Dealing with heterogeneity and complexity in the analysis of the willingness to invest in community renewable energy in rural areas

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A R T I C L E   I N F O

A B S T R A C T

Community Renewable Energy (CRE) is a central concept of current political agendas aimed at fostering a sustainable energy transition that can be linked to the development of rural areas. To design effective policies and strategies to promote the development of rural CRE, the diverse conditioning factors of the decision to invest in CRE projects should be analyzed. However, to the best of our knowledge, little research has examined this issue and no study has explicitly focused on rural "bioenergy village" projects under a quantitative research design. Moreover, although past research on the decision to invest in CRE has acknowledged the importance of the influence of alternative cognitive factors, the financial determinants of that decision have been somewhat disregarded. Furthermore, the complex and heterogeneous nature of human behavior has not been directly addressed through appropriate methodological frameworks. Applying a fuzzy-set Qualitative Comparative Analysis (fsQCA) to the responses obtained through a survey on the decision to invest in a hypothetical small bioenergy village project, we analyze a varied set of propositions related to the role of different sociodemographic, sociopsychological, and financial features as antecedents and outcomes. Results reveal the diverse configurations of all these factors that policy makers, promoters of CRE projects, and researchers should consider to effectively contribute to the development of CRE in rural settings.

1. Introduction

Sustainable development, climate change mitigation, and rural development are intertwined global priorities that can all together substantially benefit from transitioning towards a sustainable energy system, where renewable energy (RE), and both individual and community action are expected to be highly relevant (van der Schoor et al., 2016). Population ageing and decline has put the development of rural areas at risk and made it necessary to revitalize their socioeconomic status (Martínez-Filgueira et al., 2017). Rural areas are also commonly characterized by a lack of connection to gas mains and the risk of fuel poverty of rural households (Markantoni and Woolvin, 2015). The huge RE potential of these areas (Hain et al., 2005) provides an opportunity to develop rural Community Renewable Energy (CRE) initiatives (Magnani et al., 2017) involving the shared ownership and/or management of RE projects. The deployment of CRE projects in rural areas could drive the transition towards a sustainable energy system (Hicks and Ison,

2011) and positively contribute to sustainable rural development (Clausen and Rudolph, 2020).

In Europe, the development of CRE initiatives, in general, and of "bioenergy villages", in particular, has mainly occurred in Western and Northern countries (von Bock und Polach et al., 2015; Roesler, 2019). Southern countries like Spain lag behind (Romero-Rubio and de Andrés-Díaz, 2015; Becker et al., 2017). Nevertheless, recent changes in the European and Spanish regulatory frameworks are paving the way for a further development of these projects in the coming years (Campos et al., 2020). This requires a thorough analysis of the potential motivations and willingness to invest (WTI) in CRE of rural populations to design and implement effective strategies to foster engagement.

Some papers have approached the study of the profile, expectations, and behaviors of CRE investors mainly in a qualitative manner and within the geographical scope of Western and Northern European countries. However, these studies have not explicitly focused on rural bioenergy village projects. This study builds on the need to conduct

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more quantitative studies (Fleiß et al., 2017) focused in rural CRE projects (Magnani et al., 2017) in other national contexts than the United Kingdom, the United States, Germany, or the Netherlands (van der Schoor and Scholtens, 2019).

The few quantitative analyses performed in the previous literature (e.g., Kalkbrenner and Roosen (2016), and Koirala et al. (2016)) have mainly focused on the influence of alternative sociodemographic and sociopsychological features on the decision to invest in CRE. These studies rely on classic multivariate analysis techniques and show heterogeneous results. However, there are two main drawbacks of these approaches. First, the financial determinants of the WTI in a CRE project have been rarely addressed in these previous studies (Salm et al., 2016), disregarding that investor perceptions of risk and return also have a relevant impact on their investment behavior. Second, although investor heterogeneity has been acknowledged as a distinctive feature of CRE (Bauwens, 2016; Broughel and Hampl, 2018), as observed by the heterogeneous results of previous studies, these have not systematically accounted for the principle of bounded rationality, and the complex and heterogeneous nature of investors' behaviors (Wüstenhagen and Menichetti, 2012). This forces us to consider that investors' sociodemographic and sociopsychological features influence not only their decisions to invest but also their perceptions of risk and return.

This complex and heterogeneous nature of investors' behavior can be derived in the presence of the following four main core tenets of complexity theory (Fiss, 2007; Ragin, 2008; Woodside, 2014; Pineiro-Chousa et al., 2019): 1) alternative combinations of sociodemographic, sociopsychological, and financial features can lead to a higher WTI (equifinality); 2) one causal condition can simultaneously explain high and low WTI, and high WTI can be explained by high and low levels of a condition (asymmetry); 3) the influence of causal conditions on WTI depends on the presence or absence of other causal conditions (complexity or conjunctural causation); and 4) causal recipes that lead to a high WTI may differ from those leading to its absence (causal asymmetry). This suggests the convenience of applying qualitative comparative analysis (QCA) instead of classic multivariate analysis techniques to the analysis of investors' WTI in CRE.

This study's objective is to investigate the heterogenous and complex nature of the WTI in CRE of rural populations, exploring the causal recipes of sociodemographic, sociopsychological, and financial features that can drive a higher or lower WTI, and their interrelations as well. Future research should account for these complexity and heterogeneity when deciding the research design and methods to be applied. Furthermore, policy makers and CRE projects' promoters should also consider them to design better strategies to reach the involvement of rural populations in the sustainable energy transition and empower rural communities to drive an endogenous model of rural development. Using a survey in a small Spanish village, this study explores through the fuzzy-set QCA (fsQCA) methodology to examine the complex interrelations among the sociodemographic, sociopsychological, and financial features of rural inhabitants and their WTI in CRE. To the best of our knowledge, this is the first empirical application of fsQCA to the analysis of the WTI in CRE projects. The study is oriented to test a set of propositions derived from previous literature on these potential interrelations, considering alternative antecedents and outcomes. Results reveal the many diverse configurations that govern the behavioral processes conditioning the WTI in rural CRE initiatives, confirming the presence of the main tenets of complexity theory (conjunctural causation, asymmetry, causal asymmetry, and equifinality).

The rest of the study is organized around four sections. Section 2 reviews the concept of CRE and how previous studies have approached the WTI in CRE projects. We highlight the complex framework of relations among the different antecedent conditions of WTI and formulating 27 alternative propositions to be tested through the fsQCA method. Section 3 builds on the main methodological issues of the study. Section 4 presents and discusses the results. Finally, Section 5 presents the conclusions and limitations of this study, and future research

avenues.

2. Literature review

CRE refers to the active involvement of communities in the planning and development of RE projects to produce, commercialize, and/or self-consume electricity and/or heat (Walker and Devine-Wright, 2008; Seyfang et al., 2013; van der Schoor and Scholtens, 2019). Citizen involvement ranges from volunteering in the planning and development of the projects to committing financial resources (Koirala et al., 2016; Klein and Coffey, 2016). While communities of interest are defined by some common goal but do not involve a geographical nexus (Hewitt et al., 2019), place-based communities relate to shared values within a particular territory or landscape (Walker, 2008). Bioenergy villages, aimed at achieving the energy autonomy of a whole territory or village, are surely the most outstanding example of this type of CRE projects (von Bock und Polach et al., 2015).

The decision to invest in CRE has been mainly investigated for existing projects using interview-based qualitative studies (Dóci and Vasileiadou, 2015; von Bock und Polach et al., 2015; Dóci and Gotchev, 2016; van Veelen and Haggett, 2017; Yang et al., 2021) and, more rarely, with quantitative analyses (Bauwens, 2016; Braito et al., 2017; Fleiß et al., 2017; Bauwens and Devine-Wright, 2018; Bauwens, 2019). Among the studies focused on citizens' WTI in hypothetical or projected CRE projects, both qualitative (Rogers et al., 2008) and quantitative approaches are observed (Kalkbrenner and Roosen, 2016; Salm et al., 2016; Broughel and Hampl, 2018; Koirala et al., 2018; Conradie et al., 2021). Most of these studies relate to communities of interest in the form of cooperatives. None are specifically related to rural bioenergy villages. This study contributes to filling this research gap.

The factors more frequently analyzed as antecedents of WTI in CRE include sociodemographic (age, gender, and level of education and income) and sociopsychological features (mainly related with the personal beliefs, expectations, concerns, values, or norms regarding general energy issues, RE, and social capital). Nevertheless, the financial features and determinants of the decision to invest in CRE have been rarely analyzed perhaps. This maybe because of assuming that self-regarding incentives are less important in CRE than social and moral norms (Bauwens, 2016; Bauwens and Eyre, 2017), and that financial gains may be more important for communities of interest than in place-based communities (Broughel and Hampl, 2018). Some exceptions are Conradie et al. (2021), Bauwens (2019), and Salm et al. (2016). Fleiß et al. (2017) acknowledge that more research must explore both financial and non-financial motives under CRE investments. Wüstenhagen and Menichetti (2012) demand the need of a bounded rationality perspective (Simon, 1955) in the analysis of the decisions of professional investors in RE to shed light on the role of cognitive aspects shaping risk perceptions and return expectations. Similar to Reise et al. (2012) and Dóci and Gotchev (2016), this study adopts this perspective to analyze the decisions of citizens as non-professional investors in rural CRE projects. We acknowledge that perceptions of risk and return matter and are influenced by cognitive factors.

To build this study's conceptual framework, other alternative financial and behavioral theories are considered (Klein and Coffey, 2016): Utility and Rational Choice Theories, mainly related to traditional financial aspects (risk, return, and payback period); the Information Deficit Model, related to the limited knowledge about energy and financial issues of the general population; and the Theory of Planned Behavior, together with the bounded rationality and social context concepts, accounting for the influence of attitudes, beliefs, social norms, and personal characteristics. This study also embraces complexity theory (Anderson, 1999) and configurational analysis (Ragin, 2000). We do this by assuming that WTI in a rural CRE initiative can result from different combinations of causal factors and that the interrelations between sociodemographic, sociopsychological, and financial features related to WTI are probably non-linear, asymmetrical, and complex.

All these theories are merged under a conceptual framework (Figure 1) to analyze the alternative causal recipes of conditions that are related to different outcomes, with two final main outcomes being the WTI (as intention) and the amount to invest (ATI). The analysis is focused on the interrelations between the four types of conditions and outcomes: the influence of sociodemographic features on sociopsychological (arrow A) and financial (arrow B) features, and WTI-ATI (arrow C); the influence of sociopsychological features on financial ones (arrow D) and WTI-ATI (arrow E); and the influence of financial features on WTI-ATI (arrow F). Building on the contributions of previous literature regarding the relationships between sociodemographic, sociopsychological, or financial features and the WTI of potential investors, some specific propositions to be tested through the fsQCA methodology are presented in the following subsections.

2.1. Sociodemographic features

Personal characteristics, such as age, gender, income, and education, have been extensively considered by previous studies concerned about CRE investments and have demonstrated great predictive power (Li et al., 2013). Rommel et al. (2018) conclude that CRE projects are fairly homogeneous in this sense, with members being predominately male, well educated, and having above average incomes. Studies focused on the WTI also coincide with this profile.

Regarding education and income levels, many studies have found a positive impact on realized or intended investments (Salm et al., 2016; Broughel and Hampl, 2018; Koirala et al., 2018). However, Fleiß et al. (2017) find no evidence of a significant influence of income level among adopters and non-adopters. Regarding gender, most studies found that males predominate among current (Fraune, 2015; Fleiß et al., 2017) or potential (Broughel and Hampl, 2018) investors. Fraune (2015) also

confirms greater average investment sums among men. Age is, nevertheless, a more indetermined influencer. However, most studies conclude that older people are more likely to engage in CRE (Fleiß et al., 2017), with Broughel and Hampl (2018) setting the average age of potential investors at approximately 44 years. Braito et al. (2017) conclude that collective investors are older than individual investors.

Besides the impact of sociodemographic features on the decisions to invest (WTI and ATI) in rural CRE (arrow C), they can also have a direct influence on the alternative sociopsychological (arrow A) features considered in this study, mainly related with social capital. However, inconclusive results appear in previous literature. Thus, while Sørensen (2012) finds a significant positive influence of age, income, and education on different social capital components, Park et al. (2015) find no significant influence of age, gender, education, and income on social capital. Regarding the impact of sociodemographic features on financial ones (arrow B), under the lens of behavioral finance, these antecedents can also show alternative relations to the financial determinants of the decision to invest (required return and payback, perceived risk, etc.). Braito et al. (2017) find that contrary to the normative belief, the level of income can negatively affect the required return of potential investors.

Basing on this theoretical and empirical contributions, we can conclude that the impact of sociodemographic characteristics on sociopsychological (arrow A in Fig. 1) and financial (arrow B) ones, and on the decisions to invest (WTI and ATI) in rural CRE (arrow C) is subject to complexity, non-linearity, and asymmetry. However, some specific relations can be expected. This leads to the following propositions:

P1a. Both high and low age can be present in causal configurations leading to a higher WTI and ATI in rural CRE projects.

P1b. Both high and low age can be present in causal configurations leading to a lower WTI and ATI in rural CRE projects.

P2. Both high and low age can be present in causal configurations
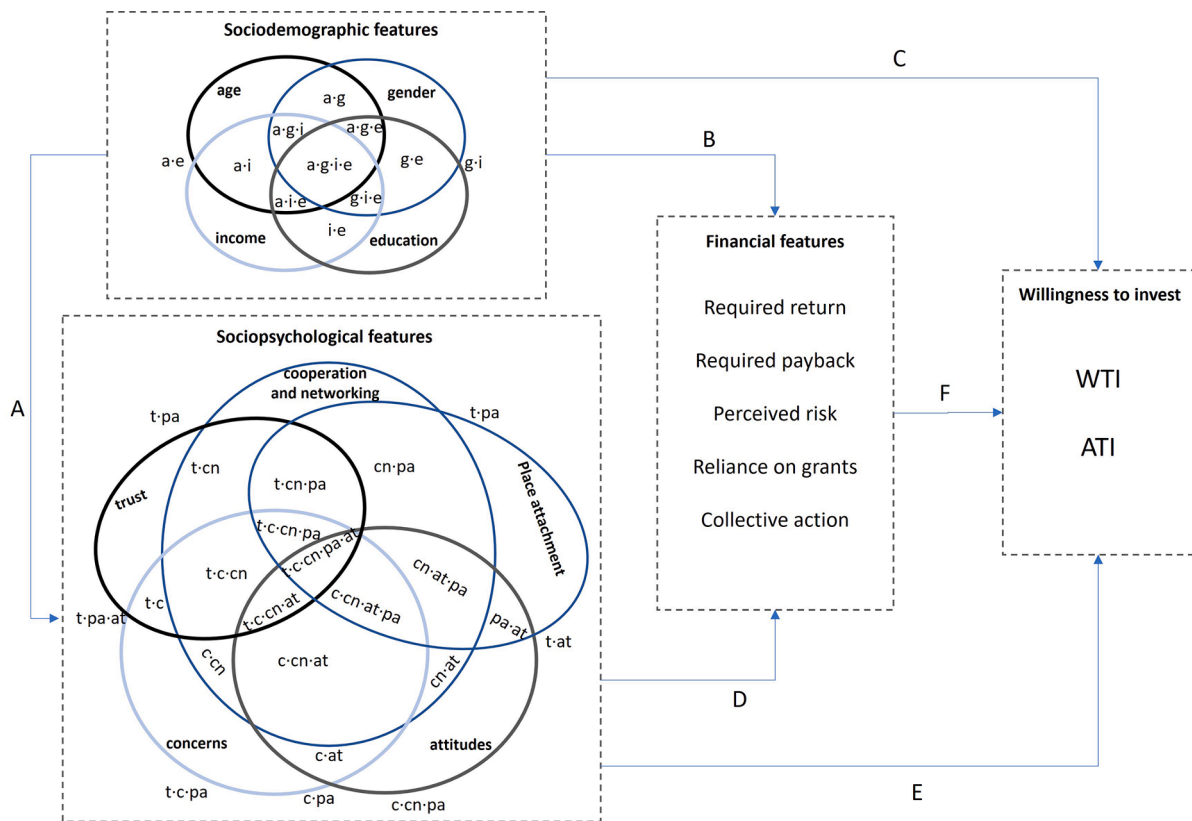
Fig. 1. A complexity view of antecedents of the WTI in rural CRE projects. Note: In this Fig., "a", "e", "I", and "g" represent age, education, income, and gender, respectively; "t", "cn", "pa", "c", and "at" represent trust, cooperation and networking, place attachment, concern (about energy issues), and attitudes (toward environmental issues), respectively; WTI represents willingness to invest, and ATI represents amount to invest. Capital letters A, B, C, D, E, and F are used to depict the direction of causal links to be analyzed through alternative fsQCA model specifications.

leading to alternative sociopsychological features.

P3. Both high and low age can be present in causal configurations leading to alternative financial features of potential investors and non-investors in rural CRE projects.

P4a. Higher income leads to higher WTI and ATI.

P4b. Lower income leads to lower WTI and ATI.

P5. Both high and low income can be present in causal configurations leading to alternative sociopsychological features.

P6. Both high and low income can be present in causal configurations leading to alternative financial features of potential investors and non-investors in rural CRE projects.

P7a. Higher education leads to higher WTI and ATI.

P7b. Lower education leads to lower WTI and ATI.

P8. Both high and low education can be present in causal configurations leading to alternative sociopsychological features.

P9. Both high and low education can be present in causal configurations leading to alternative financial features of potential investors and non-investors in rural CRE projects.

P10a. Being male is an antecedent of a higher WTI and ATI.

P10b. Being female is an antecedent of a lower WTI and AT.I

P11. Both males and females can be present in causal configurations leading to alternative sociopsychological features.

P12. Both males and females can be present in causal configurations leading to alternative financial features of potential investors and non-investors in rural CRE projects.

Notice that causal asymmetry is explicitly considered for those propositions where a concrete behavior of a condition is advanced or where ATI and WTI are involved as outcomes, testing for the influence on the presence (a) and absence (b) of the outcome. Propositions not split into a and b integrate the presence and absence of the outcome in a general manner.

2.2. Sociopsychological features

Social capital is related to the necessary trust and cooperative capacity to promote collective action to create collective benefits (von Bock und Polach et al., 2015). Studies have focused on trust (Dóci and Vasileiadou, 2015; von Bock und Polach et al., 2015; Bauwens, 2016; Kalkbrenner and Roosen, 2016; Koirala et al., 2018) and cooperation (von Bock und Polach et al., 2015) as facilitators of the decision to invest in CRE. Other associated concepts such as place attachment (Kalkbrenner and Roosen, 2016; van Veelen and Haggett, 2017) and community identity (Conradie et al., 2021) relate WTI in CRE to the willingness to protect and improve a set of place-related factors (culture, landscape, history, etc.) which matter to people (Süsser et al., 2017). Place attachment can be both positively and negatively related to the WTI. Studies do indeed consider it as an obstacle to the social acceptance of RE (van Veelen and Haggett, 2017).

Assuming that RE can display both positive and negative economic, social, and environmental impacts (D'Souza and Yiridoe, 2014; Fergen and B. Jacquet, 2016; Süsser and Kannen, 2017), attitudes towards them are important cognitive factors to account for when analyzing WTI in CRE. A positive relationship has been found both in launched projects (Bauwens and Devine-Wright, 2018) and in projected or hypothetical ones (Broughel and Hampl, 2018; Conradie et al., 2021). However, this can differ in communities of interest and place-based communities (Bauwens and Devine-Wright, 2018). Concern about energy issues, including economic, environmental, and social concerns related to rising energy costs, climate change, and energy autonomy and democratization (Rommel et al., 2018; Dobigny, 2019; Hewitt et al., 2019), are also an interesting cognitive factor to be analyzed, although it has been considered less in previous quantitative studies (Bauwens, 2016; Fleiß et al., 2017; Koirala et al., 2018).

These sociopsychological factors can also be related to the financial expectations of CRE investors (arrow E in Fig. 1). Strong social capital can reduce the risk of RE projects in rural communities (Morrison et al.,

2017) and motivate a higher reliance on the nature of collective ownership attributed to CRE. This makes individual WTI dependent on the decisions of peers (Mignon and Bergek, 2016; Proudlove et al., 2020).

Accounting for these considerations derived from previous literature, the following propositions are set regarding the influence of sociopsychological features of potential investors on their financial personal characteristics (arrow D in Fig. 1), and on their WTI and ATI (arrow E):

P13a. Higher trust leads to higher WTI and ATI.

P13b. Lower trust leads to lower WTI and ATI.

P14. Both high and low trust can be present in causal configurations leading to alternative financial features of potential investors and non-investors in rural CRE projects.

P15a. Higher cooperation and networking capacity leads to higher WTI and ATI.

P15b. Lower cooperation and networking capacity leads to lower WTI and ATI.

P16. Both high and low cooperation and networking can be present in causal configurations, leading to alternative financial features of potential investors and non-investors in rural CRE projects.

P17. Both high and low place attachment can be present in causal configurations, leading to a higher or lower WTI and ATI in rural CRE projects.

P18. Both high and low place attachment can be present in causal configurations, leading to alternative financial features of potential investors and non-investors in rural CRE projects.

P19a. High concern about energy issues leads to higher WTI and ATI in rural CRE projects.

P19b. Low concern about energy issues leads to lower WTI and ATI in rural CRE projects.

P20. Both high and low concern about energy issues can be present in causal configurations, leading to alternative financial features of potential investors and non-investors in rural CRE projects.

P21a. Higher favorable attitudes towards RE lead to higher WTI and ATI in rural CRE projects.

P21b. Lower favorable attitudes towards RE lead to lower WTI and ATI in rural CRE projects.

P22. Both favorable and unfavorable attitudes towards RE can be present in causal configurations, leading to alternative financial features of potential investors and non-investors in rural CRE projects.

2.3. Financial features

Traditional financial theory assumes that the financial objective of rational investors is to maximize return for a given level of risk (Markowitz, 1991), and that higher perceived risk leads to higher required return. Thus, required return and perceived risk are two fundamental factors to account for in the analysis of the WTI in rural CRE. Moreover, since CRE is linked to the aim of reducing energy costs (Dóci and Vasileiadou, 2015), the possibility of recovering the investment through the generated cost savings leads to questions about investors expected or required payback. Broughel and Hampl (2018) analyze risk, return, and payback period as potential barriers to CRE, assuming that these projects are long-term in nature, can yield low returns on investments, and entail a high risk. Some CRE projects offer a fixed return to investors and/or establish a binding period that relates to the project's payback (Braito et al., 2017; Fleiß et al., 2017). Other interesting antecedents of the WTI are the extent to which the individual decisions rely on the existence of subsidies or grants (Reise et al., 2012; Shi et al., 2016; Nicolini and Tavoni, 2017), and the number of collective owners involved (Mignon and Bergek, 2016; Proudlove et al., 2020). These indirectly contribute to the reduction of the perceived risk (Cato et al., 2008).

However, traditional financial theory principles are questioned by bounded rationality. Dóci and Gotchev (2016) present a thorough review of the risks faced by RE investors, particularly, CRE investors. According to these authors, CRE promoters tend to be more risk averse,

have lower expectations for profit, and require more initial support. Subsidies and grants have been positively related to investments (Shi et al., 2016) and increase (Nicolini and Tavoni, 2017) in RE generation. Investors with a high need of collective support may show a lower WTI (Mignon and Bergek, 2016; Proudlove et al., 2020).

Building upon these considerations, the following propositions are formulated in relation to the influence of financial features on the WTI and ATI of potential CRE investors (arrow F in Fig. 1). We define propositions that challenge traditional financial theory except for perceived risk (assuming that higher (lower) perceived risk leads to a lower (higher) WTI).

P23a. Lower perceived risk leads to higher WTI and ATI.

P23b. Higher perceived risk leads to lower WTI and ATI.

P24. Both high and low required return can be present in causal configurations, leading to a higher or lower WTI and ATI in rural CRE projects.

P25. Both high and low required payback can be present in causal configurations, leading to a higher or lower WTI and ATI in rural CRE projects

P26. Both high and low need of collective ownership can be present in causal configurations, leading to a higher or lower WTI and ATI in rural CRE projects

P27. Both high and low reliance on grants can be present in causal configurations, leading to a higher or lower WTI and ATI in rural CRE projects

3. Method

To analyze the complex and heterogeneous relations between the sociodemographic, sociopsychological, and financial features of potential CRE investors and their predisposition to invest in a CRE project, a case-level analysis based on the application of fsQCA is performed. Variable-based analysis techniques such as regression and structural equation models "are solutions to far away from the realities of relationship reversals, equifinality, causal asymmetries for high versus low outcome conditions, and the general low ability in regression models to achieve high levels of explanation of variance in a dependent variable" (Isaksson and Woodside, 2016, p.3308). In the following subsections, we describe the data collection procedure and the fsQCA specification.

3.1. Data collection

We adopt a case study approach focusing on the analysis of the WTI in a hypothetical bioenergy village project in a Spanish village. Some previous qualitative studies have also been built on the need to adopt this type of approach assuming that CRE is a site-specific concept, although these studies focus on diverse general success factors of this type of projects and not on the WTI (Rogers et al., 2008; Li et al., 2013; Koirala et al., 2016; Mahzouni, 2019).

Given the underdeveloped state of CRE in Spain (Romero-Rubio and de Andrés-Díaz, 2015; Becker et al., 2017; Cuesta-Fernandez et al., 2020) and expecting a boost of this type of initiatives motivated by recent changes in the regulatory framework (Campos et al., 2020), this study is focused on the analysis of the WTI in a hypothetical bioenergy village CRE project in Baltar, a small rural village in Galicia, northwest of Spain. Baltar is an interesting location since it has great RE resources and has signed the Covenant of Mayors for Climate and Energy Marinakis et al. (2017) view such actions as proof of a municipality's willingness to develop sound local sustainable energy policies. Its census at the beginning of 2020 reflected 242 inhabitants (136 male and 106 female).

Permanent residents (no second residences) are the target population of a hypothetical project to invest in a cooperative aimed at fostering local energy autonomy. A survey was administered on the 88 continuously inhabited households by hand with the help of a local social agent. 66 responses were retrieved (75% response rate), 44 of them complete

and valid to perform statistical analyses with fsQCA. 52.27% of respondents are female and 47.73% male. 40.91% have no or primary education, and only 27.27% hold a university or equivalent degree. 29.55% are in the age range of 18-40, 36.36% in the 40-60, and 34.09 are aged more than 60. 61.36% report a household monthly income lower than 1,300€, 31.82% are in the 1,300-2,000€ range, and only a 6.81% report more than 2,000€.

Under the Information Deficit Model, the survey was accompanied by a brief explanation of the most complex or potentially unfamiliar concepts (a brief introduction to the concept of bioenergy village and the main features of the proposed hypothetical CRE project, and some core ideas related to the understanding of the financial features analyzed). The survey comprises 11 single items (4 measure conditions related to the sociodemographic features of age, gender, income, and education, 5 measure conditions related to the financial features of required return, required payback, perceived risk, reliance on grants, and reliance on collective ownership, and 2 measure WTI and ATI) and 5 constructs related to the sociopsychological features of trust, cooperation and networking, place attachment, concern about energy issues, and attitudes toward RE. These 5 constructs were calculated as the average of three to five items. Table 1 shows the items, the source for its formulation, and the Cronbach Alpha (CA) of the constructs. Items are based on 5- or 6-point Likert scales.

As mentioned before, the main outcome of this study, WTI, is measured through two alternative items: as the predisposition or intention (willingness) to invest in a bioenergy village project (WTI), and as the amount that individuals would be willing to invest (ATI), both through a 6-point Likert scale ranging from 1 (no investment) to 6 (very high WTI) in the case of WTI, and from 0 to more than 3,000€ in the case of ATI. This data set is used to test the defined set of 27 propositions though alternative fsQCA model specifications considering different preconditions and outcomes.

3.2. Data analysis with fuzzy-set Qualitative Comparative Analysis (fsQCA)

In QCA conditions and outcomes represent sets, with each case having a degree of membership in each set determined through a calibration process (Schmitt et al., 2017). In fsQCA, calibration is made on continuous fuzzy-sets with membership scores ranging from 0.0 to 1.0. Based on theoretical and contextual knowledge, researchers must define the thresholds for full membership (score of 1), full non-membership (score of 0) and the crossover or point of maximum ambiguity (score of 0.5) to structure the calibration (Ragin, 2008). The "presence" or "absence" of a condition or outcome is related to having scores above or below the crossover. Therefore, the interpretation can be related to having a high or low score. The calibration was done using the calibration function provided by fsQCA 3.0 software (Ragin and Davey, 2017).

Table 2 shows the calibration anchors considered for each condition and outcome. Single items measured through 5-point Likert scales were calibrated considering the threshold of 5 for full-membership and 1 for full-non-membership (Hughes et al., 2018). To avoid assigning cases to the crossover point that could be dropped during the analysis, we calibrated values of 2.5 as a membership of 0.50 (Crilly et al., 2012). According to official statistical data, the average household income in the southeast of Galicia is 1,729€, lower than the Galician average (2,079€). Therefore, setting full-membership at 5 (more than 2,000€) for the monthly household income condition is consistent with the contextual knowledge. Following Wu et al. (2014), a data-driven adaptation of the calibration was considered for some items showing some kind of bias or consistently ignored extreme scores. This affected expected payback (where Likert values 4 and 5 showed no cases), and all construct measures that showed that the extreme values of 1 and 5 had been systematically disregarded by respondents. Following Schmitt et al. (2017), items measured on a 6-point Likert scale were calibrated setting the

Table 1

Survey items and constructs.

Condition/ Outcome	Coding	Items	Likert scale	Sources
Age	age	1- 18 - 30 years, 2- 30 - 40 years, 3- 40 - 50 years, 4-50 - 60 years, 5- 60 - 70 years, 6-70 years and older	1-6	Fraune (2015), Salm et al. (2016), Braito et al. (2017), Fleiß et al. (2017), Broughel and Hampl (2018), Koirala et al. (2018)
Gender	gender	0- Male 1- Female		
Income	income	1- Less than 900, 2- 900 – 1300, 3- 1300 – 1500, 4- 1500 – 2000, 5- More than 2000	1-5	
Education	education	1-No studies, 2- Primary education, 3-Secondary education, 4-High school or FPI, 5- FPII, 6-University education	1-6	
Trust (CA = 0.690)	trust	Generally speaking, most people can be trusted Local institutions (local government, associations) can help in the successful planning and implementation of projects for the community. I have trust in the competence of political decision-makers in the development of my community	1-5 (highly disagree to highly agree)	Bauwens (2016), Bauwens and Eyre (2017), Kalkbrenner and Roosen (2016)
Cooperation and networking (CA = 0.799)	copnetw	I think that people in my village can work together effectively In my village there are relations of mutual support between neighbors I think that it would be possible to develop a cooperative project in my village		Rogers et al. (2008), Kalkbrenner and Roosen (2016)
Place attachment (CA = 0.803)	platch	I feel strongly attached to the community I live in There are many people in my community whom I think of as good friends I often talk about my community as being a great place to live		Kalkbrenner and Roosen (2016)
Concern about energy issues (CA = 0.868)	concern	Degree of interest in energy-related issues	1-5(very low to very high)	Janhunen et al. (2014), Bauwens (2016)

Table 1 (*continued*)

Condition/ Outcome	Coding	Items	Likert scale	Sources
		Degree of concern about climate change Degree of concern for the preservation and conservation of the natural environment Degree of concern about the current and future evolution of energy prices (electricity, fuels, etc.) Degree of concern about the limited transparency and information in relation to how energy prices are determined		
Attitudes toward RE (CA = 0.753)	attitude	RE contributes to the fight against climate change RES are cleaner and healthier energy production technologies RE technologies are more expensive than non-renewable ones The use of RE allows to reduce the costs of electricity and fuel for heating REs provide economic benefits (higher incomes, job creation...) to the areas where they are installed	1-5 (highly disagree to highly agree)	Süsser and Kannen (2017), D'Souza and Yiridoe (2014), Fergen and Jacquet (2016)
Required return	return	What annual return would you consider appropriate for investing in a CRE project? 1- Less than 1%, 2- 1%-2%, 3- 2%-3%, 4- 3%-4%, 5- 4%-5%, 6- More than 5%	1-6	Braito et al. (2017), Fleiß et al. (2017), Broughel and Hampl (2018)
Required payback	payback	In what period do you think that you should recover your investment through energy cost savings? 1- 1-3, 2- 3-6, 3- 6-9, 4- 9-12, 5- More than 12 years)	1-5	
Perceived risk	risk	I think that developing a CRE project in my village entails a high level of risk (from highly disagree to highly agree)	1-5 (highly disagree to highly agree)	
	grants			

Table 1 (*continued*)

Condition/Outcome	Coding	Items	Likert scale	Sources
Reliance on grants		I would invest my own money only if a good part of the total investment is subsidized		Reise et al. (2012), Nicolini and Tavoni (2017), Shi et al. (2016)
Reliance on collective ownership	collective	I would invest my own money only if a good part of the local inhabitants do also invest		Cato et al. (2008), Mignon and Bergek (2016), Proudlove et al. (2020)
Willingness to invest	wti	In general, how high is your willingness to contribute financially and invest money in a community energy project? (very low to very high)	1-6	Kalkbrenner and Roosen (2016), Broughl and Hampl (2018)
Amount to invest	ati	What amount would you be willing to invest?1- Nothing, 2- Up to 500€, 3- 500-1,000€, 4- 1,000-1500€, 5- 1,500€-3,000€, 6- More than 3,000€		Bauwens (2016), Broughl and Hampl (2018)

Table 2

Calibration of raw scores into membership scores in the fuzzy-sets for each condition/outcome.

	Location of qualitative anchors		
Conditions/Outcomes	**0**	**0.5**	**1**
gender	0		1
payback	1	1.5	3
age	1	2,5	4
income			5
risk			
collective			
grants			
trust	2	2,5	4
copnetw			
platch			
concern			
attitude			
education	2	3,5	6
return			5
ati			
wti			

threshold for full membership at 5, and at 2 for full non-membership at, ensuring that people showing a strong tendency in either direction are clearly assessed as such. The crossover is set at 3.5. Nevertheless, building on previous knowledge that suggests that having a university degree makes a more significant difference when analyzing the influence of the education level on the decision to invest in CRE (Fleiß et al., 2017), we set the score for full-membership at 6 for this condition. Age calibration is also based on previous research pointing to a significant difference in the WTI among individuals older and younger than fifty (Broughel and Hampl, 2018); therefore, full-membership is set at 4. The calibration of the required return and the amount to invest is in accordance with the common practice in cooperative RE projects, where average returns of 3% and average invested amounts not lower than 1, 500€ are identified (Fleiß et al., 2017; Braito et al., 2017). In the case of ATI, we also consider the average household income level in Baltar, and (Broughel and Hampl, 2018) finding that Austrian investors would

invest 100 to 1000€. Therefore, setting full-membership for required return at more than 4% and for ATI at more than 1,500€ is consistent with theoretical, empirical, and contextual knowledge. Gender is the only condition included as a crisp-set or binary condition (0 - male, 1 - female). Table 3 shows descriptive information about the conditions and outcomes both on uncalibrated and calibrated scores.

In fsQCA, there may be multiple sufficient causes that combine creating a specific configuration or path leading to the presence or absence of an outcome. The sufficiency of a configuration is measured through two indicators: consistency and coverage. Consistency reports the degree to which the cases sharing the same causal conditions coincide in producing the outcome (Schmitt et al., 2017). A low consistency indicates that a configuration is not supported by empirical evidence. This study sets the recommended cutoff consistency of 0.8 and a minimum frequency of 1 case to identify sufficiency solutions using the truth table algorithm (Ragin, 2008). Coverage refers to the proportion of cases following a specific path. Low coverage is common when there are many causal configurations, with achieving high consistency being more important than high coverage (Schmitt et al., 2017). The exploratory nature of this study and the heterogeneity in previous theoretical and empirical knowledge suggest against making simplifying assumptions. Therefore, a fsQCA complex solution is chosen to report the results (Skarmeas et al., 2014; Fotiadis et al., 2016).

21×2 alternative model specifications were run in fsQCA, considering alternative conditions and outcomes (presence and absence) to test the propositions under each relationship (arrows) proposed in Fig. 1. Each one of the 21 models was split in two to analyze both the presence (a) and absence (b) of each outcome. The influence of sociodemographic features on sociopsychological ones (arrow A) was tested through 5×2 models (5 models each for presence and absence of the same outcomes). Their influence on financial features (arrow B) was also analyzed through 5×2 model specifications. The influence on the decisions to invest (ATI and WTI, arrow C) was modeled through 2×2 models. Regarding sociopsychological conditions, their influence on financial features (arrow D) was modeled through 5×2 alternative specifications, and their influence on the decision to invest (arrow E) through 2×2. Finally, the influence of financial conditions on WTI and ATI (arrow F) is tested through other 2×2 model specifications.

4. Results and discussion

The results and discussion are structured around the three main blocks of the conditions considered: sociodemographic, sociopsychological, and financial features.

4.1. Sociodemographic features

Tables 4–6 show the complex solutions considering the influence of age, gender, education, and income on the alternative features included in the sociopsychological and financial blocks, and on the WTI and ATI as final outcomes (arrows A, B, and C, respectively, in Fig. 1).

As reflected in Table 4, no configuration consistently leads to the absence of any of the five sociopsychological outcomes. This reveals that no clear sociodemographic profile clearly defines a low trust, cooperation and networking capacity, place attachment, concern about energy issues, or favorable attitude towards RE. Rather, the presence of these five outcomes is associated with various paths or configurations combining different sociodemographic conditions, confirming the presence of equifinality, although no outcome involves the four conditions simultaneously. Further, none of the four sociodemographic conditions is either sufficient or necessary to cause high levels of any of the five sociopsychological features, confirming the existence of conjunctural causation. Remarkably, there is one similar causal recipe of sociodemographic conditions leading to high levels of cooperation, place attachment, and concern about energy issues. Meanwhile, high trust and positive attitude towards renewables have three of their four

Table 3

Uncalibrated and calibrated data statistics.

Conditions/ Outcomes	Mean		Stand. Dev.		Max		Min	
	Uncal.	Cal.	Uncal.	Cal.	Uncal.	Cal.	Uncal.	Cal.
age	3.59	0.68	1.74	0.37	6	1	1	0.05
income	2.34	0.40	1.26	0.33	5	0.95	1	0.05
education	3.36	0.41	1.51	0.37	6	0.95	1	0.01
gender	0.52	0.52	0.51	0.45	1	0.95	0	0.05
trust	3.58	0.82	0.68	0.22	5	0.99	2	0.05
copnetw	3.47	0.78	0.79	0.26	5	0.99	1.33	0
platch	3.92	0.88	0.73	0.19	5	0.99	2	0.05
concern	4.14	0.93	0.66	0.09	5	0.99	2.8	0.65
attitude	3.90	0.91	0.52	0.09	4.8	0.99	2.6	0.55
risk	2.98	0.60	0.76	0.21	5	0.95	2	0.27
return	2.80	0.30	1.42	0.34	6	0.99	1	0.01
payback	1.66	0.46	0.64	0.36	3	0.95	1	0.05
collective	3.50	0.73	0.90	0.22	5	0.95	1	0.05
grants	3.52	0.75	0.66	0.17	5	0.95	2	0.27
ati	2.84	0.29	1.16	0.32	6	0.99	1	0.01
wti	3.80	0.61	1.27	0.34	6	0.99	1	0.01

Table 4

Influence of sociodemographic features on sociopsychological features.

Model	Path	age	income	education	gender	Raw Coverage	Unique coverage	Consistency	Outcome
A1a	1	•		~		0.627624	0.340884	0.942739	trust
	2			•	~	0.254144	0.0718233	0.957336	trust
	3	•	•			0.375691	0.0472376	0.984081	trust
	4	~	~		•	0.156906	0.0969614	0.827989	trust
	sol. coverage: 0.908287, sol. consistency: 0.919463								
A1b	No configuration with high consistency								~trust
A2a	1	•			~	0.404576	0.13843	0.840554	copnetw
	2	~		•		0.299739	0.170576	0.8625	copnetw
	3	•	•			0.366638	0.0550246	0.916064	copnetw
	4		~	~	•	0.327541	0.190269	0.927049	copnetw
	sol. coverage: 0.902983, sol. consistency: 0.868524								
A2b	No configuration with high consistency								~copnetw
A3a	1	•			~	0.403101	0.147545	0.938628	platch
	2	~		•		0.288372	0.165116	0.93	platch
	3	•	•			0.351421	0.0496124	0.984081	platch
	4		~	~	•	0.303618	0.176486	0.963115	platch
	sol. coverage: 0.873643, sol. consistency: 0.941783								
A3b	No configuration with high consistency								~platch
A4a	1	•		~		0.395007	0.147577	0.971119	concern
	2	~		•		0.292217	0.170093	0.995	concern
	3	•	•			0.338228	0.0469898	1	Concern
	4		~	~	•	0.287567	0.167156	0.963115	Concern
	sol. coverage: 0.854381, sol. consistency: 0.972423								
A4b	No configuration with high consistency								~concern
A5a	1	•		~		0.567205	0.426584	0.947303	attitude
	2		•		~	0.238758	0.0653417	1	attitude
	3		•	•		0.270559	0.0591304	0.990901	attitude
	4	~	~		•	0.169938	0.0899379	0.997084	attitude
	sol. coverage: 0.873043, sol. consistency: 0.961949								
A5b	No configuration with high consistency								~attitude

Note: • indicates presence and ~indicates absence.

paths in common. Both high and low levels of all four conditions are present in the alternative causal recipes leading to the same outcome, confirming the existence of asymmetry. Propositions 2, 5, 8, and 11 are partially supported in relation to the presence but not the absence of the outcomes. The four sociodemographic conditions are both present and absent to produce high levels of the five sociopsychological outcomes. This confirms the inconsistent results of previous literature showing no significant (Park et al., 2015) or positive (Sørensen, 2012) influence of sociodemographic factors on social capital-related results.

The alternative configurations in Table 4 also reveal that young women with low income and men with higher education are associated with higher favorable attitude towards RE and trust. Meanwhile, women with low income and education, and young men are associated with higher cooperation and network capacity, place attachment, and concern about energy issues. Interestingly, no consistent configuration combines a high (or low) level of education, income, and age. These can be assumed to go hand in hand as suggested by Braito et al. (2017).

Table 5 shows that no configuration with high consistency was found combining sociodemographic conditions to produce a high required return and a low reliance on grants. The presence of causal asymmetry is confirmed in relation to the outcomes of perceived risk, expected payback, and collective ownership. Equifinality is confirmed for all outcomes except for a low need of collective engagement which shows only one causal recipe corresponding to young women with high income and education. Interestingly, some paths are coincident in relation to different outcomes: B1a3, B2b3, and B4a4 show that young women with low income are related to a higher perceived risk, a higher reliance on collective action, but a lower required return; this contradicts traditional financial theory and supports the need of a bounded rationality perspective. Contrarily, high age and income consistently appear as

Table 5

Influence of sociodemographic features on financial features.

Model	Path	age	income	education	gender	Raw Coverage	Unique coverage	Consistency	Outcome
B1a	1			•	~	0.296804	0.0144597	0.811655	risk
	2	•	•			0.449011	0.156012	0.853835	risk
	3	~	~		•	0.222603	0.0369102	0.85277	risk
	4	~		•		0.371385	0.00494677	0.813333	risk
	5		•	•		0.384323	0	0.919017	risk
	sol. coverage: 0.730594, sol. consistency: 0.783993								
B1b	1	•	•	~		0.435666	0.128668	0.790174	~risk
	2	•	•		•	0.271445	0.0293454	0.75748	~risk
	3	•	~	•	~	0.210496	0.0259594	0.877647	~risk
	4	~		•	~	0.164221	0.00451469	0.848396	~risk
	sol. coverage: 0.510158, sol. consistency: 0.710692								
B2a	No configuration with high consistency								return
B2b	1		~	•	~	0.18564	0.0245796	0.951907	~return
	2	~		•	~	0.162031	0.0206987	0.907609	~return
	3	~	~		•	0.18467	0.133894	0.832361	~return
	4	•	•		•	0.188875	0.11837	0.919685	~return
	sol. coverage: 0.465718, sol. consistency: 0.891089								
B3a	1	•		•	~	0.288845	0.0268925	0.806676	payback
	2		•	•	~	0.280877	0.0189243	0.855842	payback
	3	•	•	~	•	0.213147	0.10757	0.852589	payback
	sol. coverage: 0.415339, sol. consistency: 0.796562								
B3b	1		~	•	~	0.220318	0.0928093	0.873963	~payback
	2	•	•	~		0.312709	0.130435	0.765609	~payback
	3	~	•	•		0.198579	0	0.767367	~payback
	4		•	•	•	0.228261	0.0376255	0.837423	~payback
	5	~	~	~	•	0.130435	0.0505853	0.871508	~payback
	sol. coverage: 0.561037, sol. consistency: 0.734136								
B4a	1	•		~		0.612066	0.299468	0.812448	collective
	2		•		~	0.293842	0.0875273	0.978148	collective
	3	•	•			0.394498	0.0346982	0.913169	collective
	4	~	~		•	0.196937	0.129103	0.918368	collective
	sol. coverage: 0.936542, sol. consistency: 0.837807								
B4b	1	~	•	•	•	0.298085	0.298085	0.838407	~collective
	sol. coverage: 0.298085, sol. consistency: 0.838407								
B5a	1	•			~	0.430793	0.152134	0.850181	grants
	2	~		•		0.32439	0.172256	0.886667	grants
	3	•	•			0.391768	0.0585365	0.929812	grants
	4		~	~	•	0.322866	0.172866	0.868033	grants
	sol. coverage: 0.928049, sol. consistency: 0.847911								
B5b	No configuration with high consistency								~grants

Note: • indicates presence and ~indicates absence.

Table 6

Influence of sociodemographic features on WTI and ATI.

Model	Path	age	income	education	gender	Raw Coverage	Unique coverage	Consistency	Outcome
C1a	1	•			~	0.489918	0.182972	0.78941	wti
	2	~	~		•	0.190814	0.129201	0.744898	wti
	3	•	•	~		0.329724	0.0858849	0.903787	wti
	4		•	•	~	0.214339	0.0141897	0.871017	wti
	sol. coverage: 0.727409, sol. consistency: 0.783588								
C1b	1		•	•	•	0.31475	0.206156	0.831288	~ wti
	2	~	~	~	•	0.178862	0.0702672	0.860335	~ wti
	sol. coverage: 0.385018, sol. consistency: 0.809524								
C2a	1	•	•	~	~	0.445055	0.445055	0.815827	ati
	sol. coverage: 0.445055, sol. consistency: 0.815827								
C2b	1			•		0.356366	0.22041	0.928333	~ati
	2	•	~		~	0.28055	0.171785	0.851456	~ati
	3		~	~	•	0.348688	0.196417	0.893443	~ati
	4	•	•		•	0.18842	0.0518234	0.927559	~ati
	sol. coverage: 0.84485, sol. consistency: 0.878576								

Note: • indicates presence and ~indicates absence.

configurations leading to high perceived risk, and a higher need of collective action and grants support. There is no sufficient or necessary individual causal condition. Propositions 3, 6, and 12 are again partially supported. This is because both high and low levels of income and age, and being a woman or man are related to high and low levels of all financial outcomes (except high required return and low reliance on grants). However, proposition 9 receives limited support as no low levels of education are included in configurations leading to high perceived

risk, low required return, and low reliance on collective ownership. This is an interesting result that contradicts traditional financial theory: it links higher education with both a high perceived risk and a low required return; this again shows the role of bounded rationality in understanding the financial behavior of potential CRE investors.

Differently from Tables 4, 5 reveals some configurations simultaneously involving high and low levels of all four sociodemographic conditions. B3b5 combines being a younger woman with low income

and education levels to produce the outcome of a lower payback required, while B3a3 refers to older woman with low education and high income requiring higher payback. B4b1 links being an older woman with higher income and education levels to a lower need of collective ownership. Finally, B1b3 and B1b4 relate a lower perceived risk to men with high education, and both high and low age and income.

Table 6 shows the causal recipes of sociodemographic factors leading to high and low WTI and ATI. Among the only two paths involving the four conditions, one stands out: women with low age, income, and education are associated with a lower WTI (C1b2). This relates to Braito et al.'s (2017) assumption that income can be expected to increase with age and be also directly associated with higher education levels. Path C1b2 will mean a breach of the causal asymmetry tenet if we assume Braito et al.'s (2017) argument, although it cannot be verified in Table 6 since there is no consistent configuration linking high WTI to high age, income, and education. Meanwhile, causal asymmetry is confirmed since no path leading to high WTI or ATI is the mirror opposite of a path leading to low WTI or ATI. Path C2a1 shows the only consistent causal recipe leading to high ATI, involving older man with high income and low education. Again, any individual condition is neither sufficient nor necessary, and both high and low levels of each condition are present to create the same outcome.

Basing on the results shown in Table 6, proposition 1a is partially supported since both high and low age are related to a higher WTI. However, only older men with low education and high income appear as a highly consistent causal recipe leading to higher ATI. Proposition 1b is partially supported since both higher and lower age is related with lower ATI; however, only lower age appears as an ingredient in a causal configuration leading to low WTI. Proposition 4a is also partially supported because higher income is an ingredient in configurations leading to high WTI and ATI; however, low income also appears to be associated

to high WTI. Proposition 4b is not supported because both high- and low-income levels are related to low WTI and ATI. Proposition 7a is not supported since both high and low education appear in causal recipes leading to high WTI, and higher education is not related to higher ATI. Proposition 7b is not supported too since both high and low education levels are ingredients in configurations producing a low WTI and ATI. Proposition 10a is partially supported since being male consistently appears in configurations leading to high WTI and ATI; however, high WTI is also associated with younger women with low income. Proposition 10b is also partially supported since being women consistently appears in paths leading to low WTI and ATI, although one path (C2b2) relates low ATI with being an older man with low income.

In summary, these results contradict the homogeneous sociodemographic profile of potential investors in CRE advocated by Rommel et al. (2018). Further, they provide supporting evidence to the heterogeneous results of past studies, while revealing some common patterns with previous studies relating male (female) gender with higher (lower) propensity to invest (Fraune, 2015; Broughel and Hampl, 2018).

4.2. Sociopsychological features

Tables 7 and 8 show the complex solutions obtained when considering the influence of trust, cooperation and networking, place attachment, concern about energy issues, and attitudes toward RE on the financial features and on the WTI and ATI as final outcomes.

The influence of sociopsychological features on the financial features of potential investors, shown in Table 7, exhibit highly consistent configurations for all models except for producing a high required return (D2a). The most salient result is that high concern about energy issues and high favorable attitudes towards RE seem necessary (but not sufficient) conditions for producing both high and low levels of all financial

Table 7
Influence of sociopsychological features on financial features.

Model	Path	trust	copnetw	Platch	Concern	attitude	Raw Coverage	Unique coverage	Consistency	Outcome
D1a	1	~	~	~	•	•	0.11035	0.0190259	1	risk
	2	•	•	~	•	•	0.157915	0.0452816	0.981087	risk
	3	•	~	•	•	•	0.25723	0.0825723	0.898936	risk
	4	~	•	•	•	•	0.223744	0.0711568	0.986577	risk
	sol. coverage: 0.402968, sol. consistency: 0.92007									
D1b	1	~	~	•	•	•	0.150113	0.0265237	0.917241	~risk
	2	~	•	•	•	•	0.269187	0.145598	0.800335	~risk
	sol. coverage: 0.295711, sol. consistency: 0.790347									
D2a	No configuration with high consistency									return
D2b	1	•	•		•	•	0.818887	0.0297542	0.80152	~return
	2		•	•	•	•	0.839909	0.0507762	0.805022	~return
	3	~		~	•	•	0.0756791	0.000323474	0.806897	~return
	sol. coverage: 0.873545, sol. consistency: 0.79278									
D3a	1	•	•	~	•	•	0.171813	0.171813	0.815603	payback
	sol. coverage: 0.171813, sol. consistency: 0.815603									
D3b	1	~	~	~	•	•	0.121237	0.020903	1	~payback
	2	•	•	~	•	•	0.149665	0.0321907	0.846336	~payback
	3	•	~	•	•	•	0.260451	0.0840301	0.828457	~payback
	4	~	•	•	•	•	0.220736	0.062291	0.885906	~payback
	sol. coverage: 0.387124, sol. consistency: 0.804518									
D4a	1	•	•		•	•	0.859956	0.0268835	0.870845	collective
	2	•		•	•	•	0.896843	0.0653328	0.865199	collective
	3		•	•	•	•	0.858393	0.0253204	0.851209	collective
	4	~	~	~	•	•	0.0750234	0	0.827586	collective
	sol. coverage: 0.955924, sol. consistency: 0.830301									
D4b	1	~	~	~	•	•	0.228976	0.228976	0.948276	~collective
	sol. coverage: 0.228976, sol. consistency: 0.948276									
D5a	1	•	•		•	•	0.849085	0.0228658	0.881608	grants
	2	•		•	•	•	0.881707	0.057012	0.872135	grants
	3		•	•	•	•	0.850915	0.024695	0.865158	grants
	4	~	~	~	•	•	0.0884146	0.0152439	1	grants
	sol. coverage: 0.951219, sol. consistency: 0.847135									
D5b	1	~	~	~	•	•	0.208928	0.0232143	0.806897	~grants
	2	•	•	•	•	•	0.43125	0.245536	0.810402	~grants
	sol. coverage: 0.454464, sol. consistency: 0.767722									

Note: • indicates presence and ~ indicates absence.

Table 8

Influence of sociopsychological features on financial features.

Model	Path	trust	Copnetw	Platch	concern	attitude	Raw Coverage	Unique coverage	Consistency	Outcome
E1a	No configuration with high consistency									wti
E1b	1	~	~	~	●	●	0.166086	0.0325203	0.986207	~wti
	2	●	●	~	●	●	0.225319	0.0952382	0.917258	~wti
	3	~	●	●	●	●	0.301974	0.171893	0.872483	~wti
	sol. coverage: 0.436121, sol. consistency: 0.875291									
E2a	No configuration with high consistency									ati
E2b	1	~	~	~	●	●	0.0914907	0.0159949	0.986207	~ati
	2	●	●	~	●	●	0.134037	0.040627	0.990544	~ati
	3	●	~	●	●	●	0.221049	0.0825335	0.918883	~ati
	4	~	●	●	●	●	0.182342	0.06238	0.956376	~ati
	sol. coverage: 0.348688, sol. consistency: 0.947003									

Note: ● indicates presence and ~indicates absence.

features considered as outcomes. This implies that propositions 20 and 22 are not supported. This result cannot be contrasted with previous studies since no past contributions have focused on the analysis of the interrelation between sociopsychological factors and financial expectations. Nevertheless, this can be seen as an indicator that motivations (economic, environmental, and social) and acceptance of RE are more important features in defining the potential profile of investors in place-based communities, while financial features can be more important for investors in communities of interest (Fleiß et al., 2017; Bauwens and Devine-Wright, 2018).

Propositions 14, 16, and 18 are supported, since both high and low levels of trust, cooperation and networking, and place attachment are ingredients in causal recipes both leading to the presence or absence of the five considered financial features. Nevertheless, note that a high place attachment seems to be consistently linked to a low perceived risk.

There are alternative paths revealed by the different models gathered in Table 7. A focus on those paths involving all five sociopsychological conditions allows us to verify how the same causal recipe (D1a1, D2b, D3b1) involving higher concern about energy issues, favorable attitudes to RE, and lower social capital-related factors is associated to a high perceived risk but a lower required return (inconsistent with traditional financial theory), and a lower required payback (consistent with traditional financial theory). Moreover, this same causal recipe is linked to high and low levels of reliance on collective ownership and grants (D4a4, D4b1, D5a4, D5b1), confirming the existence of causal asymmetry.

Regarding the influence of sociopsychological conditions on WTI and ATI (Table 8), no configuration with high consistency lead to high WTI or ATI. Thus, propositions 13a, 15a, 17, 19a, and 21a are not supported. Once again high concern about energy issues and higher favorable attitudes towards RE appear as necessary but not sufficient conditions

leading to lower WTI and ATI, implying that propositions 19b and 21b are also not supported. Propositions 13b and 15b are also not supported since lower trust and lower cooperation and networking do not consistently appear in all causal recipes leading to low WTI and ATI. These results confirm the heterogeneity of sociopsychological and cognitive factors characterizing investors in CRE, as suggested by Bauwens (2016). The high (and logical) correlation between WTI and ATI can also be highlighted as the 3 paths leading to a low WTI are also linked to a low ATI.

Nevertheless, it is interesting to note that low WTI and ATI are the result of different paths involving all five sociopsychological conditions. Paths E1b1 and E2b1 would reflect those more theoretically logical configurations showing that despite high concern and attitudes, a low trust, low cooperation and networking, and low place attachment lead to low WTI and ATI.

4.3. Financial features

Table 9 show the complex solutions obtained when considering the influence of required return, required payback, perceived risk, reliance on grants, and reliance on collective ownership on the WTI and ATI as final outcomes.

In this case, all models find a complex solution with overall consistency above the minimum threshold set. Proposition 23a receives limited support, as higher perceived risk is present in one configuration leading to high WTI, but high ATI is derived from only one causal recipe including low perceived risk. In contrast, Proposition 23b is not supported. as higher perceived risk is not consistently associated with low WTI and ATI. Proposition 24 is partially supported: high and low return is present in configurations leading to high and low WTI, and low ATI; meanwhile, the only causal recipe with a high consistency for a high ATI

Table 9

Influence of financial features on WTI and ATI.

Model	Path	risk	return	payback	collective	grants	Raw Coverage	Unique coverage	Consistency	Outcome
F1a	1	~	~		●		0.431292	0.118372	0.835745	wti
	2		●		●	●	0.326363	0.0791634	0.826087	wti
	3	●	~	●	~		0.233383	0.0485436	0.864454	wti
	4		●		●	●	0.519044	0.159821	0.854333	wti
	sol. coverage: 0.814414, sol. consistency: 0.815022									
F1b	1	~	~	~	●	~	0.373403	0.117305	0.812895	~wti
	2	●	~	●	~	~	0.2741	0.0569105	0.82087	~wti
	3	●	●	~	~	●	0.257259	0.087108	0.865234	~wti
	sol. coverage: 0.517422, sol. consistency: 0.815187									
F2a	1	~	●	●	●	●	0.297488	0.297488	0.871264	ati
	sol. coverage: 0.297488, sol. consistency: 0.871264									
F2b	1	~	~		●		0.376839	0.0172744	0.852388	~ati
	2		~		●	●	0.65739	0.271593	0.879333	~ati
	3	●	~	●	~		0.209533	0.0486243	0.905947	~ati
	4	●	●	~		●	0.21753	0.0722967	0.901857	~ati
	sol. coverage: 0.795585, sol. consistency: 0.867457									

Note: ● indicates presence, ~indicates absence.

includes high required return, without any evidence about the association between low required return and high ATI. Proposition 25 receives limited support since only higher payback periods appear in causal recipes leading to high WTI and ATI, while low WTI and ATI derived from different paths involving both high and low payback periods. Proposition 26 also received partial support due to the existence of only one causal recipe for the high ATI model (F2a), with higher and lower need of collective ownership being included in alternative configurations leading to high and low WTI, and low ATI. Finally, proposition 27 finds limited support because lower reliance on grants appears only in causal configurations leading to lower WTI.

Most paths contradict traditional financial theory and support the principle of bounded rationality. Paths F1b3 and F2b4 seem more consistent with portfolio theory, showing that higher perceived risk, higher required return, lower required payback, and higher reliance or need of grants all lead to lower WTI and ATI. Interestingly, paths F1a1 and F2b1 relate individuals with low perceives risk, low required return, and high reliance on collective action to a high WTI and low ATI. This may be interpreted as a manifestation of the so-called value-action or intention-behavior gap (Broughel and Hampl, 2018).

5. Conclusions

This study contributes to the promotion of bottom-up processes leading to sustainable rural development, which is essential to achieve global sustainable development and counteract climate change. Rural areas in Europe are facing great challenges related to depopulation and loss of economic relevance. CRE initiatives have been acknowledged as potential drivers of their competitiveness and development (Rogers et al., 2008; Hicks and Ison, 2011; Yildiz, 2014; Clausen and Rudolph, 2020). Therefore, in-depth analysis of how to foster their deployment can be worthwhile, particularly in Southern European countries which are lagging behind Northern ones in this field.

The decision to invest in CRE has been predominantly analyzed through qualitative studies which do not specifically focus on rural areas and, more concretely, in the potential development of bioenergy villages that are non-existent in Spain. Moreover, studies have not explicitly considered the heterogeneity and complexity of human behavior. Studies have paid attention to the sociodemographic and, more importantly, sociopsychological features that drive the decision to engage or invest in CRE, with a special focus on social capital factors, while acknowledging that self-regarding (financial) motives are not the only relevant ones in this type of decisions (Bauwens, 2016; Bauwens and Eyre, 2017). These approaches have thus somewhat embraced the principle of bounded rationality, but disregarded the analysis of the underlying financial conditions that also have an influence on the decision to invest (Dóci and Gotchev, 2016).

All models explored through the fsQCA methodology have shown that the decision to invest in rural CRE is conditioned by diverse combinations of sociodemographic, sociopsychological, and financial features involving asymmetry, equifinality, complexity, and causal asymmetry. Acknowledging this heterogeneous and complex nature of the decision to invest in CRE is important both to avoid oversimplifying policies and strategies to promote this type of initiatives (Dóci and Gotchev, 2016) and to suggest researchers against the use of theoretical frameworks and methodological approaches that are not well suited to the problem under analysis (Fiss, 2007). Moreover, although financial motivations can be secondary in communities of place related to the achievement of energy autonomy in a specific rural location, their analysis can bring about relevant issues to account for when designing effective strategies and policies to foster its development, aimed at reducing risk and providing adequate returns (Wüstenhagen and Menichetti, 2012), and specifically tailored to fit the existing institutional conditions configuring social capital (Wirth, 2014). Furthermore, dealing with information asymmetry and the population's low financial literacy is essential to help potential investors in making well-informed decisions (Reise et al., 2012).

This study has enriched knowledge on the different antecedent recipes for the WTI in rural CRE initiatives. This should be considered by policy makers and potential promoters to gain social acceptance and engage individuals. Being aware of the heterogeneous preferences, perceptions, and expectations of individuals can facilitate the design of effective policies (i.e., to reduce perceived risk) and proper planning of rural CRE projects (i.e., based on building interpersonal and institutional truth). Policy makers and CRE promoters should also consider the different motivations of investors in communities of place and interest (Bauwens and Devine-Wright, 2018). Many avenues for future research are left open.

Although the sample size could be deemed small, the case-specific approach of the research and the specific rural context analyzed, characterized by low population densities, justifies the narrow size of the target population. Moreover, fsQCA was originally designed for small-N studies allowing a case-oriented interpretation of the results, and above 30 cases samples are considered large (Isaksson and Woodside, 2016). Nevertheless, although QCA methods are originally designed for small-N studies, they are also well-suited for the analysis of larger samples (Fiss, 2007). A further extension of this research would profit from this, enriching the heterogeneous and complex set of cases and relations that can define the universe of potential investors in rural CRE projects.

Other limitations are derived from the use of survey data. Responses are affected by different potential biases that were minimized through appropriate design of the survey instruments and procedures. Regarding the fsQCA technique, each model specification in a fsQCA should include a limited number of factors. This is because a high number of antecedents increases the number of paths leading to a same outcome, thereby reducing valid inference. The consideration of alternative model specifications counteracts this limitation and enriches the scope of the study.

Future research can also consider different sets of factors as antecedents of the decision to invest in CRE, such as electricity consumption (Bauwens and Eyre, 2017), the type of RE technology to be implemented (wind, photovoltaic, biomass, etc.,), or the type of business model (cooperative or others) to be adopted. These can have a direct relationship with financial variables such as perceived risk (Rommel et al., 2018) and required return. Differences between perceptions of locals and second-home owners can also be considered (Janhunen et al., 2014). Furthermore, other empirical approaches can be explored, such as the analysis of the risk premium or additional return required by potential investors to invest in CRE projects depending on alternative features (lower or greater percentage of the investment subsidized, type of technology, etc.,) through choice experiments (Salm et al., 2016), or the application of alternative financial analysis models (Reise et al., 2012). Segmentation of the different profiles of investors and non-investors through cluster analysis and similar techniques may also provide relevant information to project promoters and policy makers.

Author Statement

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript. Furthermore, each author certifies that this material or similar material has not been and will not be submitted to or published in any other publication before its appearance in *Technological Forecasting and Social Change*.

CRediT authorship contribution statement

These are the specific contributions made by each author:
Conception and design of study: N. Romero-Castro, J. Piñeiro-Chousa;
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Analysis and/or interpretation of data: N. Romero-Castro, A. Pérez-Pico;

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