusters of potential investors in Switzerland.

^{***} Chi-squared test significant at the 0.01 level (2-tailed).

^{**} Chi-squared test is significant at the 0.05 level (2-tailed).

^{*} Chi-squared test is significant at the 0.1 level (2-tailed).

Potential investors in community finance can also be found in the rural areas. The second largest cluster, 'rural wind energy enthusiasts', accounts for about a quarter of the potential-investor sample (25.1% in AT, 22.3% in CH). A typical member of this cluster can be described as a rural homeowner, who is rather optimistic about the achievement of grid parity and would accept a wind installation in her vicinity. Note that rural residents are in general more likely to be homeowners in both countries.

The surprising result is that nearly a quarter of potential investors into a CRE project would not welcome a wind turbine near their domicile. We call them ‘urban and rural wind energy skeptics’ and they account for 25.1% of potential investors in Austria and 21.9% of potential in Switzerland. Still, 27% of rural wind energy skeptics in Austria and 16% in this segment in Switzerland would invest in wind power. In general, willingness to participate in a community finance project is not contingent upon acceptance of a wind turbine in the backyard. Though counter-intuitive, it has been confirmed by prior studies that people involved in CRE projects do not necessarily welcome local wind energy developments (Walker and Devine-Wright 2008; Bell et al. 2005). Despite their low levels of acceptance of wind energy, the majority of urban wind energy skeptics (rather) disagree with the ‘solar myth’ and show significant optimism about solar energy reaching grid parity in the future. Compared to other clusters, the ‘urban wind energy skeptics’ are the most educated among the Swiss potential investors. The ‘rural wind energy skeptics’ in Austria are the least educated, predominantly male homeowners with high incomes. Note that in urban areas, Austrian and Swiss respondents are more likely to have attended high school or college, while in rural areas respondents with vocational education are overrepresented.

Concerning the willingness to invest in monetary units, the respondents in the two countries have slightly different preferences. The largest share of potential investors in both countries (44.4% in CH and 56.2% in AT) would invest 100 to 1,000 CHF or EUR; while 35.2% of Swiss investors would be willing to dedicate 1,000 to 10,000 CHF to CRE project (compare to 10% in AT). Swiss potential investors are generally willing to invest higher amounts than their Austrian counterparts, which, perhaps, is not surprising given higher income levels in Switzerland. In both countries, there is also a small segment of ‘wind energy enthusiasts’ who would be willing to invest more than 10,000 EUR/CHF into CRE projects.

The importance of wind energy skeptics should be stressed here: 79.2% of the Austrian and 49% of Swiss rural wind energy skeptics indicate the willingness to invest between 100

and 1,000 EUR or CHF. The share of urban wind energy skeptics willing to invest the same amounts is also considerable (51.3% in AT and 43.4% in CH). Note that most preferred technology for investment by wind energy enthusiasts and skeptics alike is solar PV. Still, a small share of urban and rural wind energy skeptics in both countries would invest into wind power (possibly, as long as the project is situated further away from their residence). Instead of wind, these investors would prefer investing into hydropower, which is a more established technology that contributes 60% and 56% to the electricity mix in Austria and Switzerland, respectively (E-Control, 2017; Swiss Federal Office of Energy, 2017). Thus, urban and rural wind energy skeptics represent an important customer segment for CRE project developers and their preferences should be taken into consideration.

Since community finance is a relatively new investment instrument for RE development, it is important to know perceived drivers for and barriers to its implementation. For Austrian respondents, most important aspects of CRE projects are: their support for RE, the protection of climate and natural resources, and independence from foreign energy suppliers. Rural wind energy skeptics in Austria seem to put higher emphasis on independence from energy imports. Overall, our findings on motives for investment in CRE initiatives correspond to insights from prior work by Bauwens (2016), Dóci and Vasileiadou (2015), Kalkbrenner and Roosen (2016) and Yildiz et al. (2015).

The respondents from these two countries have a quite different perspective on barriers to investment in CRE, and the most striking difference is the reported availability of financial means. Austrian respondents name the lack of financial means as the top barrier to participation in community finance, while Swiss respondents rank this barrier as the least important. In general, economic considerations are more prominent in Austria, perhaps due to lower income levels. In both countries, the respondents evaluate the riskiness of CRE projects as ‘too high’, often comparing it to the investment in a startup company (Ebers and Wüstenhagen, 2015). For the Austrian segments of potential investors we find that urban and

rural wind energy enthusiasts see, besides the lack of financial means, the immaturity of RE technologies as the main barriers to investment in CRE. Specifically, urban wind energy skeptics emphasize the duration of the investment as the most important barrier. The Swiss clusters do not significantly differ in their perception of investment barriers, except for that rural wind energy skeptics particularly highlight political uncertainty as one of their main barriers to investment and stress the duration of the investment.

4. Conclusions and Policy Implications

Increasing the share of RE in order to meet emission targets requires considerable public and private investment. Engaging small-scale investors through CRE projects offers an alternative and promising source of private funds. From an investor's perspective, community finance allows investing incremental amounts in local or regional RE projects with a promise of a conservative, but a positive return, thus presenting an alternative to savings accounts widely used by individual investors. Investors in CRE projects, however, are not a homogenous group of individuals. They follow different rationales and their socio-demographic and socio-psychological profiles differ within and among geographic markets. The current study is among the first to investigate the potential investors' preferences, including their difference from non-investors, willingness to invest, technological preferences, and their personal beliefs related to RE.

In our study, we identified that roughly half of respondents in Austria and 60% of respondents in Switzerland are potential investors interested in committing up to 10,000 CHF or EUR to CRE projects. This gives an indication of the potential market size for CRE in these countries. To gain a deeper understanding of investor heterogeneity we identified four distinct segments of CRE investors. In both Austria and Switzerland, the respondents' beliefs were strongly related to their investment intentions. The largest group of potential investors in community finance can be characterized as urban wind energy enthusiasts, who would be

happy to accept a wind turbine close to their community. The study also identified a significant share of wind energy enthusiasts living in the rural areas, who together with the first group account for about three quarters of the potential investors in both countries. Yet, one does not need to be a staunch wind energy enthusiast to invest into RE projects, and more specifically into wind energy. Nearly a quarter of potential investors did not show high levels of wind energy acceptance in their communities, but some of them would still invest in community wind projects. This group of investors might be interested in CRE projects that finance other technologies, such as solar photovoltaic and hydropower.

The knowledge of different investor profiles offers the opportunity for more tailored approaches in project development and communication. Project developers, policy makers and other stakeholders (such as NGOs and representatives of local cooperatives and companies offering shares in CRE projects) might target potential investors with messages emphasizing topics that most resonate with their audience. In Austria, we found that three investor groups out of four, but especially wind energy enthusiasts, are driven by the support for renewable energy and protection of climate and natural resources. These investors might be likely to respond to the measures that emphasize environmental benefits of CRE projects. Other potential investors, most notably rural wind energy skeptics in our sample, see CRE projects as a way to increase energy independence. They might be more attracted to the messages of reducing energy imports thanks to the CRE projects at home. On average, wind energy skeptics were also concerned about local value creation. A certificate of origin for the locally- or regionally-generated electricity can create value for this investor segment. Note that labeling local produce is a common practice in supermarkets in both countries (Hampl and Looock, 2013), but is yet to find wider acceptance in the renewable energy sector.

Our study indicated the need for further consumer education with respect to RE in general and community finance opportunities in particular. First, non-investors in our sample were on average more likely to believe that solar cells use more energy than they later

produce (an erroneous statement) and that solar power will not be able to achieve grid parity in the coming years (grid parity is already achieved in a number of European countries). This pessimism points to the need for more active communication about the actual performance of RE technologies, which might be necessary for overcoming investment skepticism and creating a business case for CRE projects.

Second, a large group of respondents in both countries (but especially in Switzerland) considered themselves not well-informed about community finance projects. The respondents were concerned about risks, returns, and duration of the investment, also mentioning political uncertainty and complexity. This suggests considerable uncertainty about the risk-return profile of CRE finance, as it is a relatively new investment vehicle. The stakeholders need to disseminate more information about the unique characteristics of community finance, in order to raise awareness and to align perceived and real riskiness of CRE projects in the minds of potential investors. This could be done by setting up marketing and awareness-raising campaigns. Information about CRE projects might also be disseminated by the finance sector, such as local banks and investment advisors, who could help bring CRE from the niche to the mainstream. Another option is setting up one-stop-shops to inform interested parties about CRE projects, bringing together potential investors with project developers, as well as providing project developers with information on relevant regulations. An example of such a one-stop-shop is the Community Renewables Initiative (CRI), established by the Countryside Agency in the UK (Walker and Devine-Wright, 2008).

There is further potential for creating socio-political acceptance of RE technologies through stable and effective policies (Wüstenhagen et al., 2007). The importance of policy design has been highlighted in a number of prior studies (e.g. Bauwens, 2016; Bauwens et al., 2016; Boon and Dieperink, 2014; Dóci and Gotchev, 2016). With the Swiss adoption of Energy Strategy 2050 (Swiss Energy Law, 2016) as well as amendments in the Austrian Green Electricity Act (2017), the policies in both countries are in flux. Given the budding

nature of the CRE investments, caution is advised when changing to the current policy system, with the need to pay special attention not to disadvantage community energy initiatives. An example from Germany illustrates how the policy makers can create an advantageous framework for CRE projects despite a policy change. Seen as a success story, about 20% of onshore wind power and about 9% of total RE⁷ installations are owned by German communities (trend:research and Leuphana Universität Lüneburg, 2013). Even after the switch to a tender system, which was feared to stifle the sector (Müller and Holstenkamp, 2015), CRE projects could successfully compete in the market (Bundesnetzagentur, 2017).

We acknowledge some limitations of the study. First, the intention to invest in CRE projects might not translate into real investments, a phenomenon known as the *intention-behavior gap* (Carrington et al., 2010). This gap is frequently observed in connection to environmentally-friendly products and behaviors, where socially desirable answers and prediction errors of future behavior bias survey results. Further research might consider surveying a panel of respondents or tracking certain CRE projects over a time to investigate whether the investment intention resulted in actual investment. Second, our study only covers two countries, Austria and Switzerland, that are similar in their culture and topographic conditions. Even though our findings reveal important differences in the profiles of potential investors between these two countries, future work might investigate a broader range of geographical regions with more distinct differences.

Another promising venue for further research is the investigation of whether different types of investors prefer different types of CRE projects. It can be assumed that investors who are more interested in local and cooperative forms of RE projects put more emphasis on local recreation and earnings and values such as social identification and interpersonal trust (Bauwens, 2016; Salm et al., 2016). Investors that specifically emphasize financial gains (Fleiß et al., 2017) might be more interested in investing in so-called ‘communities of

⁷ Excludes pumped-storage hydropower, offshore wind power, geothermal power and electricity from biogenic waste (trend:research and Leuphana Universität Lüneburg, 2013).

interest' projects, i.e. community projects that are not defined by a certain place or local community but a common interest or goal (Bauwens, 2016; Heiskanen et al., 2010). It might be worthwhile to experimentally investigate the WTI of different investor segments by varying project characteristics and incentive schemes (cf. Bauwens and Eyre, 2017).

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7. Appendix

Appendix 1: Pearson Chi-squared tests for independence between cluster membership and characteristics of potential investors in Austria and Switzerland

Variable	Clusters membership Austria	Clusters membership Switzerland
<i>Socio-demographic variables</i>		
Gender	^a 10.526**	
Young age: <24		
Middle age: 25-54	6.309*	
Older age: >54	8.466**	
Education	18.413**	26.049***
Income	15.774**	
Home ownership	67.115***	16.380***
<i>Psychological variables</i>		
Solar myth	20.850**	40.089***
Grid parity optimism		20.191**

^a Value of Pearson's chi-squared statistic, only statistically significant results are presented.

*** Chi-squared test significant at the 0.01 level (2-tailed).

** Chi-squared test is significant at the 0.05 level (2-tailed).

* Chi-squared test is significant at the 0.1 level (2-tailed).