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

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HIGHLIGHTS

- Out of 1990 retail investors surveyed, 1041 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.

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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

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[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