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The influence of social capital on community participation in the energy transition

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Introduction¹

Climate change is a global phenomenon characterized by significant alterations in Earth's climate patterns, mainly attributed to human activities. Scientists are 95% sure that human activities are the leading cause of global warming (Hoekstra, Steinbuch, & Verbong, 2017). There are many causes attributed to climate change related to human activities. Carbon dioxide produced by burning fossils such as coal, oil and natural gas for energy production, heating and transport (IPBES, 2019). Methane emissions during the production and transport of coal, oil, and natural gas, as well as from agricultural activities and the decomposition of organic waste. Deforestation for various purposes related to human survival, such as large-scale agriculture, livestock farming in underdeveloped areas such as the Amazon (Norris et al., 2022), and legal and illegal logging for the production of various goods, from paper to furniture (Geist & Lambin, 2002). Furthermore, the urbanization process, which in recent decades has led many families to migrate from rural areas in search of better economic and social conditions, has resulted in an increased demand for energy and resources in the cities, contributing to the increase in greenhouse gas emissions (IPCC, 2022).

The climate changes are many and varied, including an increase in global temperatures as a direct result of the accumulation of greenhouse gases in the atmosphere (Masson- Delmotte et al., 2021), leading to higher average temperatures; melting glaciers and rising sea levels (Ethiopian Panel on Climate Change, 2015); extreme weather events (Steffen, Dean, & Rice, 2019), droughts and floods (Thoman, Druckenmiller, & Moon, 2022); impacts on biodiversity (IPBES, 2019), leading to the extinction of certain species; impacts on human health, such as an increase in diseases, reduced crop yields, and increased agricultural losses (Ethiopian Panel on Climate Change, 2015); and migration of people forced to move due to adverse climatic conditions (Canton, 2021). At the European level, efforts have been made to implement strategic and policy plans aimed at making the economy sustainable through climate change initiatives such as the Green Deal (European Commission, 2020), which aims to promote biodiversity and improve the quality of life of citizens. Another example is the European Climate Change Law (Erbach, 2021), which creates a legal obligation to achieve climate neutrality by 2050. From this perspective, greenhouse gas emissions resulting from energy production to meet human needs have reached critical levels, contributing significantly to global climate change (Gowrisankar et al., 2022).

In recent decades, increasing awareness of the urgency of tackling climate change has led to a greater focus on the transition from fossil fuels to renewable and low carbon energy sources (Masson-Delmotte et al., 2021). This transition is driven by the need to reduce greenhouse gas emissions, mitigate the negative impacts of climate change, and ensure a secure, sustainable, and affordable energy supply for future generations (Creutzig et al., 2012). The energy transition, in fact, refers to the shift from an energy system based mainly on fossil fuels (such as coal, oil, and natural gas) to one based on renewable and sustainable energy sources (such as solar, wind, hydro and geothermal energy). At the policy level, the transition to energy considers a variety of regulations and incentives to support the introduction of renewable energy and sustainable technologies. The energy transition also considers investments and technological innovation to improve existing technologies. In this transition process, active and inclusive community participation in the energy policy making process is crucial in the energy transition process (Wahlund & Palm, 2022).

¹ **Declaration of generative AI and AI-assisted technologies in the writing process.**

During the preparation of this work, the author used DeepL and ChatGPT in order to improve language. After using these tools, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

Community participation is essential to ensure that decisions on the transformation of the energy system are legitimate, acceptable, and responsive to the needs and concerns of those affected.

In this regard, social capital plays a crucial role in fostering participation, enhancing public acceptance (Batel & Rudolph, 2021), strengthening cooperation between actors, and building community resilience throughout the transition to a more sustainable energy system. Therefore, the energy transition can be made more effective, equitable and inclusive by investing in building and strengthening social capital (Stigka, Paravantis, & Mihalakakou, 2014). Studying how social capital affects energy transitions can provide valuable insights on how to encourage community participation, facilitate collaboration between different actors, and support the adoption of sustainable energy practices. Increasing public awareness and participation in decision-making processes related to energy use is crucial to achieving the ambitious goal of climate neutrality of the European Union by 2050 (Alsamara et al., 2023; Colli, 2021; Hadjichambis, 2022). Encouraging active participation is essential to tackle climate change and achieve European targets in an effective and sustainable way (Sezgin, 2018). Cooperation between all sectors of society can lead to innovative and shared solutions to this global problem (Alsamara et al., 2023). In my study, I adopt the concept of social capital as defined by Baker and Obstfeld (1999), who describes it as a resource that actors derive from specific social structures. Furthermore, I delve into the concept through the subdivision by Nahapiet and Ghoshal (1998), who break it down into three different dimensions. The structural dimension encompasses the networks, relationships, and institutions that connect people and groups, serving as the foundation for social structures that enable interaction and collaboration. The cognitive dimension refers to the individual characteristics that bind a person to his or her territory. It is defined as the shared understanding that includes the values, codes, and narratives that unite the inhabitants and give the territory its intangible characteristics. The relational dimension refers to the nature and quality of relationships (that is, what people feel and experience in their social interactions) (Nahapiet & Ghoshal, 1998).

This research explores the three dimensions of social capital to understand the role of social capital in community participation in the energy transition. In addition, this research explores how an understanding of social capital can serve as a strategic resource to support local community members' participation in energy transition projects. This study does not seek to resolve the debate over the definition of social capital in energy studies, but rather to position the concept of social capital within the broader literature linking community participation and energy transition.

The following paragraph presents the theoretical framework on which this research is based, with a particular focus on the interpretation of three key concepts: social capital, community participation, and energy transition. The second paragraph introduces the topic of retrofitting historic buildings, with a focus on the Italian context, and examines its impact on the energy transition, providing the necessary background for the case study analysis. The third paragraph is dedicated to the case study, which specifically analyzes the community engagement process in the retrofitting of a historic building. Finally, the last paragraph outlines the contribution of each chapter of the thesis to the discussion on the role of social capital in strategically guiding community participation in retrofitting a historical building.

1 Theoretical framework

The theoretical framework of the research will be based on the following concepts: community participation, social capital, and energy transition. In this research, the term *community participation* refers to the active participation of community members in various areas: political, economic, cultural, etc. In sociology, participation is often confused with social participation, although they refer to distinct concepts. The key difference lies in their context: social participation involves community engagement in social activities and networks that reinforce the social fabric,

whereas participation refers more broadly to community involvement across various sectors and processes, such as energy (Dekker & Uslaner, 2003). Social participation is particularly associated with social cohesion, emphasizing interpersonal relationships and the community's structural integrity. In contrast, participation serves more general and evolving objectives (Dekker & Uslaner, 2003). A common element shared by both concepts, though mostly explored in relation to social participation, is the role of social capital in shaping participation.

Social capital reflects the complexity of social relationships in the real world (Pisani, Franceschetti, Secco, & Christoforou, 2017) its theoretical framework is still evolving, its role in the study of social phenomena is growing, and its concept is used to understand various social phenomena. The debate around social capital is hindered by a lack of consensus on its conceptualization (Rupasingha, Goetz, & Freshwater, 2006), and no single definition is widely accepted. Many studies define social capital in terms of social ties, shared norms, and sanctions. Dekker and Uslaner (2003) define it as networks of relationships, trust and reciprocity norms, while Coleman (1990) emphasizes trust, seeing it as essential to achieving common goals. In fact, trust has been widely cited as a unique indicator of social capital (Halpern, 2005), and plays a significant role in participation. People who trust others are more likely to participate in collective activities and invest in their communities (Dekker & Uslaner, 2003). Other authors, such as Paxton (1999), argue that social contacts, trust and, in particular, trust in institutions are fundamental elements of social capital, as they foster cooperation, collective action, and the effective functioning of society. A further distinction in the literature on social contacts is the distinction between bonding and linking relationships (Burt, 2000; Putnam, 2000). Bonding relationships assume that members of a small group are tightly knit, have clear rules and sanctions, trust each other, and thus help each other achieve common goods that would otherwise be difficult to achieve. In this perspective, some authors, including Burt (2000), Freeman, Borgatti, and White (1991), and Granovetter (1985), emphasize the influence of external contacts on facilitating the generation of new ideas within small groups. In fact, the cultural and social context plays a very important role in the development of social capital and the different social norms and local expectations that result from it (Dekker & Uslaner, 2003).

Another major controversy related to social capital is whether it should be considered a primarily personal characteristic (Bourdieu, 1986; Coleman, 1990) or a community characteristic (Knack & Keefer, 1997; Lochner, Kawachi, & Kennedy, 1999). Other authors see social capital as a fixed resource present in the community (Atwell, Schulte, & Westphal, 2010; Macias, 2015), while others see it as a flexible element that can be modified (Balfour & Alter, 2016; Devine-Wright, Fleming, & Chadwick, 2001; Exner et al., 2016).

Despite all these differences in the interpretation of social capital, participation plays a very important role in almost all approaches to social capital that have been developed, whether one considers it as an individual or collective, static or changing characteristic, or whether one is interested in bonding or bridging relationships (Guillen, Coromina, & Saris, 2011).

Introduced into the social sciences by Bourdieu (2011), Coleman (1990), Fukuyama (1995) and Putnam (1995), social capital has become a central concept. The concept of capital has been used to understand various social phenomena, including social cohesion, associations, and social relations. Putnam (2000) employs the concept of social capital to examine social cohesion, with a particular focus on the decline of social capital in American communities. Provides a thorough analysis of how social participation plays a crucial role in shaping social cohesion. In the context of southern Europe, Putnam, Leonardi, and Nanetti (1999) use the concept of social capital to analyze how the political and social history of a region can influence participation and forms of associationism. In particular, low levels of social and civic participation are seen as a direct consequence of historical and political factors such as civil and external conflicts,

authoritarian regimes, centralised governance and the influence of patronage networks. These elements have weakened formal associations, which normally promote social cohesion and cooperation, and led people to create informal local groups in response to the constraints imposed by institutional structures. In other words, the weakening of formal associations caused by a history marked by these factors has led to the emergence of new forms of participation that have developed outside of traditional institutional channels. In this sense, social capital becomes crucial in understanding how southern European communities have responded to the lack of trust in formal institutions by seeking solutions through informal ties that, although less structured, still allow for the creation of support and solidarity networks. Bourdieu (2015) offers a theoretical perspective on various forms of capital, highlighting how social capital is intrinsically linked to social participation and plays a key role in these informal networks. Pichler and Wallace (2007) investigates the patterns of formal and informal social capital in Europe, shedding light on the different forms of social participation. Dekker and Uslaner (2003) analyze social capital and everyday forms of participation. Among their key conclusions, they note that both formal participation (such as membership in organizations and associations) and informal participation (such as everyday social interactions) are shaped by the level of social capital within a community. In recent years, there has been growing interest in the role of social capital in the development of local and rural areas (e.g. Raagmaa (2016); Pisani et al. (2017)). Many studies have highlighted the potential of social capital to drive development in regions marked by socioeconomic marginality (Marquardt, Mo' llers, & Buchenrieder, 2012). These studies argue that social capital empowers local actors to mitigate the negative effects of rural abandonment, loss of biodiversity, unemployment, and social exclusion.

Furthermore, it supports the spread of new services, social innovation, the preservation of natural and cultural heritage², and the creation of new governance and landscape management models (see, for example, Farrell and Thirion (2022); Bosworth et al. (2016); Wiesinger (2007)). Researchers have also extensively examined social capital in the energy sector, with 90 scientific articles focusing on its role. (Giacovelli, 2022). Social capital can facilitate the participation of local communities in energy transition processes, thereby strengthening the objectives of these transitions in various ways. Promote dialogue and collaboration through networks and relationships, fostering the sharing of information and cooperation necessary to develop and implement sustainable energy projects. Social capital strengthens trust within communities, which is crucial for fostering acceptance and support of energy transition initiatives. In addition, the social capital can mobilize both material and immaterial local resources, enhancing the effectiveness and efficiency of energy projects. Through the ability of social capital to build a sense of belonging among community members, social capital helps foster ownership and responsibility toward the local territory, encouraging more sustainable and long-term behaviors. As a result, it plays a key role in promoting cooperation among various actors in the energy sector (Sánchez- García, Marco-Lajara, Seva-Larrosa, & Martínez-Falco', 2024) and is crucial to prepare communities to face the challenges of climate change (Dudka & Magnani, 2024). In this

² Cultural heritage is defined by UNESCO as "Cultural heritage includes artifacts, monuments, a group of buildings and sites, museums that have a diversity of values including symbolic, historic, artistic, aesthetic, ethnological or anthropological, scientific and social significance. It includes tangible heritage (movable, immobile and underwater), intangible cultural heritage (ICH) embedded into cultural, and natural heritage artifacts, sites, or monuments. The definition excludes ICH related to other cultural domains such as festivals, celebrations, etc. It covers industrial heritage and cave paintings." (source: UNESCO Institute for Statistics, 2009 UNESCO Framework for Cultural Statistics). In this article, according to UNESCO, historic buildings are defined as cultural heritage buildings that have historic, symbolic, social, and anthropological value.

context, social capital is vital to supporting local communities' participation in energy transition processes, reinforcing the objectives the transition aims to achieve (Giacovelli, 2022).

However, in most cases, social capital has only been considered in some of its dimensions (Broska, 2021), mainly as a component encompassing support networks, mutual trust, and shared norms (Fernando, Maloney, & Tappel, 2023; Sa'nchez-Garc'ia et al., 2024). Another limitation is the limited knowledge about the community members who participate in energy transition processes, and the characteristics that distinguish them from those who choose not to participate (Bauwens & Devine-Wright, 2018). Nevertheless, existing research indicates that gaining deeper insight into communities, particularly to identify the most suitable forms of participation, leads to more positive outcomes in energy sustainability projects (Palm, Bissa, & Knaus, 2014).

Geels (2002, 2019) has made a particularly significant contribution to the study of energy transitions, especially through his multi-level perspective on energy transformation. This framework emphasizes that technological change and energy shifts occur within a broader socioeconomic and political context. Geels (2002) emphasizes the importance of supportive policies that create incentives and facilitate the adoption of sustainable technologies, promote cooperation between various social actors (governments, industry, universities), stimulate research and exploit changes in the sociotechnical landscape to accelerate the transition. The perspective proposed by Geels (2002) offers a compelling framework for understanding how energy transitions can unfold when applied to the retrofitting of historic buildings. For example, the evolving sociotechnical landscape could create pressure on existing systems, such as traditional energy-inefficient building practices, opening up opportunities for innovative retrofitting solutions. This could include integrating sustainable technologies into heritage buildings, not only to reduce energy consumption but also to ensure that these buildings are adapted for future use, all while respecting their cultural and historical heritage. In this way, the energy transition, as envisioned by Geels (2002), could transform how we approach the retrofitting of historic buildings, blending sustainability with heritage preservation in innovative ways. Based on Geels (2002) Multilevel Perspective, the energy transition is not just a technological shift but a complex process involving citizens at various levels. As described by Noboa and Upham (2018), this process unfolds in several stages: At the strategic level, a politically and socially shared vision of the transition is created and disseminated; At the tactical level, concrete measures and barriers are identified for new energy interventions; at the operational level, energy interventions are executed; and finally, at the reflective level, the transition is monitored and evaluated.

This heuristic approach to managing the energy transition, which emphasizes community participation, aligns well with the idea of Geels (2002) of using changes in the sociotechnical landscape. In fact, the Geels (2002) framework could contribute significantly to the promotion of citizen engagement, since it calls for collaboration and alignment among diverse social actors such as governments, industries, and local communities. By actively involving communities, this approach not only steers regimes toward sustainability but also creates opportunities for niche innovations, which can include local efforts like the retrofitting of historical buildings. The energy transition process, as described by Geels (2002), offers a pathway to enhance participation, particularly when communities are empowered to shape the energy transition through inclusive stakeholder participation, thus ensuring that heritage preservation and energy efficiency go hand in hand.

2 The role of energy retrofitting of historical buildings in the energy transition

The energy retrofitting of historical buildings plays a crucial role in the larger context of the energy transition, representing a fundamental strategy to improve energy efficiency while preserving cultural heritage. The challenge

lies in balancing the need for modern energy solutions with the urgency of maintaining the architectural and historical integrity of these buildings. In addition, adaptive reuse of cultural heritage is an effective strategy for recovering abandoned or poorly used buildings, contributing to the achievement of climate objectives, promoting social cohesion, and improving well-being and quality of life (Gravagnuolo et al., 2024). Adaptive reuse can be defined as 'any work and intervention in a building aimed at changing its capacity, function, or performance to adjust, reuse, or upgrade a building to suit new conditions or requirements' (Douglas, 2006). Diverse case types of cultural heritage adaptive reuse can be identified based on heritage typologies (e.g. residential buildings, commercial, industrial, religious, civic). At the global level, exemplary case studies of adaptive reuse of historical buildings have been analysed by international research projects such as CLIC, ROCK, OpenHeritage, HERSUS, RETOU. Retrofitting historic buildings for energy helps to achieve national and international climate goals. European and global policies are promoting energy efficiency and emission reductions in the building sector, and retrofitting allows adaptation to these regulations without compromising heritage (European Commission, 2024). Furthermore, investing in retrofitting avoids significant CO₂ emissions associated with the construction of new buildings. The life cycle of a building is significantly influenced by its construction and demolition, and therefore the decision to renovate and optimize historical buildings, rather than demolish them, is a way to reduce resource consumption and overall environmental impact (Panakaduwa, Coates, & Munir, 2024).

In fact, historical buildings are often energy-inefficient due to outdated construction methods, poor insulation, and inefficient heating and cooling systems. Through retrofitting with modern, energy-efficient technologies - such as improved insulation, high-performance windows, efficient heating systems, and renewable energy sources (like solar panels) - significant reductions in energy consumption can be achieved. This directly contributes to the reduction of the carbon footprint in the building sector, which is a major source of global greenhouse gas emissions. In the European context, for instance, the building sector represents about 40% of total energy consumption and 36% of CO₂ emissions, making retrofitting interventions essential to achieving climate goals (Commissione Europea, 2020). Moreover, historical buildings are important assets that represent identity and cultural heritage. Energy retrofitting allows these buildings to become more sustainable without compromising their aesthetic or historical value (Nair, Verde, & Olofsson, 2022). Careful planning, accurate design, and the use of modern technologies ensure that interventions do not damage the culturally valuable architectural features (Nair et al., 2022). By integrating modern energy technologies with traditional materials and construction methods, retrofitting becomes a means to preserve historical value while ensuring that buildings are prepared for the future. This balance is key to maintaining both the environmental and cultural integrity of these buildings (Buda et al., 2021). Another important aspect is the process of energy retrofitting of historical buildings, which often involves local communities, architects, engineers, and other stakeholders, fostering collaboration and participation. In many cases, retrofitting projects provide job opportunities and the exchange of local knowledge, strengthening social capital within communities (Viola, 2022). Additionally, engaging the community in the evaluation of adaptive reuse of buildings should be a dynamic and co-evolutionary approach that takes into account the preferences of the involved stakeholders. In this way, the evaluation can transform abandoned cultural heritage into a driver of sustainable development that integrates the community with the regeneration of the territory (Gravagnuolo et al., 2024). As people witness the benefits of retrofitting, such as energy savings and improved living conditions, the process can serve as a model for future sustainability efforts within the community, building a shared sense of environmental responsibility. The energy retrofitting of historical buildings can also stimulate local economies by creating jobs in construction, design, engineering, and technology sectors (Hadda

et al., 2022). Furthermore, these interventions can increase the value of historical properties, attract investment, and improve the overall quality of the built environment. This economic stimulation is particularly important in regions with a high number of historical buildings, where traditional industries or urban areas need revitalization. Additionally, retrofitting interventions lead to long-term savings on energy costs, making buildings more affordable to maintain and inhabit, especially in a context of rising global energy prices. Energy retrofitting of historical buildings represents a sustainable solution that directly addresses the challenges of the energy transition and climate change. Through improved energy efficiency, preservation of cultural heritage, promotion of community involvement, and creation of economic opportunities, retrofitting not only contributes to emission reductions but also avoids the heavy environmental impact of demolition and new construction. Therefore, retrofitting becomes a key strategy for reducing the ecological footprint in the building sector and promoting a more sustainable future while respecting history and traditions.

In Italy, the smallest municipalities have experienced a continuous population decline from the 1990s to the present, with the most significant decrease occurring between 2011 and 2018 (De Rubertis et al., 2019; Istat, 2018). To counteract this trend in Italy, the National Recovery and Resilience Plan (PNRR) (Governo Italiano, 2021) was introduced, which allocates substantial resources to the preservation and enhancement of rural architecture and landscapes. This initiative aims to protect both tangible and intangible cultural heritage while fostering the regeneration of local communities. However, in practice, particularly due to the regulations established by the 2019 PNRR, historically significant buildings often undergo retrofitting processes that overlook their cultural and social importance to the local community. The ISTAT Census 2021 (Istat, 2021) stated that of the 35.5 million properties surveyed, 10 million were unoccupied. Even then, 28.3% of the apartments were empty and the distribution of abandoned houses was uneven across our peninsula. The abandonment of dwellings contributes to social degradation and is at the same time a consequence of it. To counteract this phenomenon, the construction of incentives and repopulation initiatives could be an effective solution (Case, n.d.). To strengthen the role of culture in the retrofitting of historic buildings, a key development in the Italian context has been the emphasis on community involvement from the early stages of design (Battisti, 2020). These participatory approaches aim to ensure that interventions respect local identity and remain sustainable in the long term (Chirico, 2024).

3 The Participatory Process for the retrofitting of building at Col Ventidueore

The case study examined in this thesis focuses on a European Interreg project called SHELTER: Smart Rural Heritage along Tourism Routes (Project duration: September 2019 - December 2022). The investigated case is a building located in a mountain valley in the province of Valstagna. The building, located in Col Ventidueore, is part of the municipality of Valbrenta in the province of Vicenza, northeastern Italy. The historical building is perched at a high point overlooking the valley and can only be reached on foot via a trail with an uphill hike of approximately 50 minutes. Over the years, Valstagna has experienced significant depopulation (Varotto et al., 2004). Following the 1950s, much of the community relocated to neighboring areas in search of better employment opportunities. The building at Col Ventidueore was originally a tobacco farm, which was shut down following the state monopoly on tobacco established in 1861. Later, in the early 1950s, the closure of a major shoe company prompted residents to migrate to a larger town about 30 km away in search of work. Migration of residents led to abandonment of cultivated areas, which, over time, contributed to landscape deterioration and environmental decline, including increased hydrogeological risks, reduced biodiversity, and loss of productive land (Bottino-Leone, Exner, Adami, Troi, & Balest, 2024). Furthermore,

the depopulation of this rural area resulted in the deterioration of its historical and cultural heritage (Varotto et al., 2004). For many years, the building at Col Ventidueore has been a focal point for local associations determined to restore its historical significance. One of the associations most dedicated to the preservation of the landscape in this area has spent years restoring and managing the artificial landscape shaped by the local community called *Terrazzamenti*³, which, beginning in the 18th century, predicted the future development of tobacco cultivation.

Figure 1: Terrazzamenti - Photograph by Giorgio Bertoncello



The terracing system covers the lower slopes of Valbrenta and represents a form of collective architecture. Another characteristic feature of this place are the dry stone walls, known as *maie`re*, from the Latin *maceria*, which divide and subdivide the landscape into different levels suitable for cultivation. This association had already organized various activities to raise awareness about the site, with the main objective of encouraging the support of the public administration for redevelopment. However, due to limited financial resources, the administration was unable to initiate a concrete project. In response, the association sought alternative funding sources. In 2018, a participatory process was launched to revitalize the area while preserving its natural characteristics. The first step was to identify external funding sources. The association secured support from the European Interreg SHELTER program, which provided an opportunity to develop a retrofitting project. With this funding, the association outlined an intervention strategy focused on community participation and energy-efficient redevelopment aligned with sustainability principles. Once initial funds were secured, a proactive stakeholder engagement phase was initiated. Several key actors participated, including local heritage and cultural associations, the public administration (which provided institutional support), and local businesses interested in future sustainable management. This phase refined the initial concept into a concrete proposal through meetings, workshops, and public consultations, emphasizing community needs while preserving the architectural and landscape characteristics of the site. The involvement of the academic community proved crucial in the final phase. Universities and researchers assessed local needs and translated their findings into sustainable and energy-efficient redevelopment solutions. Experts in the energy sector designed targeted interventions to address community needs while safeguarding the historical integrity of the building⁴. Although no redevelopment work has been carried out yet, the participatory process has yielded significant results. Col Ventidueore has regained attention

³ A particular agricultural system that involves shaping the hillsides to allow cultivation even in areas without plains.

⁴ All participants in the doctoral research were given equal opportunities to engage in the retrofitting. Therefore, the perceptions collected through the questionnaire were designed to reflect their views on possible participation. This approach was selected to assess not only actual participation but also intention or perceived participation, which could be valuable for future analyzes.

from both the community and institutions, and a well-structured redevelopment proposal is ready for implementation once additional funding becomes available. In addition, the memory of the site has been preserved through active participation of the community, local associations, the public administration, and experts. This journey highlights that even without immediate physical interventions, the participatory process has played a vital role in maintaining the connection between the building at Col Ventidueore and its community, laying the groundwork for future enhancement opportunities.

4 Contribution of each paper

The general objective of this thesis is to look deeper into the social and individual processes to better understand how local actors participate in the retrofitting of historical buildings through immaterial resources and sustainable interventions for their conservation and adaptation. Each section of the thesis delves into how each dimension of social capital can impact this process.

A review of the existing literature on social capital in the energy field reveals a significant gap, particularly regarding the cognitive dimension of social capital. Although playing a crucial role in influencing community participation, this dimension remains understudied and requires further exploration. In addition, this research employs an innovative network approach to examine how community relationships can increase the probability of community participation in energy retrofitting projects.

Analysing 90 articles published between 2001 and 2021, the first paper provides a comprehensive overview of how the concept of social capital has been explored in the social sciences, with a particular focus on the energy sector. This level of detail allows for the identification of trends, gaps, and emerging areas of interest, laying a solid foundation for future studies. The study examines how different dimensions of social capital — structural, cognitive, and relational — have been defined, measured, and analysed in energy science. This detailed analysis is innovative because it not only highlights the definitions and methods used but also explores how these dimensions can influence the energy transition, both positively and negatively. Understanding the distinction between positive and negative impacts is crucial for better comprehending the dynamics of social capital in the energy sector. The objective of the paper is to analyse the literature on how social capital has been studied in the social sciences, with a particular focus on energy. To achieve this, it identifies the key journals and authors who have contributed to this field, examines the definitions and dimensions of social capital, explores the methods of analysis used, and evaluates the influence of social capital on the energy transition. This type of research is essential for gaining a better participatory process understanding of how social capital can be leveraged to facilitate a more efficient and inclusive energy transition, and which aspects require further investigation to optimize these processes. This literature review provides an insight into how social capital has been approached in the energy science and explores the meanings that have been attributed to the relationship between social capital and community participation in energy transition by scientists. This conceptual review shows that social capital is a concept marginally or partially used to analyse the community participation in energy transition processes. Findings highlight weaknesses in the literature, such as inconsistent definitions of social capital related to energy transition and limited investigation into certain dimensions of social capital (e.g., cognitive dimension). This review also demonstrates that it can be relevant to analyse the influence of all the three dimensions of social capital (structural, cognitive, relational) on the participation in energy transition processes, gaining important insights both for studies in energy transition, community participation and for policy-makers. To advance the understanding of the role of social capital in the energy transition, future studies should explore the interactions

between the three dimensions of social capital. This could include analysing how social networks (relational dimension) influence trust (structural dimension) and shared norms (cognitive dimension) and vice versa. Additionally, investigating more deeply the potential negative effects of social capital, such as the risk of resistance to change, is important. Understanding these aspects can help develop more targeted strategies to mitigate such effects. The limits related with this article are identify in the keyword selection may have excluded relevant articles. Additionally, studies from environmental sciences were not included, despite their relevance. Finally, although an extensive range of articles was reviewed, some key studies may have been missed, and the taxonomy parameters used could be refined for future research.

To complement the literature review, an appendix is provided that expands on the original work concerning the role of social capital in the energy transition, published in 2022. Given that the initial version of the review was published in 2022, this supplementary section seeks to update the bibliographical and theoretical framework by incorporating key contributions from 2022 to 2024. From this integration of the literature review, it emerges that social capital is considered a key element in the energy transition, not just a by-product. (Anglada, 2022). Strengthening trust, networks, and reciprocity helps communities sustain renewable energy projects (Boonstra & So" derberg, 2024). Integrating traditional knowledge in the energy transition process improves resilience and disaster preparedness (Koopman, 2023). Energy communities do not need to be geographically localized; Models based on shared interests and flexible policies expand the impact of cooperatives (Dudka & Magnani, 2024). Digital technologies can reduce energy poverty, but equitable access is essential (Tao, Yan, Wu, Silva, & Qi, 2024). Social innovation transforms environmental conflicts into opportunities; urban regeneration projects should integrate green social capital and principles of the circular economy (Saidin & O'Neill, 2022; ZHANG, CHEN, YAN, & LI, 2023). In agriculture, sustainable strategies and education (for example, Farmer Field Schools) improve food security and social capital (Charatsari, Lioutas, & Koutsouris, 2022). Policies must ensure a just transition by supporting vulnerable populations and fostering collaboration between cities and regions. Inclusive governance and energy democratization strengthen energy justice (Li & Sunikka-Blank, 2023). Academic interest in social capital and energy transition is growing, but a more structured approach is needed for effective application (Eklund, Khalilpour, Voinov, & Hossain, 2023).

The second paper discusses the dimension of social capital that has been least explored by the social sciences in the energy field: the cognitive dimension. In particular, it considers an energy retrofitting of a historical building in an ex-tobacco factory in Valstagna (Italy), one of the four case studies of the Interreg Austria-Italy SHELTER project. This study explores the role of the cognitive dimension of social capital and place attachment in community participation in energy retrofitting projects for historical buildings, using the example of Col Ventidueore in Valstagna. Using a mixed methods approach, it involved interviews and questionnaires with various stakeholders to evaluate their engagement and examine how the cognitive dimension of social capital influences the participation of the community in the project. In addition, to investigate the participation of the community in the energy retrofitting of the historical building, we have proposed a 5-step approach following the process developed by Devine-Wright (2009). The authors point out that, for energy projects, the planning process can take several years before development actually begins. However, the early stages of a project are a crucial time to understand the position of the community on the project. In this study, we have chosen to move from the individual perspective outlined by Devine-Wright (2009) to the community perspective to reflect on the social aspects that characterize the cognitive dimension of capital. Devine-Wright (2009) explores the relationship between individuals and changes in significant spaces, places, and buildings by analysing the stages of psychological response to change in the place over time.

The cognitive dimension of social capital has emerged that provides a better understanding of the dynamics of community participation and guides strategies to promote community participation based on local values and priorities. Knowledge about local values and priorities for the community is crucial in forming a new shared identity between the community and a new place or building.

In addition, the second paper considered the concept of place attachment to explore how the link between community and place meaning affects participation through Smith, Davenport, Anderson, and Leahy (2011)'s 7 dimensions and how this knowledge supports me in developing the future use of a historic building. The results of the interviews highlight that public authorities play a vital role in fostering community participation in energy retrofit projects. Strong emotional attachment to the place, along with well-defined community priorities and concerns, can greatly impact the success of these initiatives.

The interaction between the cognitive dimension of social capital and the attachment of the place reveals that these two concepts can enhance participation in the retrofitting of historic buildings energy by fostering a shared vision and consolidated values, promoting collective engagement that strengthens community identity and connection to the meaning of the place.

This approach provides suggestions to promote a more strategic participation approach in future sustainability initiatives, incorporating the cognitive dimension of social capital as a vital and indispensable element in promoting community participation.

This third article is a contribution that explores energy transition processes in rural contexts. In particular, innovation applied to energy retrofitting is considered here as a strategic lever to address sustainability challenges and promote socioeconomic development in rural areas. In such settings, retrofitting is not merely a technical intervention, but a transformative process capable of activating the dynamics of territorial regeneration, improving local well-being, and strengthening social capital. According to the definition provided by the European Commission (European Commission, 2004), innovation involves not only the renewal of products and services, but also the introduction of new methods of production, distribution, work organization and skill management. From this perspective, energy retrofitting interventions take on a broader meaning: they contribute to redefining local governance models and reinforcing active community participation. This contribution analyzes a case study of energy retrofitting of a historic building in the rural context of Col Ventidueore (Valstagna), with the aim of exploring how technical innovation can be accompanied and supported by social dynamics that facilitate its diffusion and collective adoption. To support this analysis, an innovative methodological approach was employed: the autologistic actor attribute models advanced by Parker, Pallotti, and Lomi (2022). Although not the theoretical core of the work, the autologistic actor attribute models proved to be an effective tool for understanding how social connections influence participatory behavior and the spread of sustainable practices within the community. By integrating autologistic models and social capital theory, it was possible to jointly analyze individual and relational dimensions Ocelik, Lehotsky', and C̃ernoch (2021), highlighting how participation emerges as a collective phenomenon rather than a simple sum of individual choices. The results reveal the central role of social networks in fostering engagement, suggesting that leveraging these connections may be an effective strategy to promote broader and more inclusive participation. In this sense, energy retrofitting is framed not only as a technical innovation, but also as a social innovation, capable of concretely contributing to the sustainable development of rural areas.

This research uses a mixed methodology. I used questionnaire, interviews, observations, and the case study method.

The case study allows the research to have an empirical application of the underlying concepts. The analysis of this case study used an inductive approach (Eisenhardt, 1989), starting with the collection of empirical data and attempting to inform energy studies of the relationship between social capital and energy transition (Glaser & Strauss, 2017). This bottom-up approach was used to begin observing and interviewing community members to understand their behavior and attitudes toward the retrofitting project. questionnaire, interviews, and observations were used to collect information on the different dimensions of social capital, participation in the retrofitting project, and association with the regenerated building. The target sample consisted of 15 community members identified based on their dominant role in community life.

This study has certain limitations, such as the small sample size. The primary issue is not the number itself, but rather the challenge in network studies to precisely delineate the specific boundaries within the network. In this particular case, these boundaries were further constrained because it was not possible to include all the individuals who were named but did not participate in the research, mainly due to the inability to incorporate their socio-demographic characteristics and level of participation into the model.

This thesis aims to serve as a proposal for future research that examines the influence of social capital and the characteristics of individual social actors on participation in retrofitting projects. By adopting this approach, researchers could identify and understand the aspects of social capital that hinder the participation of certain members of the community. The ultimate goal is to address the gap highlighted by Bauwens and Devine- Wright (2018), which identifies a lack of research focused on the characteristics of those who do not participate in the energy transition. The challenges related to the transition of energy are seen in this study as an opportunity to generate and implement social capital in local communities, through participation in energy projects that define a new possibility of social cohesion.

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Abstract

The impact of social factors in energy transition has become increasingly important in recent decades. In this context, Social Capital (SC) has been used to give greater importance to social aspects that can influence community involvement in the energy transition. Two approaches were used to select the academic literature on SC and energy transition for this review, (1) a keyword search through the main bibliographical databases to ascertain the number of articles on this topic and (2) a theoretical investigation of certain aspects that unite or differentiate the various articles. Specifically, this review paper considers the different definitions given to SC in the energy field, the dimensions and indicators of SC considered in different studies, and the methods, qualitative or quantitative, used to operationalise SC. The review stresses some weaknesses in the literature, such as the split in the definition of SC in relation to the energy transition, the interaction of SC with social rather than individual factors of the person, and indicators of SC that can influence, positively or negatively, energy transition. A shared methodology should be developed with a multidisciplinary approach that would allow SC to be considered in its totality.

Keywords: social capital, energy transition, community change, review.

1. Introduction

Much progress has been made in recent decades in different fields to try to facilitate energy transition (Noboa & Upham, 2018), which is considered a complex, multidimensional, and long-term process (Sovacool, 2016). Energy transition is important to alleviate air pollution, mitigate greenhouse gas emissions, and ensure household access to safe, sustainable, affordable, and modern energy (Xie & Zhou, 2021). Additionally, from a political point of view, much effort has gone into developing global policies (e.g., Delbeke et al. (2019)) with increased sensitivity to environmental issues. Despite all the action taken at the global level, the energy supply dynamics have not been remedied (Noboa & Upham, 2018), leading to a continuous increase in greenhouse gas emissions, loss of biodiversity, and increasing social inequality. In the context of energy transition, it is crucial to consider the role that the community plays in this process and the weight of its decisions on a collective level. In recent decades, the role of the community in energy policy has changed; there has been a shift from the traditional to a people-centric approach (Trombin et al., 2020) which sees the degree of success of energy transition closely linked to the transformation and growth of awareness among citizens about the importance of their actions. People's behaviour in their daily life and their lifestyle are

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essential factors in climate change (Broska, 2021). This is why the need to create a relationship in the energy sector between the scientific community and the community has been emphasised, with the aim of making citizens aware of and responsible for energy issues that could affect their community and themselves (Pidgeon et al., 2014). Citizens are seen as the masters within this process of change. The 21st century is seen as the century in which social aspects will be reconsidered in their entirety in order to contour with larger problems, underlining the importance of considering these factors in decision-making processes (Silver, 2008). To date, however, there is little evidence from academic studies analysing the social factors influencing the success of community energy projects (Warbroek et al., 2019). The purpose of this article is precisely to explore one of the most important social aspects, if not the most important aspect, of society in energy transition: SC. To clarify some concepts, energy transition in this article is considered a process that includes four levels of interaction between the society and energy interventions to lead to greater sustainability: the strategic level in which a socially shared vision is created; a more concrete tactical level that includes all specific measures and barriers to be considered in new energy interventions; an operational level in which energy interventions are made operational; and the last reflective level in which the transition should be monitored and evaluated (Noboa & Upham, 2018). In particular, this approach sees a relationship between different stakeholders to develop, improve, and implement sustainable practices (A. Smith, 2007), as depicted in the following image (Figure 1):

Figure 1: Energy transition:



To understand the energy transition process, SC plays a key role in social change or as an explanation of why these developments do not occur in each context. Context sensitivity is precisely what has very often been criticised in the management of energy transition (Noboa & Upham, 2018). In this study, I would like to consider a particular insight that sees SC as a determining factor in being able to use this academic knowledge in different contexts. This research starts from the consideration that an energy transition process takes place in parallel with the sensitivity of society, which is of fundamental importance for the emergence and facilitation of energy transition processes. The management of energy transition could be considered as the theoretical aspect that characterises change, while SC, through research on its different indicators, aims at producing knowledge to facilitate energy transition.

What I want to point out is that, although SC is a term that has been in the literature for more than 30 years, there is

no single view of it, which makes its conceptualisation very difficult. Juxtaposing these terms with something as new and changing as energy transition is something that can guide some energy interventions, but it risks creating a lot of confusion, as the indicators that are used are not always the same and, in some cases, are simply the result of an author's interpretation based on some documents (ex: secondary data).

In the following section, I briefly address SC and how some of these indicators can influence the environmental choices that each person makes daily. It was not intended to take up the entire concept of SC, but only parts of it to get an overview before moving on to the next section. Section 2 describes how the literature was identified. Based on the identified literature, some elements that characterise the papers that have dealt with these issues are considered. The aim of this section is to have a broader overview of these two concepts to facilitate readers' reflections, considerations, and methodologies that characterise the relationship between SC and energy transition in the social sciences. Section 3 explicates the goal of the research and the methodology used to identify the reference literature. Based on the identified literature, some elements that characterise the papers that have addressed the link between SC and energy transition are considered. The goal of this section is not to have an exhaustive view of these two terms but to be able to have a broader overview of these two concepts to facilitate readers' reflections, considerations, and methodologies that can be applied to understand the relationship between SC and energy transition in the social science world. Section 4 considers some limitations of the present literature in the energy field in relation to some aspects and indicators characteristic of SC. Section 5 highlights some limits in this review and offers recommendations on what aspects of SC should be explored in energy transition in order to outline potentially fruitful paths for future research in the energy field.

2. Theoretical Framework of social capital

There have been various criticisms of the development of the concept of SC over time, and even today, there is no single definition. Despite this, SC and its importance have never lost value. Putnam (1994) sees it as a collective resource, where each individual comes into contact with the rest of society. Each member makes his or her own set of resources available to others in order to realise common projects that would not otherwise be feasible. SC is a system of shared norms, values, and beliefs embedded in social networks (Forbes & Zampelli, 2014) and is characterised by cooperation, reciprocity, and trust, and it is said to improve social relations (Morrison & Ramsey, 2019). Subsequently, Coleman (1988) defines it as a set of resources that the individual uses to achieve his or her goals. The networks of relationships that are created within society are the result of different types of social investment strategies that have the characteristic of creating and developing resources that can be spent over time. The interaction between the different members of a community, in fact, is durable and useful as it produces both material and symbolic profits. Coleman (1988) attributes to SC the same characteristics of a public good, therefore usable by any social actor in that community.

Coleman (1988), Bourdieu (2011), and Portes (2009) refer to an approach based on the calculation of the costs and benefits of an action. Bourdieu (2011) was mainly concerned with using the concept of SC in the study of the analysis of social stratification. He defines SC as a resource for the achievement of individual strategies; its formation is linked to a deliberate action to achieve certain ends.

Subsequently, Portes (2009) focuses on the formation of SC by referring to four processes: the internalisation of values, reciprocity exchanges, collective solidarity, and imposed trust. An important aspect of SC is precisely the types of possible ties and types of trust, as they are linked to the behaviour of the individual and the acquisition of

norms. Bonding bonds refer to relationships that occur within a community, characterised by the fact that the reference social group shares a common sense of identity. Bonding refers to relationships that occur within a community, characterised by the fact that the reference social group shares a common sense of identity. This concept can be found in individuals living in the same geographical area, where relationships are based on a well-localised level of trust that considers friends, relatives, and neighbours as social actors. Individuals with whom close-knit relationships are established usually share the same values, attitudes, and behaviours (J. W. Smith et al., 2012; Weil, 2013). A negative effect that can occur in a predominantly bonding environment is a limitation on the part of the community to positively consider development and innovation processes, as relationships with individuals outside the network are limited. In fact, this type of bond is characterized by reinforcing the already existing social network by generating what Macias (2015) defines as personal trust. Personal trust refers to the relationship we establish with the people we are in close contact with. In particular, at the housing level, it has been noted that a good connection between neighbours is positively correlated with environmental conservation actions and active participation in the community (von Bock und Polach et al., 2015).

On the other hand, we find generalised trust. Macias (2015) defines this type of trust as widespread confidence in the integrity of others even if we do not know them. In the field of environmental sustainability, studies show that generalised trust makes it more likely that people will actively engage in collaborating to preserve the environment in the confidence that others will do the same (Macias, 2015).

This kind of trust tends to create bridging ties, which specifically create ties outside the network by extending beyond the immediate community. Openness to the outside world allows the social actors involved to distance themselves from the behaviours and customs of the community of reference. This action is possible thanks to the moral support they receive from individuals outside the network with whom they have relationships.

This phenomenon is linked to the propensity of those with bridging ties to believe in and view social changes positively. This process is also favoured by the fact that these individuals receive more information than social actors who choose to have bonding ties, allowing them to have a broader view of social situations (J. W. Smith et al., 2012). SC is a concept that has evolved over time and has taken on a multidisciplinary character. Different disciplines have used it to try to understand different issues, such as social tensions (Perez-Sindin, 2021), social conflicts (Sumkoski, 2016), local development (Felice, 2010; Huruta et al., 2020; Sumkoski, 2016), rural development (Morrison & Ramsey, 2019), system development (Devkota, 2007; Frantál & Nováková, 2019), etc. In the last 20 years, a new form of energy economy has arisen. Consequently, the concept of SC has been introduced to understand and explain some elements of energy transition. Rogers et al. (2011) consider the level of SC as an essential element for the success of energy projects because it can influence their results. SC can make a difference in the growth of innovative energy companies (Kjeldsen & Svensen, 2011). von Bock und Polach et al. (2015) stress that a good balance between collective activity and leadership can generate trusting relationships, ties, and community networks that foster the sustainable use of renewable energy. Yang et al. (2016) highlights the influence of SC in active participation in initiatives that address energy change. J. W. Smith et al. (2012) identify a sense of community and SC as essential aspects for the success of energy projects that involve the community. Below, I will look at all the relationships between SC and energy transition highlighted in the literature.

3. A Conceptual Review of Social Capital and Energy Transition

3.1 Objectives

The goal of this literature review is to explore how the concept of capital has been studied in the social science field in relation to energy transition. To this end, I will examine what dimensions of SC have been considered in energy-related research and identify which indicators of SC have been considered in energy transition. In this way, I will provide a broader view of the research conducted so far and provide insights into what characteristics, dimensions, and indicators of SC are important in order to better understand the role of the community in energy transition.

3.1.1 Methodology

This literature review has a two-pronged approach. Its first objective is to quantitatively assess changes in the intensity of research on the relationship between SC and energy transition, measured in terms of the volume of publications that have appeared over time. For this, I used two different databases, Scopus and ISI Web of Science. These two databases were chosen for two reasons. The first is that in recent years these two databases have been regarded as integrated, making it possible to merge the databases to create a single integrated analysis (Caputo & Kargina, 2022). Secondly, both allow searches limited to “titles”, “abstracts”, and “keywords”. All articles containing the words “SC” and “energy*” were selected. The new search resulted in 143 articles (The research was conducted in October 2021). Only articles from the area of social sciences published between 2001 and 2021 were selected. Of these 143 articles, some were excluded for the following reasons: double in the two journals, the concept of energy was understood as “emotional energy”; in other cases, “SC” was confused with the word “Social Capitalism”. The total number of articles considered is 90.

The second objective is a more qualitative conceptual review that allows us to understand how these two concepts have been considered over time. Through the NVivo software, different codes were used to investigate different aspects of the articles. In particular, the geographical distribution of departments that dealt with this topic was considered, as well as the number of authors interested in these topics in the various departments. Subsequently, the publications by years were considered. The different indicators of SC considered in the articles and the methodological approach used were also considered.

1. Topic: I examined which fields have been most explored in studies of SC and energy transition. Which of these goals do researchers have in using SC to understand certain community attitudes? This aspect is important to understand what fields are mostly considered, how SC is explored, and what interpretations of the findings are made regarding the energy transition.
2. Definition of SC: I explored how many terms are used to define SC and how they relate to specific indicators of SC (Yeung et al., 2021). For example, it is not easy to define what SC is, but very often, the level of SC is associated with specific aspects of it, such as relationships, trust, etc.
3. SC dimensions: SC is composed of three dimensions: structural, relational, and cognitive (Seliverstova et al., 2018). In studies, particular importance is often given to the structural dimension, more to the relational and less to the cognitive. In doing so, there is the risk of neglecting important elements of SC in relation to energy transition.

4. SC indicators: Because the term “SC” is difficult to define, we examined what elements were commonly included when discussing SC. There seems to be disagreement about which elements are necessary to understand SC. In fact, studies of it in the energy field have often included only a few indicators of SC.
5. Methods used: I examined what methods were used to gather information about SC, primarily whether they were qualitative, quantitative, or mixed.
6. Distribution of departments/Relations between authors in different countries: I explored the geographic area of departments that have explored the concept of SC and the collaborations between authors from different countries. This choice was made to see how the relationship between SC and energy transition was approached based on different cultural realities (Noboa & Upham, 2018).

In the process of reviewing the literature, I identified two main journals that frequently consider at a theoretical and empirical level the relationship between SC and energy transition, Sustainability Switzerland and Energy Research and Social Science (Table 1). Most of the rest of my discussion revolves around the articles published in these journals.

4. Results and Trends

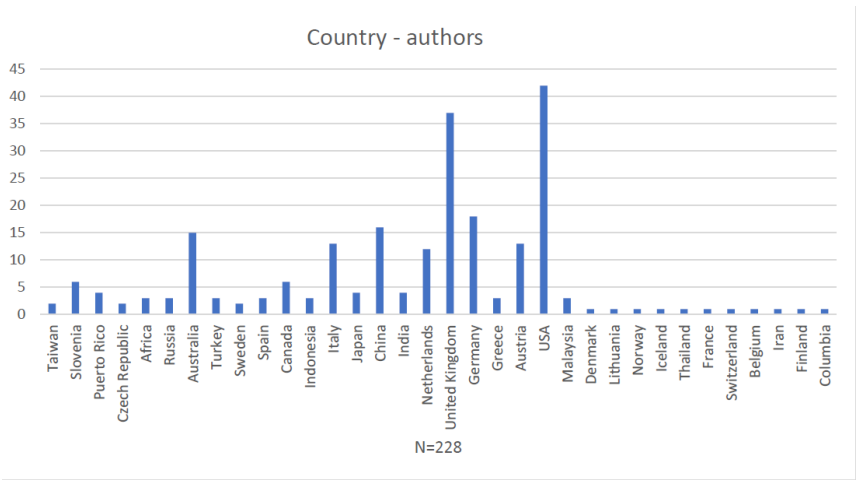
The concept of SC and energy transition is developed in a broader context, particularly in journals dealing with sustainability issues and seeking to bring the energy field closer to and complement the social field. Many authors working in very different contexts have looked into this relationship (Figure 4):

As can be seen from the graph, the values are unevenly distributed, and few appear in places such as South America, where I find only one Colombian author (Polanco, 2018) who has published a paper on this topic. This aspect is very interesting and relates to the considerations made by the authors Noboa & Upham (2018). The

Table 1: Main journal (based on searches in ISI Web of Science and Scopus)

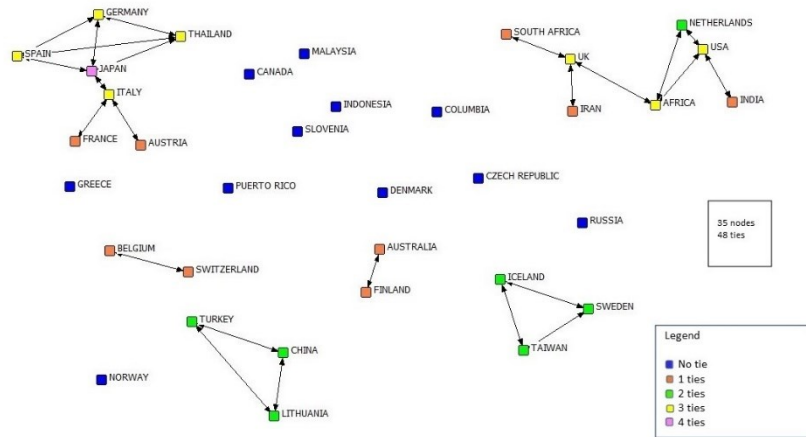
Journal	N.
Sustainability Switzerland	14
Energy Research And Social Science	9
Scientometrics	3
Business Strategy And The Environment	2
Environment And Planning A	2
Extractive Industries And Society	2
Geoforum	2
Global Networks	2
Quality And Quantity	2
Sustainable Cities And Society	2
Other	50
Tot.	90

Figure 2: Number of authors by country of scientific activity (location is based on the location of the institutions where authors were based, not the nationality of authors. If authors had multiple affiliations in different regions, the location of the author was divided between those regions).



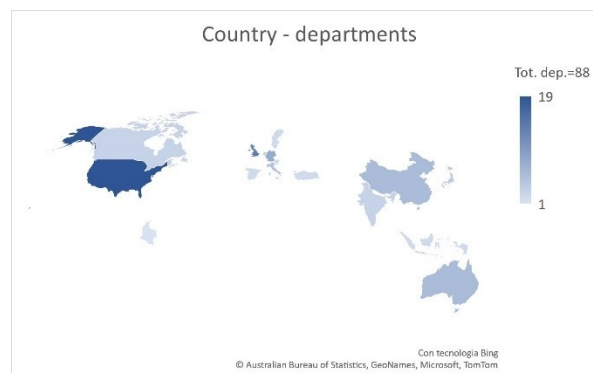
authors point out that the concept of energy transition is much discussed in Europe, where the regime is liberal-democratic, but little considered in other contexts, such as in South America, where there is an illiberal democratic regime that does not consider the participation of citizens in energy decisions. There are two different forms of government, a centralised and privatised form of political economy, for example, in Peru, Chile, and Colombia, where some international companies exploit natural resources related to energy. In other states, however, such as Venezuela, Ecuador, Bolivia, and Nicaragua, there has been a redistribution of resources, and management is in the hands of state-owned companies. What all forms of government have in common, however, is that ownership patterns and management of energy resources are controlled by a few actors and citizen participation is not contemplated. To facilitate a large-scale sustainable energy transition, the role of the community is important. In fact, projects that start from the bottom up allow achieving energy savings and changes in behaviour by the community that cannot be achieved through top-down policies (Yeung et al., 2021). Energy initiatives that start from the bottom are able to reach actors that other types of projects cannot (Seliverstova et al., 2018). This is precisely attributable to the SC that is generated among the different members of the community. The following figure (Figure 3) is a relational representation elaborated through the UCINET software and represents the collaborations between different countries for the writing of different articles.

Figure 3: Relations between authors in different countries.



In total, I found 35 nodes and 48 ties. Some countries, such as Denmark, Russia and Colombia, have not collaborated with other countries in writing articles on SC and energy transition. Japan appears to be the state that has the most relations with the outside world within the European context (Spain, Italy, and Germany). It is very interesting to see how other countries, despite not being geographically close, have built a network with other countries, such as the UK and Africa or the USA and India. This makes us understand that there is a willingness to collaborate even if the authors' working contexts are very different. A collaboration that considers different contexts could help to deepen these two concepts giving a more global vision of the relationship between SC and energy transition. The following image (Figure 4) shows the location of the departments to which the authors who have worked on this topic are affiliated (If several authors of the same article collaborated in the same department, the department was only entered once anyway).

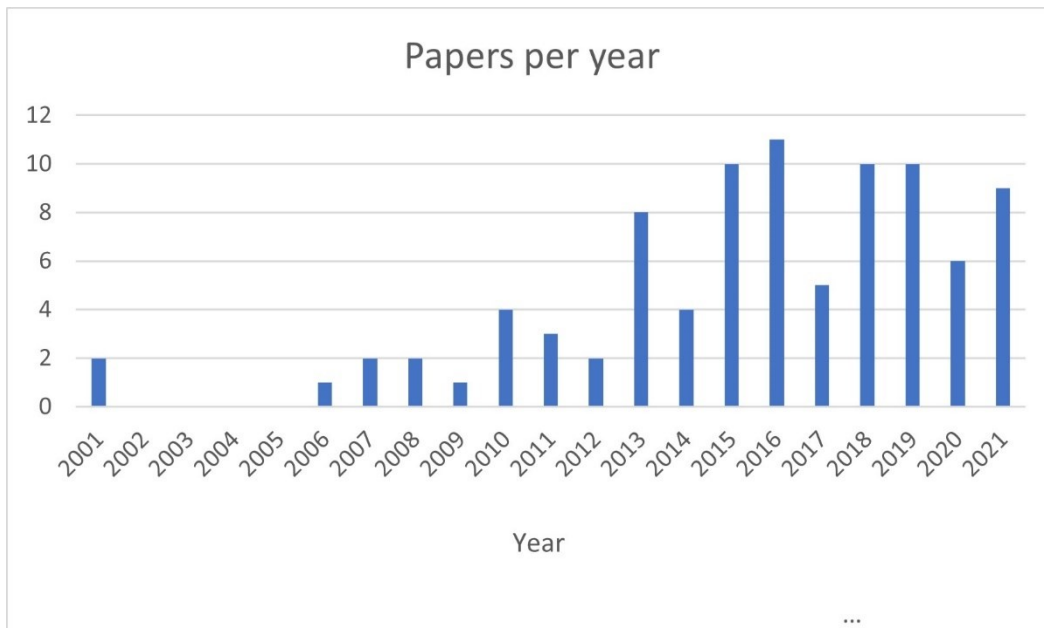
Figure 4: Distribution of departments that have dealt with this topic.



As can be seen, there are states that have dealt with this issue more than others, in particular the United States (19 departments) and Great Britain (14 departments). The United States is an important pillar in the history of energy transition and, in particular, citizen participation in this process. In fact, some terms that identify precisely a change in the role of citizens in energy-related decision-making, such as “energy democracy”, originate in the United States (Polanco, 2018). In this context, it is also important to remember that the Aarhus Convention and UN policies in some countries, particularly in the UK and US, guide planning policies that ensure that public participation takes place with local communities in many projects such as low-carbon infrastructure (Servillo et al., 2012). These could be some of the reasons for these countries to contribute more to understanding the link and influence between SC and energy

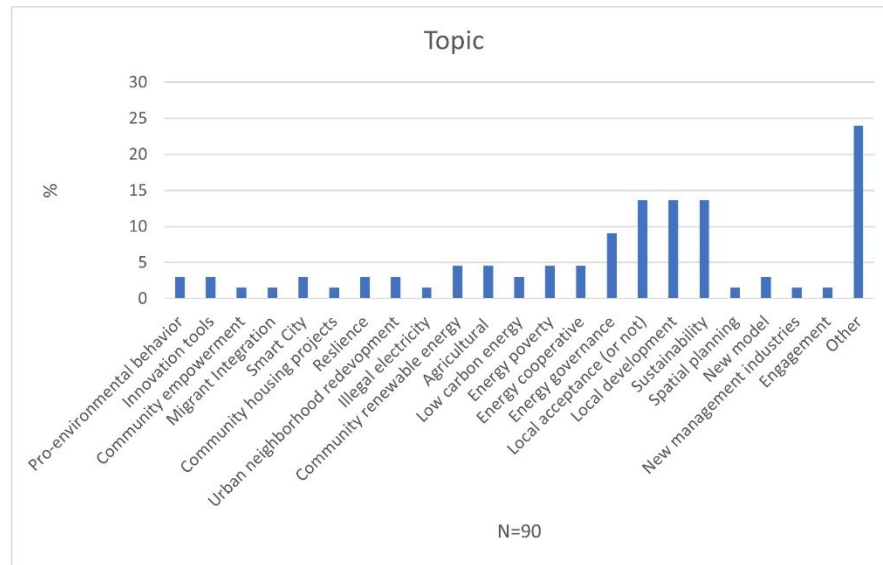
transition. The following graph (Figure 5) shows the papers published in the last 20 years on SC and energy transition (N = 90). The papers are distributed as follows.

Figure 5: Number of articles published per year from 2001 to 2021.



Publications began in 2001, followed by some very poor years on this topic until 2006, when publications began again. The peak years are 2013, 2015, and 2016, with a decline in 2017 and a recovery in the following years. Some of these years are particularly indicative of historical events on energy issues that may justify this trend. In particular, in 2012, there was the Doha Conference (COP 18) on climate change. In the European context (accounting for 33% of the departments dealing with these issues), many important regulations were introduced this year. In 2015, the European Commission published a new strategy (COM(2015)0080) with the aim of achieving an Energy Union that offers EU households and businesses a secure, sustainable, competitive, and more affordable energy supply. In 2016, the European Commission (COM(2016)0860) proposed a package consisting of 8 proposals promoting clean energy for all. Part of this package is renewable energy (UE) 2018/2001), introduced in 2018, and energy efficiency, also from the same year (UE) 2018/2002). All these elements help us to understand the connection between the years of these publications and the new regulations. The following graph (Figure 6) shows the topics covered by the selected articles. SC is considered with reference to different topics. A number of authors (Polanco, 2018; Rogers et al., 2011; Satoh & Weiss, 2021; Steward et al., 2009; Szulecki & Overland, 2020) consider how SC could play an important role in the acceptance or non-acceptance of new energy practices (local acceptance (or not)), production processes, and the construction of renewable energy facilities. In particular, SC is seen as empowering in protests over new plants (Steward et al., 2009) or as facilitating transition and adaptation to change in certain contexts, such as rural ones (Knudsen, 2018). The relationship aspect of SC is considered an element that fosters cohesion to achieve common goals (Rogers et al., 2011; Scheffran et al., 2012; Servillo et al., 2012).

Figure 6: Topic of articles considering “social capital” and “energy**”.



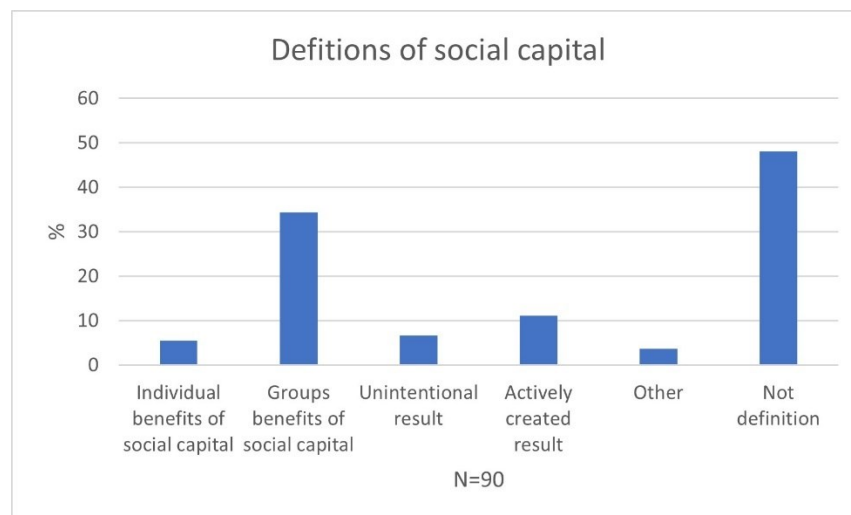
Other authors (Exner et al., 2016; Parkhill et al., 2015; Tilt & Gerkey, 2016) give importance to the technological and innovative aspects of energy and how new norms or values related to energy and its use can be compared to the development of SC. SC is considered a collective good derived from compliance with shared social norms that influences the socio-cultural acceptance of new energy technologies (Parkhill et al., 2015). The relationship between residents can be a determining factor in the success of innovative energy interventions (Tilt & Gerkey, 2016). SC has also been considered in relation to sustainability (Cirman et al., 2013; Haque et al., 2021; Nilsson & Larsen, 2020; Qi et al., 2020; Winskel et al., 2006) and in the development of new sustainable business models. Again, importance is given to the ability of SC to create networks both outside the target community (Qi et al., 2020) and within the community (Nilsson & Larsen, 2020), consolidating and building both social and human capital. It is also considered one of the five factors that make up capital in its most general sense (physical, natural, human, financial, and SC). In particular, a high level of SC can foster relationships between communities and institutions by promoting energy change (Cirman et al., 2013; Nilsson & Larsen, 2020; Qi et al., 2020; Winskel et al., 2006). In other research, SC appears to be relevant in the creation of renewable energy cooperatives (H. Chen et al., 2013; Herbes et al., 2021; Hu et al., 2015; Straka, 2002). In this context of SC, its relational aspect and how these relationships within co-operatives can facilitate their development are explored. SC is also related to energy poverty (Brummer, 2018; Huruta et al., 2020; Putnam, 1994). In this case, SC is considered in relation to socio-cultural aspects of specific contexts. Rogers et al. (2011) refer to how neighbourly relations are important in spreading the importance of energy conservation and good energy use. In other research, it has been seen as important in promoting environmental initiatives and actions (Abdallah et al., 2015; Devkota, 2007; Satoh & Weiss, 2021). SC is considered an important promoter in collective actions (Abdallah et al., 2015), and in general, in defence of common goods and ecosystem services (Abdallah et al., 2015). In these studies, SC and a sense of community are considered important aspects of the success of energy projects (Rogers et al., 2011) and the connection between these projects and socio-economic aspects, such as crime, which can be influenced by the level of SC (Macias, 2015). Once again, the power of capital in facilitating collective actions is emphasised (Mishra, 2013).

The different definitions of SC have been regrouped following the more important classifications of SC:

- Individual benefits of social capital: “Friends, colleagues, and more general contacts through whom you receive opportunities to use your financial capital and human capital” ((Anderson & Schirmer, 2015): 9);
- Group benefits of social capital: “Social capital flows from the endowment of mutually respecting and trusting relationships which enable a group to pursue its shared goals more effectively than would otherwise be possible” ((Bauwens & Defourny, 2017):57);
- Unintentional result: “Social capital depends on being a byproduct of activities engaged in for other purposes” ((Felice, 2010): 312);
- Actively created result: “Becker supposes that people choose social networks in ways that will maximise their utility” ((Q. Chen et al., 2015): 82).

The following figure (Figure 7) represents the frequency for each definition given to SC in articles in the energy field.

Figure 7: Definitions of social capital.

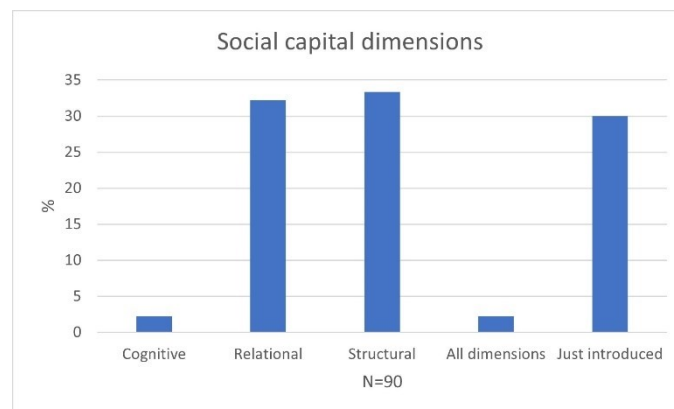


The graph shows that SC, in most cases, is considered to be an element that benefits the group. In fact, social networks are often referred to in the definition of SC. The network is considered a feature of the community, allowing people to be able to help each other in times of economic need (Bereményi & Montero-Díaz, 2019). Community-based initiatives are essential to address the need for renewable sources in some countries where non-renewable sources are not only not sustainable but also not sufficient (Devkota, 2007). In this situation, mobilising SC (actively created result) is seen as important for preserving the environment, although a more energy-conscious behaviour may not always lead to a more sustainable behaviour (Broska, 2021). According to other authors, however, it is considered a facilitator, particularly in cooperation and collaboration for mutual benefit (Tilt & Gerkey, 2016). It is also interesting to note that almost half of the authors do not give a definition of SC (ex: (Devkota, 2007)). This is because, in many cases, it is only introduced in the studies but not explored in depth. In energy transition, understanding the link between social and economic development is very important. Social networks and collaboration are elements that lead to social development, and energy in this context is a means for people to satisfy their daily, personal needs

(Qi et al., 2020). The individual aspect that characterises the link between energy and society is not reflected in the definitions used to define SC in the literature. Involving the community in the appropriate way within the transition process by considering the different facets of SC leads to two types of benefits, it favours economic development, as energy is fundamental for production (Valente et al., 2021), and the availability of energy increases social happiness, just think of the possibility of heating one's own flat (Qi et al., 2020).

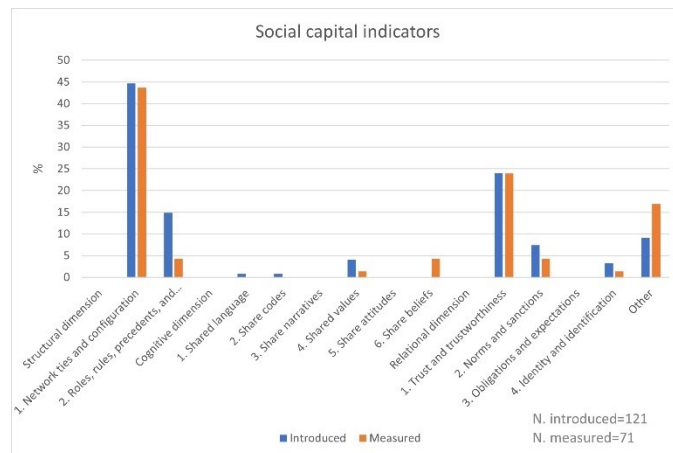
The next graph (Figure 8) shows the three dimensions of SC (J. W. Smith et al., 2012) that are considered in the articles.

Figure 8: Social capital dimensions.



From (Figure 8), the two dimensions of SC that are considered are relational and structural. This is linked to what was previously considered in the definition of SC. In fact, the structural dimension refers to the network within the community. In order to address the characteristics of SC and to provide a shared model, SC was usually divided into two dimensions, structural and relational, which in some cases were confused, such as in the work of Nyqvist et al. (2014), who classify some indicators of SC that belong to the relational dimension to the cognitive dimension. Nyqvist et al. (2014), in fact, consider structural SC as “networks, relationships, and institutions that connect people and groups” Ahmad et al. (2013), quantification of network ties and group participation, and cognitive SC, which refers to “values, attitudes, trust, confidence, and norms”, measured through more subjective characteristics. In particular, the structural dimension refers to what people do in their social life, while the cognitive dimension refers to how people feel about their social life (Yang et al., 2016). Only three of the articles of the literature review within their research take into account all three dimensions. This is an aspect that is also highlighted in the paper of Broska (2021), which highlights the lack of the three dimensions of SC in all studies that link SC to pro-environmental behaviours. In some of the articles, the concept of SC was only introduced but not further explored, and therefore, it was not possible to identify one or more of the dimensions of SC. The following graph (Figure 9) shows the indicators that are considered within the papers and the indicators that are measured. The same indicators used by Claridge (2004) were considered for each dimension of social capital (The X-axis shows the three dimensions of the SC and the distribution of data for each indicator, numbers are useful for understanding how many indicators exist for each dimension of SC).

Figure 9: The different indicators used to measure social capital.



From Figure 9, the network indicator is the most often considered. Followed by trust and ties, these indicators are part of the structural and relational dimensions. An interesting aspect that could explain this gap between the introduction and use of these indicators is that very often, SC is not actually measured with specific questions but is only used as an element that can explain certain phenomena (see: Burt (2012)). The network in Balfour & Alter (2016) research was used to identify critical actors in the community; the results of this analysis were considered important in understanding the dynamics within the community. The same article by Broska (2021) considers, in the initial part of his article, the three dimensions of SC. The empirical part of his research does not consider explicit questions on some of these indicators but is the result of an interpretation of the results of the interviews. The cognitive dimension is considered an important indicator of SC by some authors (Claridge, 2004; Parkhill et al., 2015), but no method is used to be able to qualitatively or quantitatively understand this indicator. Another element that could also explain this gap between the elements considered and those measured is that in some articles (ex: Parkhill et al. (2015)), some indicators such as trust, considered important as an indicator in the next stage of analysis, are explained using networks. An interesting aspect of indicators is that there are usually positive and negative aspects to SC, but usually, in the various research, the former is considered while the latter remains unknown (Straka, 2002). The following graphs (Figures 10 and 11) represent the methods that were used to collect the data in the various studies (The total number of research considered in these graphs is 50, the remaining 40 articles have not been considered because they are not empirical research or secondary data were used (12 articles) that cannot be entered in either method.) From Figures 10, there are different types of methods used to collect data.

Figure 10: Qualitative methods used.

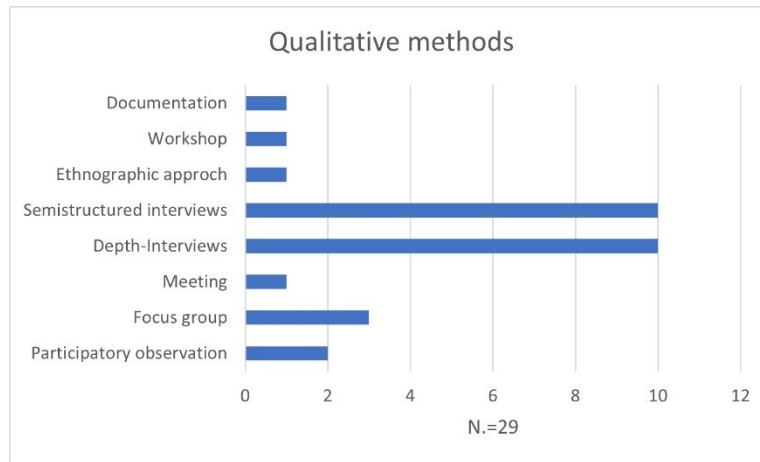
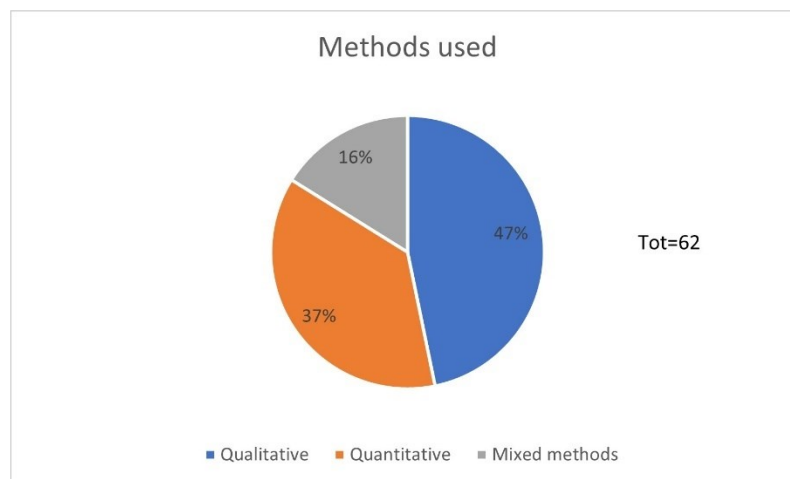


Figure 11: Methods used to investigate social capital.



In most cases, the methods used are qualitative (58%) (see: Bereményi & Montero- Díaz (2019) and Broska (2021)), in others, quantitative (22%) (see: Abdallah et al. (2015) and Bereményi & Montero-Díaz (2019)), and to a lesser extent, mixed method (20%) ((Macias, 2015; Winskel et al., 2006)) (The different methods for data collection and data modelling are important because they might affect the results in primary studies. This aspect, however, should not affect my review because I concentrate on a descriptive analysis of the research available online and don't look for statistical differences across studies.) Usually, in empirical research concerning SC, a qualitative approach is chosen. The method used in quantitative research is a survey.

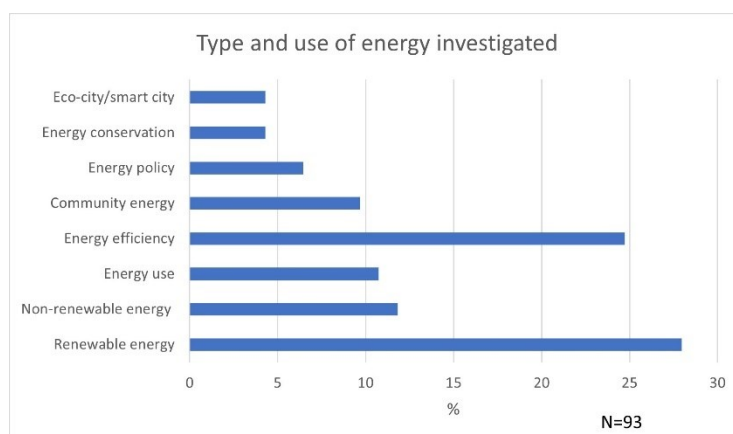
In addition, most of the research (12) used secondary data to explore the relationship between SC and energy (ex: Haque et al. (2021) and Tilt & Gerkey (2016)). This relates to what is shown in Figure 6, where socio-demographic or crime data appear among the indicators of SC. As far as the questionnaires are concerned, these were usually conducted by telephone, and the sample is not representative but only includes those who agreed to be interviewed. Rogers et al. (2011), on the other hand, refer to a tool created by the World Bank that has conducted extensive work on the development of methods and indices to measure SC. In particular, the SC Thematic Group within the World Bank has two tools for assessing SC, the SC Assessment Tool (SOCAT) and the SC Integrated Questionnaire

(SOCAPIQ). SOCAT is a tool designed to collect information on SC at the household and community organisational level. The second tool, SOCAPIQ, is more quantitative and can be added to existing family questionnaires and is the one used by Rogers et al. (2011) in their study.

Figure 9 (The names of the methods have been given as they appear in the articles so as not to alter their meaning.) (Figure 11) shows the qualitative methods used to examine data. There are several methods that are used to collect data, the most used being semi-structured interviews and in-depth interviews. In some research (Nygqvist et al., 2014; Warbroek et al., 2019), data are collected with qualitative methods such as in-depth interviews or documentation concerning the local reality, but in a later stage of analysis, quantitative methods are used in which the authors analyse the data. Anderson & Schirmer (2015) used a qualitative approach using semi-structured interviews, as did Ahmad et al. (2013) and Bereményi & Montero-Díaz (2019). Haque et al. (2021) and Perez-Sindin (2021) used a qualitative method but included focus groups in addition to the semi-structured interview. In some cases, the participatory observation method was used (Hu et al., 2015; Parkhill et al., 2015).

The following graph (Figure 12) (The total number of articles in this chart is 93 and not 90 as the number of articles selected because 3 of the articles refer to both renewable and non-renewable energy (i.e., nuclear and photovoltaic);) (Non-renewable energies to be included in these categories have been selected in accordance with US Department of Energy (Energy Sources | Department of Energy);) (The categories eco city and smart city have been included in the same category, because in this study I was interested in the social and environmental aspect that both have in common: they share the aspirations of reducing environmental loads and improving human welfare (www.ecocitystandards.org: access 17 May 2022);) considers the different types of energy or energy sustainability that are considered in SC research.

Figure 12: Energy investigated.



As can be seen from Figure 12, there are several energy topics where the SC concept is introduced. The field where it has been most used is renewable energy, where the percentage is 28%. These articles look at renewable energy as a whole and community interaction as a very important aspect of the adoption of this type of energy. SC plays a very important role in this type of research because it is very often related to sustainable practices within households (Balfour & Alter, 2016; Winskel et al., 2006) and the use of renewable energy (Petropoulou et al., 2018). An interesting aspect that is not possible to see from the graph is that, among the selected articles, only one refers to biomass, which we find in the renewable energy category, namely, The Efficiency of Biomass Energy Management with Local

Resource Management Potential (Lin et al., 2018). Probably all the articles that deal with biomass are not found in the social science part of the journals but in the environmental ones, which I will not go into in this article. The article by Hu et al. (2015) introduces a 'hub-and-spoke' model of eco-cities (Woetzel et al., 2009) (clusters of small and medium-sized cities around larger ones) designed to make China an international pioneer in eco-city development. This approach used is called top-down. An interesting aspect of this study is the role attributed to the community. Identity aspects such as community acceptance and cultural rootedness are only considered in the final stage of this approach. Instead, great emphasis is placed on the institutional role, macro-level policies, and the implementation of laws. The aspect that makes this study misleading is the idea that instead of humans, society is the essential part of the city. Excluding the community from the entire initial design phase in this approach makes the characteristics of society and social capital marginal. Renewable energy is becoming an increasingly important topic, and its continued growth is progressing at a very high level. In fact, 260 GW of renewable energy was planned to be installed globally in 2020 (Whiteman et al., 2016). Moreover, renewable energy represents the cheapest source of energy in most of the world; even coal-fired power plants are now more expensive than renewable energy (IRENA, 2020), in addition to being more harmful to the environment.

5. Problems and controversies

What can be seen from this literature review is that the concept of SC in the energy field and beyond is very difficult to delineate. This aspect generally characterises many concepts in the social sciences, which is not necessarily seen in a negative way. As SC is a very broad concept and has also been studied for a long time, it might be plausible that there is no single definition of this term. In particular, as already suggested for other terms (Trombin et al., 2020), it might be useful to move away from the definition of the concept and focus on those SC indicators that connect with energy transition or on the presence in different contexts of these specific indicators. What follows are the different discourses in the literary world regarding the characteristics of SC, linking it to a process such as energy transition. How do the different disciplines dealing with these topics create confusion or clarity? Is SC the result of social or personal characteristics? Are there variables or factors that influence SC? What are the indicators of SC that can influence energy transition?

5.1 Features of social capital

To date, there is no single definition of this term, although we often start with the classic definition given by Putnam (1994) and Coleman (1988) and move on to new interpretations such as Macias (2015), who have made this concept increasingly dense. From the analysis of the articles, some characteristics of SC emerged that create a division in the interpretation of this term. Some consider it as a fixed resource ((Atwell et al., 2010; Macias, 2015)) present in the community, while others consider it as a flexible element that can be modified (Balfour & Alter, 2016; Devine-Wright et al., 2001; Exner et al., 2016). To date, the flexible characteristic of SC is the most dominant one, which leads many authors to use some terms that indicate a transformation linked to this concept, such as "development of SC" or "creation of SC". However, what is missing in considering SC as something that changes are the practical actions that can lead to this development or creation, in reference to which the literature remains very vague. In some cases, SC is considered as a support (Wächter, 2013) or facilitator of energy transition processes (Kawamoto, 2015; Petropoulou et al., 2018), but even in this case, the considerations often remain generic and do not provide tools to use SC for this purpose. These different characteristics of social capital in relation to energy transition reflect the

classical division in the view of social capital. In fact, there are usually two different camps, those who consider social capital as an unintentional result (Bauwens & Defourny, 2017) and other researchers dealing with social capital who consider it as actively created and fostered by social relations.

5.2 Social capital, Social or Individual Interaction?

The SC is, perhaps because of its name, considered in almost all studies as something related to society, considering how the individual interacts with society through values, norms, and relationships. Only a few authors, three, consider an individual aspect of SC, such as the experience and motivation that creates what is referred to in SC as identity. Personal motivation drives people to take part in sustainable community projects, committing to environmentally friendly behaviours (Broska, 2021). The characteristics of individual SC also play an important role in sustainable energy initiatives; in fact, the implementation of technologies, if accompanied by a strong individual and family network, can have an immediate and very strong impact on fossil energy consumption and greenhouse gas emissions (Morrison & Ramsey, 2019). Sustainable community projects that aim to create only collective actions can be disadvantageous while combining an individual and family level in these projects can have very positive feedback. Knowledge, which in fact, is a very important element of SC, is one of those aspects that exist only within the individual (Macias, 2015). In my view, the individual aspect of SC, i.e., the wealth of experience and motivation that drives a person to take part in energy transition and to perform concrete actions, should be explored in greater depth.

5.3 Social capital, Positive or Negative Aspect?

SC is considered something positive for the community, and in contexts where it is not present or not so developed, it is important to create it through relationships and trust (Yurtseven, 2015). This idea, however, does not differentiate between those indicators of SC, such as personal trust or territorial identity, which, if developed further, could go against energy transition precisely because of their characteristics and the sense of community they create. With reference to this point, which very often sees SC as a big bag that contains several indicators that do not have a fixed or shared distribution, no author, except one, considers the three dimensions of SC that are nowadays recognised and shared in most of the world of sociological sciences, in his analysis. What I think should be done to make the best use of this concept and to help to define it is to consider what are the essential indicators that must be considered to talk about SC and to suggest practical actions to be able to understand, develop, and/or create it. In relation to energy transition, each indicator should be considered in more detail with the aim of giving a clearer view of which SC indicators favour energy transition in order to develop them, and which ones limit it in order to control them. Only through an in-depth and shared study of what SC is and its relation to energy transition can this tool support this process, giving added value to all the research that in the last 20 years has dealt with these issues.

6. Limits

This article describes studies conducted over the past two decades that analyse the relationship between SC and energy transition. Some features, such as the dimensions of SC, the definition, and the methods used, aim to increase the understanding of SC in the energy field and help research in this area. This article elaborates some limitations, which can be overcome in future research for better results:

- Keywords in the article, abstract, and title were used to select papers. There might be some articles,

however, that consider other keywords such as “social network analysis” and therefore do not consider “SC” and “energy*”, but that could have been relevant to this study;

- This study selected studies in the field of social sciences, but in the last decades, environmental sciences have also dealt with SC, but that was not considered in this article;
- An attempt was made to cover as many research articles as possible, but it is possible that some research articles which focus on the relationship between SC and energy may be missing;
- Likewise, the taxonomy parameters adopted in this research could be improved.

7. Conclusion

The concept of SC has evolved over time and has slowly been used in different contexts to understand phenomena and facilitate a process, as in the case of energy transition. In recent years, the terms SC and energy transition have become increasingly used, and several disciplines have stressed the role of citizens in defeating climate change and decarbonisation, in particular, their social characteristics and their social factors, considered important elements in these environmental changes.

The literature review regarding SC and energy transition found that studies and research conducted so far have not fully considered the three dimensions of SC: structural, relational, and cognitive (Nahapiet & Ghoshal, 1998; Seliverstova et al., 2018; Yurtseven, 2015).

The fact that these studies have focused only on the structural and relational dimension of SC, and therefore on relationships and trust, has led to highlighting the positive role of SC within energy transition. In fact, as highlighted by various studies, trust, relationships, etc., support transition processes, but there are also some aspects of SC that limit energy transition and that have been little considered in the research conducted so far. In particular, the cognitive dimension, which are individual characteristics that bind a person to their territory, defined as shared understandings that enclose a set of aspects that unite the inhabitants, such as values, codes, and narratives, and that attribute peculiarities to the territory itself. In the energy field, considering this aspect within energy transition is of fundamental importance because this transition process brings with it many changes that can affect places considered important by the inhabitants.

This passage also includes place meaning that has various aspects that tie a person to their place of origin, from a historical point of view and, especially, from an individual point of view (Broska, 2021). Place meaning (J. W. Smith et al., 2012) encompasses a dual aspect that characterises an individual, their social reality, and their personal reality (Šlaus & Jacobs, 2011). Place attachment generates an emotional bond between individuals and/or groups and familiar places. It is a complex phenomenon that usually generates a positive, though sometimes ambivalent or negative, bond (Manzo, 2005). Very often, identity and place attachment have been considered elements that relate to each other. Individuals, in fact, seek out typically natural places, which give the possibility of psychological restoration and become the most loved places (Devine-Wright & Howes, 2010). Considering all these aspects in order to make the European Commission’s new strategy of increasing energy from renewable sources to 40 per cent feasible is of fundamental importance. In this context, territorial identity has a very important role to play in facilitating or limiting interventions, including technological ones, that can alter the landscape, change places, or ask the

community to change their traditions and their history.

The implementation of a solar panel in a specific place, for people who do not live there, has no value whatsoever, but is seen only as an ecological transition. For the locals, it might be perceived differently. If the place where the solar panel is installed is a place with a high level of place meaning, it can lead to the failure of a project if the implementation does not consider this aspect. For example, conflicts can arise between the community and the project managers. Contradictions between project and place can be experienced by the community as a threat to their identity, provoking negative attitudes towards projects (Devine-Wright & Howes, 2010). Despite the existing relationship between identity and place attachment, there is little research (ex: Devine-Wright et al. (2001) and Vorkinn & Riese (2001) that has empirically examined the links between place attachment and support for a renewable energy project. Capturing all this information previously through SC knowledge is extremely important to avoid the occurrence of those phenomena named by Durkheim (2018) that lead to the disintegration of social norms and values associated with abrupt changes in the life of the community as a result of processes such as the industrial revolution in the past, and energy transition today (Perez-Sindin, 2021). Another aspect that emerges from this analysis is the lack of a methodology to better understand SC. This results in countless definitions of SC and its relation to energy transition, a relationship which, in some cases, becomes very reductive because it is associated with the simple social network created within the community. Future research needs to further clarify the concept of SC in the energy field, including the different indicators and all three dimensions that comprise it, exploring in more detail which of these indicators can positively or negatively influence energy transition. In particular, the concepts behind the SC indicators should be unravelled to understand how each of them can change the community. The most important challenge for researchers in this field will be to understand which dimensions of SC add value to the transition and which dimensions need to be reduced for the community to positively approach all the changes that energy transition brings. This requires researchers to consider each dimension of SC and use a similar methodology to operationalise the SC. The dimensions and methodology should be explored through theoretical and empirical research in this field. Researchers should pay particular attention to all the social characteristics that characterise a community and influence SC. All these characteristics and methodologies should be shared and used in all disciplines that deal with understanding energy transition through SC.

Appendix

Social Capital and Energy Transition: A Conceptual Review (2022-2024)⁶

The aim of this integrative paper is to fill the gap of using only a few dimensions and indicators of social capital by proposing a comprehensive approach that makes social capital of the community central to understanding the social phenomena related to the transition of energy. The contributions of this paper are as follows:

- i. To develop a conceptual framework that presents how social capital has been considered and used to explain social phenomena related to energy transition
- ii. Highlight the implications related to social capital that can foster a faster energy transition.

1. Methodology

The review focuses on the documentary analysis related to the use of social capital to understand the social phenomena linked to the energy transition. The aim is to highlight the impact of social capital on the energy transition and to highlight how an in-depth analysis could contribute to accelerating the transition to a faster energy shift. The methodology is qualitative and is based on the analysis of scientific articles published between 2022 and 2024. The SCOPUS online database was consulted to search for and collect all publications related to the following specific keywords in social sciences:

- 'SOCIAL CAPITAL' AND 'ENERG *'

The research resulted in 50 results, of which 7 papers were removed as they were not relevant to the energy topic, leaving a total of 43 papers analyzed. The second objective is more conceptual and allows us to understand how these two concepts have been considered over time. Specifically:

- Social aspect: to understand which social aspect has been studied through social capital in the energy transition;
- Social capital and relationship with the energy transition: what is the definition of social capital in relation to the indicators considered to understand a particular phenomenon as energy transition;
- Methods: the methods that have been used to understand the energy transition through social capital have

⁶ Declaration of generative AI and AI-assisted technologies in the writing process.

During the preparation of this work, the author used DeepL and ChatGPT in order to improve language. After using these tools, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

been considered;

2. Results

2.1 Social aspects analyzed

Below are grouped the various aspects analyzed in the literature regarding the influence of social capital in the energy transition. Specifically, the different objectives have been divided based on social interactions, community adaptation, and the role of culture and tradition.

2.2 Culture, Tradition, and Conflict

This category examines the role of culture and traditions in the formation of collective identities, forms of resistance to change, and conflicts that may arise during transition processes. Koopman (2023) analyzes how social capital can promote and improve preparedness for environmental disasters. In particular, the author examines the context of the Sasak community in Lombok, Indonesia, showing how beliefs and spiritual practices can contribute to effective disaster risk reduction strategies. Special attention is paid to the "cultural commons" (Anglada, 2022) as a tool to facilitate the energy transition. The analysis focuses on the role of cooperation between public entities and local communities to promote the autonomy of sustainable energy. Two articles (Boonstra & Söderberg, 2024; Vercher, 2022), on the other hand, address the connection between the cultural, religious, and traditional characteristics of specific contexts and the social reactions that arise from them, such as conflict and resilience in response to transition phenomena. Regarding conflict, Vercher (2022) studies the socioenvironmental dynamics in the Balearic Islands, with particular reference to hydrocarbon extraction projects in the Balearic Sea. The goal is to explore how environmental conflicts can trigger processes of social innovation, transforming community relationships, and promoting sustainable development at the local level. In relation to resistance, Boonstra & Söderberg (2024) examine the process of mobilization of social resistance against fossil fuel-based energy regimes and emerging renewable energy structures. The authors delve into the role of collective emotions, such as ecological grief and justified anger, in shaping resistance dynamics and supporting the transition to more sustainable energy systems.

2.3 Challenges and Adaptation

In this paragraph, the adaptive capacities of communities, their vulnerabilities, and issues related to energy poverty are considered, highlighting disparities and specific needs. The concept of resilience plays a central role in various areas, especially in managing socioeconomic transitions and environmental challenges. Research on Supply Chain Resilience (SCRes) provides a significant example (Chen & Huang, 2022) in the new energy vehicle sector in China, which uses advanced mathematical models to identify key factors that strengthen supply chain resilience. This approach emphasizes the importance of resilient structures to ensure the continuity and adaptability of production systems in a rapidly evolving sector. Another dimension of resilience concerns the solution to the "resource curse" in regions of the Czech Republic characterized by coal extraction (Frantal et al., 2022). Here, regional resilience is analyzed in relation to the phase-out of coal, aiming to understand the socioeconomic differences between mining and non-mining districts and identify the factors influencing socioeconomic transformation. Vulnerability, closely related to resilience, is

studied in contexts where environmental and socioeconomic conditions exacerbate risks (Bergene et al., 2024). In the Hamassa basin, Ethiopia, food security in rain-dependent subsistence farming systems highlights the varying exposure and sensitivity of local communities based on agroecological zones. Similarly, a study in the historic city of Madurai, India (Kitchley et al., 2024), develops a composite heat vulnerability index to identify the areas most at risk and the critical factors contributing to thermal vulnerability, considering the socio-cultural and environmental peculiarities of the context. The issue of energy poverty is intertwined with both vulnerability and resilience (Tao et al., 2024), as it reflects the ability of families and communities to access and use energy efficiently. In China, a study analyzes the impact of digitalization on energy poverty, showing how the use of digital technologies can improve energy efficiency and reduce the economic difficulties of vulnerable families. A similar analysis is conducted in Norway (Bredvold & Inderberg, 2022), a highly electrified country, to understand how social and economic vulnerabilities can affect families despite the prosperous context. Finally, further research explores the use of mobile phones in agricultural and pastoral areas of Tibet (Zang et al., 2023), highlighting how mobile technology can help improve economic and social conditions, thus reducing energy poverty in rural contexts. These studies show how resilience, vulnerability, and energy poverty are deeply interconnected. The resilience of communities and supply chains depends largely on the ability to reduce vulnerabilities and address the challenges posed by the energy transition. At the same time, strategies to combat energy poverty, such as the introduction of digital technologies or the promotion of supportive policies, can help improve socioeconomic resilience, especially in vulnerable contexts.

2.4 Social and Community Dynamics

This category focuses on social interactions, collective strategies, and collaboration within communities to address common challenges. The concept of community emerges as a fundamental pillar for promoting sustainability and social justice in the context of the energy transition. Energy Communities (ECs) represent a model where citizens, businesses, and institutions collaborate for the shared production and management of energy. One article examines whether these communities must necessarily be rooted in a specific geographic context or can operate as communities of interest without physical proximity, as illustrated by the comparison between the European cooperatives Ecopower (Belgium) and *ènostra* (Italy) (Dudka & Magnani, 2024). Another study delves into the concept of prosumerism by combining it with commons theory, developing the concept of commons prosumer (co-prosumer) (Ritzel et al., 2022), which fosters a social environment based on collective capital, as opposed to the individual prosumer (p-prosumer), focused on personal needs. These approaches highlight the role of ECs in strengthening energy democracy and energy justice, as evidenced by a critical analysis of the social impacts of such projects in Europe. In the context of the boom-bust cycles associated with the development of unconventional oil and gas in the United States (Bielig et al., 2022), the socio-economic and environmental impacts on local communities are explored, offering recommendations for future studies. Social actions and institutional strategies also play a crucial role in promoting sustainability. An example is the experiment in the Northgate Industrial Precinct

in Brisbane, Australia, where a model of urban production integrating craftsmanship, art, and advanced technologies is being developed with a view to sustainable urban regeneration (Hearn et al., 2023). Similarly, the study by Beck & Ferasso (2023) links the concept of Stakeholder Value Creation (SVC) with urban sustainability, proposing a theoretical framework that integrates the environmental dimension into sustainable urban strategies. Trust in institutions and social capital are essential for enabling domestic energy transitions in India, where access to energy is limited. In this context, research examines the shift to cleaner cooking fuels, such as LPG (Soni & Chatterjee, 2023). Other studies explore the role of social capital in the adoption of eco-friendly technologies by small-scale farmers in China (ZHANG et al., 2023) and the effectiveness of Farmer Field Schools (FFS) in Greece (Charatsari et al., 2022), highlighting how co-creation of knowledge enhances agricultural innovation. Finally, the social capital of communities influences the adoption of renewable energies in cities, as demonstrated by the study by Fraser et al. (2022) on the actions of mayors in Massachusetts (USA) and Chiba (Japan). Another study in China analyzes the impact of children's domestic practices on urban energy consumption (Li & Sunikka-Blank, 2023). Cooperation and social and institutional networks are critical for the success of energy projects. A study analyzes the evolution of European Administrative Networks (EAN), focusing on the network of energy regulators and exploring the transition from simple learning tools to mechanisms of political influence (Vantaggiato, 2022). Another article proposes a conceptual framework for the success of community microgrids (Eklund et al., 2023), emphasizing how the design and management of these infrastructures must address the social and energy needs of communities. Finally, cooperation among businesses in territorial clusters in the Spanish energy sector is identified as a key factor for improving innovative performance, mediated by social capital (Sánchez-García et al., 2024). Community, social actions, and cooperative networks represent three interconnected pillars supporting the energy transition and sustainable development. Collaboration among local and institutional actors, social capital, and the ability to create inclusive and resilient environments are fundamental to addressing the environmental and social challenges of the future.

3. Social capital and relationship with the energy transition

The following paragraph adopts the division of social capital proposed in Nahapiet & Ghoshal (1998)'s theoretical framework (Table 1) to analyze how this concept can be used to identify the individual and community characteristics that promote the acceleration toward a green energy transition.

Table 1: Social capital dimensions from Nahapiet & Ghoshal (1998):

Social capital dimensions	Characteristics	Description
Structural	Network structure; Network ties; Suitable organisation	Social structure
Cognitive	Shared narratives; Shared codes and ethics	Shared understandings
Relational	Trust; Norms; Obligation and expectations Identification	Nature and quality of relationships

3.1 Structural social capital: social structure

The concept of social capital is widely recognized as a fundamental resource for fostering cooperation, facilitating the adoption of sustainable practices, and strengthening community resilience. Numerous studies have analyzed social capital as a complex network encompassing mutual trust, shared norms, and connections among individuals and communities (Koopman, 2023). These dynamics are crucial for addressing collective challenges, stimulating innovation, and promoting adaptation to global issues such as climate change and energy inequality. The various approaches examined provide valuable insights into how social capital can act as a lever for positive change in diverse contexts. In the context of territorial clusters, social capital fosters cooperation among businesses, enhancing access to resources necessary for innovation and the development of new technological solutions (Saidin & O'Neill, 2022). Furthermore, social capital is considered essential for promoting the adoption of sustainable and clean technologies, creating an environment conducive to cooperation for the common good. In this study, social capital is measured through participation in community networks and trust in local institutions (officials, teachers, etc.) (Soni & Chatterjee, 2023).

Green social capital is interpreted as the network of social connections, trust, and cooperation oriented toward environmental sustainability (Saidin & O'Neill, 2022). This form of social capital is seen as critical for promoting collective actions and green policies, supporting collaboration among various actors (governments, local communities, international organizations) with a focus on climate resilience and sustainable development. Defined as the network of social connections oriented toward environmental sustainability, green social capital promotes the adoption of green and sustainable policies (ZHANG et al., 2023). Encourages cooperation between various stakeholders to build climate resilience and sustainability. In agriculture, social capital is defined as the network of connections, informal norms, and mutual trust that develops between farmers, facilitating cooperation for the common good (Charatsari et al., 2022). The authors base their definition on the works of Putnam and Fukuyama, emphasizing that social capital can enhance collective learning and motivation, strengthening group dynamics, and community cohesion.

In co-prosumer contexts (for example, shared gardens or energy communities), social capital enables the creation of common benefits (Ritzel et al., 2022). Fosters cooperation and cohesion, which are essential for maintaining systems that manage common resources. In the realm of energy communities, social capital is defined as the network of trust and cohesion that develops within energy communities, facilitating

cooperation and a sense of belonging between members (Bielig et al., 2022). Social capital is viewed as a prerequisite for improving energy justice and democratic participation, two key goals of energy communities. Based on Bourdieu (2018)'s theory, social capital includes networks of relationships, trust, and mutual support that can mitigate energy poverty. In the study by Bredvold & Inderberg (2022), social capital helps families reduce energy poverty through mutual support within family and social networks, facilitating access to financial resources and reducing dependence on electricity. This is crucial for addressing high energy costs and reducing exclusive reliance on electricity. In the economic sphere, Chen & Huang (2022) analyze social capital as an intangible resource that enhances the effectiveness of interactions among organizations within supply chains. It is essential for trust, collaboration, and information sharing, which are all key elements for effective disruption management.

Social capital is also defined as the network of relationships, trust, and social participation that improve families' access to resources and opportunities. In family and community contexts, social capital promotes mutual assistance in coping with food insecurity. This capital, in the form of reciprocal support and resource exchange, is crucial for family resilience to food insecurity, although the analysis results show that the impact of social capital dynamics can vary depending on the agroecological zone (Chen & Huang, 2022). Brodny et al. (2023) analyze social capital as one of the key factors for promoting innovation. It includes networks, trust, and cooperation that enhance access to resources, promote knowledge diffusion, and facilitate the adoption of new technologies (Brodny et al., 2023). Frantal et al. (2022)'s study considers social capital as an indicator of social cohesion and community well-being. Mining regions exhibit lower social capital, with lower levels of education, political participation, and trust in institutions, which hinders community resilience and their ability to adapt to economic and social challenges. Social capital is defined as the set of relationships and networks that facilitate the sharing of information, knowledge, and resources among businesses (Sánchez-García et al., 2024). In the context of energy clusters, social capital promotes cooperation among companies, improving access to critical resources for innovation. Overall, social capital is viewed as a crucial resource for supporting cooperation, resilience, and the adoption of sustainable solutions in both community and economic and environmental contexts.

3.2 Cognitive social capital: shared understandings

The cultural and social dimensions of a community influence its goals (Eklund et al., 2023). The cognitive dimension of social capital plays an important role in defining a community's objectives, as highlighted by Koopman (2023). In this study, the concept of social capital is illustrated through the lens of "interaction rituals," an approach based on Randall Collins' theory, which emphasizes the crucial role of these rituals in fostering solidarity and a sense of belonging within a group. These rituals not only strengthen bonds among individuals but also provide a powerful mechanism for processing and transforming negative emotions, such as shame and pain, into a positive drive that fuels motivation and offers emotional and social justification for undertaking collective resistance actions (Boonstra & Söderberg, 2024).

3.3 Relational social capital: nature and quality of relationships

The concept of social capital is widely studied for its ability to facilitate cooperation, strengthen community resilience, and promote sustainability (Atkinson, 2023). It is based on a complex network of trust, shared norms, and social connections that develop among individuals, communities, and, in some cases, spiritual or cultural entities (Wang et al., 2021). Various approaches highlight how social capital influences the ability to address collective challenges, stimulate innovation, and support sustainable initiatives.

In the context of local beliefs, social capital encompasses a network of interactions between humans and "other-than-human" entities, such as spirits and deities (Koopman, 2023). These spiritual entities, embedded in traditions, contribute to a social structure that fosters cooperation, mutual support, and resilience against natural disasters.

Within cooperatives like Ecopower and ènostra, social capital emerges from interactions among members, fostering bonds of trust, empowerment, and the sharing of knowledge about sustainable energy (Dudka & Magnani, 2024). This supports the adoption of sustainable practices and strengthens community participation. In collaborations among artists, artisans, workers, and researchers, social capital manifests as a set of intangible resources that promote collaboration, stimulate innovation, and enhance both productivity and the sense of community belonging (Hearn et al., 2023). Digitalization expands social capital through virtual support networks that connect families to a broader system of relationships (Tao et al., 2024). This improves access to social resources and facilitates community initiatives, particularly in the context of sustainable energy transitions.

Cultural commons (Anglada, 2022) provide a social infrastructure that integrates shared norms, mutual trust, and relational resources to support sustainable community practices. Similarly, initiatives like Alianza Mar Blava demonstrate how social capital can bring together actors from diverse sectors, transforming into an effective tool for collective actions against environmental challenges (Vercher, 2022).

Fraser et al. (2022) revisit one of the most classic classifications that differentiate types of connections based on the subject (understood as an individual or community) with whom the bond is established, specifically: Bonding: Ties among similar individuals within a community; Bridging: Ties between different groups; Linking: Vertical ties between individuals and institutions or local leaders. Finally, urban social capital is viewed as a pillar of sustainability, promoting cross-sector cooperation through trust, shared meanings, diversity, and collective learning (Beck & Ferasso, 2023). This approach helps create resilient environments that address the needs of various stakeholders. This conceptual richness demonstrates the versatility of social capital in tackling diverse challenges, from community support to sustainable innovation.

3.4 All dimension of social capital

Two articles (Eklund et al., 2023; Mayer et al., 2022) explore the concept of social capital through its three dimensions, aiming to understand how social networks, shared norms, and mutual trust influence a community's cohesion and resilience. In the first article (Mayer et al., 2022), social capital is analyzed through two main dimensions: structural social capital, which pertains to the networks and organizations that

facilitate community participation, and cognitive social capital, which focuses on values. Additionally, relational social capital (though not explicitly mentioned by the authors) is implicitly considered, as it centers on the norms and trust that bind individuals within society. The second article (Eklund et al., 2023) adopts the tripartite framework of social capital, encompassing:

- The structural dimension: highlighting the importance of networks and organizational structures in encouraging social interaction;
- The cognitive dimension: focusing on shared norms and values that influence collective engagement;
- The relational dimension: examining the quality of interpersonal relationships and the trust that facilitates cooperation among community members.

This integrated view of social capital underscores how the combination of structural networks, shared values, and trust-based relationships can foster active participation and collective commitment, which are essential for addressing social, economic, and environmental challenges.

4. Methods used

4.1 Qualitative methods

The analysis of public-community initiatives in Barcelona integrates case study methodologies and participant interviews, complemented by document analysis (Anglada, 2022). This layered approach allows for a comprehensive evaluation of how effective these collaborations are in achieving shared goals.

Researchers draw upon multiple data sources (Boonstra & Söderberg, 2024), such as interviews with movement representatives, social media posts, and journalistic accounts. This triangulation ensures a nuanced understanding of how public and community actors interact and innovate together. Additionally, Nvivo software is used for thematic coding, enabling the identification of themes such as emotions and resistance, which are crucial to understanding community dynamics.

One study employs ethnographic methodologies (Koopman, 2023), involving 162 in-depth interviews, participant observation, oral histories, and informal conversations. These methods bring to light the cultural and social nuances of community rituals and networks of mutual aid, offering an invaluable lens to capture the lived experiences of individuals and communities.

A conceptual approach has also been used (Hearn et al., 2023), blending literature reviews with case studies from energy and agriculture sectors. These studies examine both individual prosumer models, such as household energy self-production, and collective models like community gardens. This innovative framework bridges disciplinary gaps, allowing for comparative insights across different contexts.

Other research employs a theoretical case study methodology (Ritzel et al., 2022), drawing on secondary data from historical documents, corporate reports, and interviews with key stakeholders. This approach is strengthened by field observations and validation by participating organizations, ensuring reliability and real-world relevance.

In Oslo, for example, 17 semi-structured interviews with energy-poor households form the basis of a study that applies social practice theory alongside Bourdieu (2018)'s concepts of economic and social capital (Bredvold & Inderberg,

2022). This method innovatively explores how families navigate energy poverty, unveiling strategies and implications through a lens of both economic and social resilience.

4.2 Mixed methods

The study employs a comprehensive mixed-methods approach, combining both quantitative and qualitative techniques to gain a deeper understanding of the issues at hand. The quantitative component includes surveys conducted among members of cooperatives to explore key variables such as participation, social capital, empowerment, local engagement, and public benefits. This broad analysis identifies patterns and relationships within the data (Dudka & Magnani, 2024). Qualitative methods complement this by using semi-structured interviews with cooperative members, leaders, and industry experts (Dudka & Magnani, 2024). These interviews provide rich, detailed insights into perceptions and themes related to community models and collaborations. Social Network Analysis (SNA) is also integrated into the methodology to map connections between participants and assess how trust and collaboration evolve over time (Vercher, 2022). This adds a layer of understanding to the dynamics of community interactions. The research follows a sequential mixed-methods framework (Beck & Ferasso, 2023), beginning with conceptual exploration, followed by qualitative and quantitative analyses, and culminating in a synthesis of findings. This structure allows for thematic classification, network mapping, and an integrated understanding of sustainability dimensions.

In agricultural contexts (Charatsari et al., 2022), the study combines thematic analysis of qualitative data from interviews and observations with regression models to investigate how social capital drives knowledge sharing and innovation in farming practices. Another study (Fraser et al., 2022) incorporates both statistical modeling and in-depth case studies to analyze the impact of leadership support on renewable energy adoption while uncovering the detailed local dynamics of decision-making. Bayesian network analysis methods add another dimension (Vantaggiato, 2022), revealing changes in collaboration networks over time and providing insights into the historical and social contexts of regulatory partnerships.

4.3 Quantitative methods

The studies reviewed employ a variety of sophisticated quantitative and spatial methods to analyze complex societal and environmental challenges, with an emphasis on spatial modeling and geographic analysis. These approaches offer innovative ways to understand dynamics such as energy poverty, social capital, and policy impacts across diverse contexts. A notable study applies spatial difference-in-differences (SDID) models to measure both direct and indirect effects of innovative policies on a composite livelihood index (CLI) (ZHANG et al., 2023). Using econometric spatial analyses and panel data from 283 Chinese cities over a 14-year period, it evaluates how policies generate spillover effects between urban areas, highlighting inter-city dynamics that traditional methods might overlook.

Another significant contribution involves geospatial techniques using GIS to map thermal vulnerability on a city scale (Kitchley et al., 2024). The method combines indicators such as surface temperature and

socioeconomic sensitivity with adaptive capacity metrics like cultural and social capital. Principal Component Analysis (PCA) ensures a robust weighting and normalization of these indicators, resulting in precise vulnerability maps that aid in climate resilience planning. An advanced methodological combination of DEMATEL, ISM, and Cloud Models identifies cause-effect relationships (Chen & Huang, 2022), establishes hierarchical structures among factors, and handles the uncertainty inherent in qualitative assessments. This layered approach is especially useful for policy and strategic planning in uncertain environments. By comparing structural and cognitive social capital across relocated and host communities, another study employs field surveys and proxy indicators to understand the social dynamics of resettlement, offering insights into how spatial displacement impacts social networks (Mayer et al., 2022). Leveraging regression models and geospatial data, studies analyze the adoption of technologies such as LPG and its relationship to household socioeconomic and geographic factors (Frantal et al., 2022). Multi-stage models further dissect the adoption process, offering nuanced perspectives on how spatial and economic factors interplay in decision-making. Spatial methodologies like GIS mapping and spatial econometrics provide a transformative lens for understanding interconnected issues, from urban policy impacts to localized vulnerabilities. These methods uncover patterns and spillover effects that static analyses might miss, emphasizing the importance of geography in shaping social and economic outcomes (Kitchley et al., 2024). By integrating geographic data, spatial analysis, and mixed methodologies, these studies demonstrate the critical role of location-based approaches in addressing global challenges. This innovation allows for actionable insights, particularly in urban planning, environmental policy, and community resilience strategies.

4.4 Literature reviews

In the last two years, there have been some literature reviews, albeit in small numbers, on certain concepts related to social capital and the energy transition. The authors conducted a systematic review of the literature, categorizing evidence on the social impacts of Energy Communities (ECs) (Bielig et al., 2022). This comprehensive approach included quantitative, qualitative, and case study methodologies, along with a detailed mapping of evidence gaps. Using the PRISMA framework, the review examined 19 selected studies, focusing on key dimensions such as energy justice, energy democracy, community empowerment, and social capital. One article employs a systematic review to synthesize existing literature and case studies from the MENA (Middle East and North Africa) region (Saidin & O'Neill, 2022). It draws on qualitative sources, including academic articles, institutional reports, and public policy documents, providing a broad understanding of regional challenges and opportunities. Another article merges a literature review with a conceptual framework based on social capital theory (Eklund et al., 2023). It introduces a social capital index, which can be implemented through surveys to evaluate a community's capacity to adopt and manage microgrids. This innovative tool provides actionable insights for fostering sustainable energy systems at the community level. A broader systematic review spanning 192 studies delves into the boom and bust cycles of energy projects (Klasic et al., 2022). It explores a wide range of impacts, from economic and environmental factors to infrastructure, public health, housing, and social capital, offering a multi-faceted understanding of the ripple effects caused by such projects.

5. Discussion and conclusions

There are several points that emerge as recommendations from the analysed articles to improve the use of social capital in the energy transition. Social capital is not merely a byproduct of energy transitions; it is an essential enabler (Anglada, 2022). Policymakers should promote initiatives that strengthen trust, reciprocity, and networks within communities. Such strategies can empower local groups to adopt and sustain renewable energy projects, ensuring inclusive, and long-term success (Boonstra & Söderberg, 2024). Recognizing and integrating traditional knowledge and spiritual beliefs can significantly enhance disaster preparedness and community resilience (Koopman, 2023). This approach has proven effective in diverse contexts, such as Lombok, Indonesia. Expanding these practices to energy planning can build trust and align energy goals with community values. Energy communities do not always need to be geographically localized (Dudka & Magnani, 2024). Models based on shared interests, supported by flexible policies, can expand the reach and effectiveness of energy cooperatives (Hearn et al., 2023). These can cater to diverse demographics and amplify the impact of collective energy efforts. Digital technologies, including mobile connectivity and smart systems, can play a crucial role in mitigating energy poverty (Tao et al., 2024). Governments should prioritize equitable access to these technologies, especially in rural and marginalized regions, ensuring the most vulnerable populations benefit from the digital revolution. Social innovation can transform environmental conflicts into opportunities for sustainability. Policymakers should support initiatives that foster innovation at the grassroots level, enabling communities to address challenges collaboratively and create social value (ZHANG et al., 2023). Urban regeneration projects should integrate green social capital and circular economy principles (Saidin & O'Neill, 2022). These approaches can promote sustainability, enhance urban resilience, and serve as models for future industrial transformations. Energy transition strategies in agricultural regions must consider agroecological differences. Expanding access to water, credit, and sustainable farming practices will improve food security and environmental outcomes. Programs such as Farmer Field Schools (FFS) demonstrate that education fosters not only knowledge co-creation but also social capital (Charatsari et al., 2022). Adapting these programs to prioritize community networks can increase agricultural resilience and sustainability.

Energy policies should prioritize vulnerable populations by providing targeted subsidies, education, and infrastructure support. This ensures an equitable transition, leaving no one behind in the move toward renewable energy. Collaboration between cities and regions can amplify the impact of innovative policies. Shared best practices and synergies between urban centers can accelerate the transition to sustainable, green economies. ICT integration, including mobile technology, has shown potential to address energy access challenges. Supporting digital literacy and access in underserved areas can ensure broader participation in the energy transition. Governance structures for energy transitions must be inclusive and representative. Policies should incentivize participation from diverse demographic groups to strengthen energy justice and democratize energy access (Li & Sunikka-Blank, 2023). By embracing these recommendations, stakeholders can create more resilient, inclusive, and sustainable energy systems, ensuring that social and environmental goals go hand in hand. To conclude, it is interesting to note that the number of articles published in the past two years (43 articles) has significantly increased compared to the previous two decades (Giacovelli, 2022). In particular, there is a growing interest in exploring social capital as a key to understanding various phenomena related to the participation of community in energy transition such as community participation, trust, and innovation in renewable energy projects. Studies focusing on the spatial dimension to understand energy transitions have increased, along with research proposing alternative directions for further investigation. However, the three dimensions of social capital are not yet evenly utilized across studies, which likely

represents a limitation in its application to certain phenomena. Many authors refine and apply this concept selectively, often focusing on only a few aspects, which can be considered a shortcoming in itself. Following the example of Eklund et al. (2023), who aim to operationalize social capital, could lead to a more rigorous use of this concept in the social sciences, avoiding its superficial application across diverse contexts.

Second paper - Engagement of rural communities in energy retrofitting of historical building: a case study in Northern Italy^{*,78,}**

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Abstract

The abandonment of rural buildings is a growing challenge for heritage preservation and rural development. Retrofitting of energy offers a strategic solution, but its success is based on community participation. This study explores how the cognitive dimension of social capital and place attachment influence local involvement in retrofitting projects for historic buildings. Focusing on a case study at Col Ventidueore, a ex-tobacco farm in Northern Italy, the research examines the role of social and emotional ties in community participation in sustainability efforts. Despite recognizing the cultural value of the building, community participation remains limited. The findings highlight the need to integrate local knowledge, build trust, and strengthen cultural identity to improve participation. Furthermore, the study underscores how the cognitive dimension of social capital and place attachment shape perceptions of sustainable interventions, affecting their acceptance and long-term success. In fact, it is an innovative integrated approach that seeks to combine tradition and modernity. It seeks to improve historical memory while responding to current needs for sustainability and community participation.

Keywords: Retrofitting energy project, community participation, place attachment, cognitive dimension, social

⁷ Declaration of generative AI and AI-assisted technologies in the writing process.

During the preparation of this work, the author used DeepL and ChatGPT in order to improve language. After using these tools, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

⁸ A working progress paper has been published to illustrate the importance of citizen participation in the energy transition: Giacobelli G., Caballero N., Estrada A., and Balest J. Resident Participation for a Energy-Efficient Transition Project (December 5, 2022). Available at SSRN: <https://ssrn.com/abstract=4293805> or <http://dx.doi.org/10.2139/ssrn.4293805>. Part of this project was presented at the Conference Series: Earth and Environmental Science: Balest, J., Lucchi, E., Haas, F., Giacobelli, G., Exner, D.(2021). Materiality, meanings and skills for historic rural buildings: A social practice approach to engage local communities in the energy transition. IOP Conference Series: Earth and Environmental Science, 863(1). Further insight into how best to involve the community in sustainable energy projects is available in this report of project SHC Task 63: Solar neighborhood planning and work performed in Subtask B: Economic strategies and stakeholder engagement: Caballero, N., Balest, J., Giacobelli, G. (Eds.). (2024, March). An integrated framework for stakeholder and citizen engagement in solar neighborhoods.

capital

1. Introduction

The United Nations 'sustainable development goals' (SDGs) emphasize the importance of creating safe, inclusive, and resilient human settlements. They highlight the need to support positive economic, social and environmental links between urban, periurban, and rural areas. During the past few decades, Europe has undergone significant economic changes that have particularly impacted rural areas (Cuca & Agapiou, 2021). An example of economic change in rural areas is the lack of economic diversification to generate new employment opportunities, particularly for young people and women (Martínez- Carrasco Pleite & Colino Sueiras, 2024). These economic changes have led to a significant problem in large areas of Europe: the depopulation of rural areas. Consequently, these structural population shifts have contributed to a decrease in community identity and, more broadly, a decline in social relationships (ie, social capital (Paumelle, 2021; Ren, 2008; Xu, 2020). These challenges in the structural population require additional transformations to strengthen the resilience of local communities and align with the objectives and policies of the European Union (Cuca & Agapiou, 2021).

In this context, the energy transition is interconnected. The energy transition can be investigated as a social change process that can potentially build resilience in rural areas (Aasa et al., 2025; Stephens, 2019). For example, improve resilience in rural areas by increasing local energy independence, generating job opportunities, and fostering social cohesion. Although local opposition to the use of renewable energy technologies has been significantly higher than expected. For example, processes based on assumptions not in My Backyard (NIMBY) often leave local stakeholders feeling powerless and disillusioned by formal engagement processes (Butler et al., 2014; Van de Grift & Cuppen, 2022). Consequently, there is a clear need for governance structures and organizational forms that are participatory, inclusive, and attentive to the lived experiences of local populations (Lennon et al., 2019).

In fact, local communities are not passive spectators; rather, they actively engage in this process, leveraging their knowledge and identity as valuable resources to drive a positive, fair and sustainable energy transition in rural areas. A sustainable path is unattainable without the active participation of citizens and communities in the energy transition and a bottom-up approach in the implementation of sustainable energy initiatives (Fernandez, 2021). Local communities appear as important agents that can facilitate or limit the acceptance (Batel & Rudolph, 2021) of the transition process towards sustainable, decarbonized, and decentralized energy systems (Svobodova et al., 2020). However, the inclusion of local communities in sustainable transition processes faces limitations that require further investigation, such as the low capacity for the inclusion and empowerment of individuals (A. Smith et al., 2023) , or the emergence in the community of environmental or climate-related conflicts (Batel & Rudolph, 2021). For example, the social impacts of transition processes such as energy efficiency interventions are overlooked (Jafari et al., 2016), and there is limited knowledge about these strategies that can be attributed to the retrofit of existing buildings (Jafari & Valentin, 2017). Retrofitting existing buildings can play a vital role in the global decarbonization strategy. Understanding how these retrofitting projects impact the community and influence people's attitudes, behaviors, and decisions is a crucial step (Long et al., 2015). In contrast, Tetteh et al. (2024) highlight a lack of comprehensive studies that assess the sentiments of the general public toward the retrofitting of existing buildings with energy efficiency, and how local communities influence the retrofitting choices of buildings that affect cultural, historical and social relevant values for the community (Echeverria et al., 2023).

This study offers an innovative approach using the concepts of Cognitive Dimension of Social Capital (CDSC) and

Place Attachment (PA) to understand communities that participate in the successful retrofitting of existing historical buildings with energy efficiency. In this context, PA plays a key role in re-wakening the emotional bond and personal experiences that connect people to a place or building. At the same time, the CDSC helps decipher a community's codes, narratives, and values, providing valuable information to guide the participation process. In addition, the interaction between CDSC and PA can give the possibility of adding intangible heritage to the place (Zhong & Leung, 2019) and can facilitate the identification of the most effective engagement strategy, tailored to the social and individual characteristics of the community where the project takes place. This study uses the definition provided by Nezhad et al. (2015) that defines PA as a place where the interaction between people and nature over time has cultivated a profound sense of value. On the other hand, given that certain dimensions of social capital have been less thoroughly explored than others (Broska, 2021; Giacobelli, 2022; Pisani et al., 2017), we explore the CDSC with the concept developed by Nahapiet & Ghoshal (1998), who divide social capital into cognitive, relational, and structural dimensions. This study uses CDSC, which are social characteristics, defined as shared understandings that attribute peculiarities to the community.

In this context, social capital emerges as a fundamental driver of rural development (Pisani et al., 2017), particularly in addressing challenges such as rural isolation (Christoforou & Davis, 2014). Although energy interventions located away from developed areas (as in this case study) have been suggested to generate less social controversy (Haggett, 2008), empirical evidence on community reactions and their influence on local development proposals remains scarce (Devine-Wright & Howes, 2010). This gap raises the need for a deeper investigation of how communities perceive and respond to such interventions. Building on this reflection, the research questions are as follows:

- i. What is the role of CDSC on community participation in the energy retrofitting of an existing historic building?
- ii. What is the role of PA on community participation in the energy retrofitting of an existing historic building?
- iii. How can the interaction between CDSC and PA further foster community participation in the energy retrofitting of existing historical building?

The article is structured as follows. The 'Analytical Framework' section introduces the key concepts used in this paper and provides an overview of the relevant literature on CDSC, PA and retrofitting existing historical buildings and community participation. The section 'Methodology and Data' outlines the methodology used to answer the research questions and highlights the specific characteristics of the chosen case study. The 'Results' section presents the findings obtained from interviews and questionnaires. The 'Discussion' section interprets these results, explaining their significance in relation to the research questions and addressing the limitations of the study. Finally, the 'Conclusions' section summarizes the article and suggests potential avenues for further research.

2. Analytical framework

This study examines the interaction between CDSC and PA concepts in influencing local community participation in the retrofit of an ex-tobacco farm at the rural level. Although these concepts are rarely explored together in the literature, this study recognizes their collective significance in transmitting community values, codes, and attitudes (CDSC) to a

place or historic building (PA). This approach seeks to foster a new bond, defined as a sense of belonging and positive interaction (Scannell & Gifford, 2010) between the community and the building. By integrating community values into the engagement strategy, it aims to prevent abandonment post-retrofitting, ensuring a lasting connection with Col Ventidueore.

2.1 Cognitive dimension of social capital

Social capital is commonly defined as a concept based on reciprocity norms, values and beliefs embedded in social networks (Putnam, 2000) characterized by cooperation, reciprocity, and trust and said to improve social relations (Putnam, 2000; Ratten & Welp, 2011). The establishment of resilient local networks of participants, founded on trust and collaboration, was regarded a key element in shaping and propelling transitions toward low carbon energy (Bush & Bale, 2019). Over the past two decades, social capital has been used to understand social effects in the energy transition process in addition to understanding the need to consider citizens as the essential part of the energy transition, with the aim of involving the entire community in this change. The review of the literature on social capital and the transition of energy (Broska, 2021; Giacobelli, 2022) found that to date studies and research have not thoroughly considered the three dimensions of SC: namely, the structural, relational, and cognitive dimensions (Nahapiet & Ghoshal, 1998; Seliverstova et al., 2018). In particular, the two dimensions (structural and relational) have been considered in scientific articles, although often separately. In addition, these studies focus on some indicators of social capital, such as relationships and trust, and lead to an emphasis on the positive influence of social capital in energy transition projects.

Onyx & Bullen (2000) introduced the concept of 'bonding' social capital, referring to greater trust and mutual support found in rural areas. Huijts et al. (2019) considered cognitive aspects of social capital from a psychological and behavioral perspective. In this sense, the implementation of the CDSC in research would allow the inclusion of all indicators that define 'shared understanding', such as values, codes, and narratives. These elements encapsulate a range of aspects that collectively define what constitutes a community (Scannell & Gifford, 2010). Specifically, the CDSC encompasses the individual characteristics that connect a community to a place. It is defined as shared understandings that encompass various aspects uniting the inhabitants to a place, e.g., values, codes, and attitudes, thereby attributing peculiarities to the place itself. In the realm of energy, acknowledging this aspect within the context of an energy retrofitting project is crucial because the CDSC and the bond with a place, or a historical building, can influence the success of energy retrofitting projects. Furthermore, CDSC can influence the shape of community participation in existing historical building projects, as in the project mentioned in this case study.

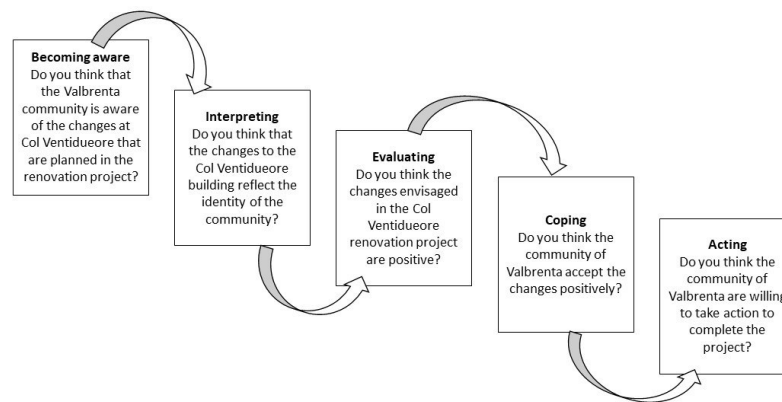
To deepen CDSC in this study, we have reconceptualized the stages of psychological response of the individual over time to the changes in place developed by Devine-Wright (2009). Devine-Wright (2009) stressed as in energy projects, usually planning procedures may take several years before development actually begins. However, the initial phases of a project are a crucial period to understand the position of the community with respect to the project. In this study, we have chosen to change from the individual perspective defined by Devine-Wright (2009) to a community perspective to reflect on the social aspects that characterize CDSC (Figure 1).

2.2 Place attachment (PA)

Various factors contribute to the attachment an individual has to a place and the importance that place holds. J. W. Smith et al. (2012) considered a further differentiation of PA: their social and individual reality (Šlaus & Jacobs, 2011).

The individual aspect refers to the specific memories that enhance attachment to a specific place.

Figure 1: Stages of community response over time to changes in place (Reconceptualization of Devine-Wright (2009)).



The individual aspect of PA deals with the personal bonds that one has with a place. For example, PA is stronger for places that evoke personal memories, such as a place where one celebrated a family event or where one played with childhood friends. This type of PA is believed to contribute to stable self-sense (Twigger-Ross & Uzzell, 1996). As reported by Manzo (2005) the significance of a place lies not solely in its physical attributes but rather in the experiences that forge a bond to it. These occurrences establish a profound bond that imbues the place with meaning.

At the group level, attachment to a place is formed through specific actions related to the culture, religion, and history associated with a specific place. Through these actions, the older generations pass on the PA to the following generations.

In the previous conceptual division reported, created by Scannell & Gifford (2010), the personal dimension of PA refers to the individual and the group attachment, although the two often overlap, because each influences the other (Scannell & Gifford, 2010). PA establishes an emotional connection between individuals and/or groups and familiar places. The emotional connection is a complex phenomenon that typically generates a positive bond, although it can sometimes be ambivalent or negative (Manzo, 2005). Identity and PA are often intertwined, with people seeking comfort in natural places that provide psychological comfort and become valued locations (Devine-Wright & Howes, 2010). The maintenance of valuable landscapes often results from the active participation of local communities in their planning, management, and sustainable development (Selman, 2004).

If we talk about energy retrofit projects, PA can play a decisive role in the success or failure of projects. In fact, practical interventions in energy projects, such as the installation of solar panels, energy efficiency monitors, or the promotion of sustainable transportation, change the territory in which they are implemented, potentially generating a high impact on the society living there (Wang et al., 2021). For example, the installation of solar panels is a positive action in the transition to energy, but the panels may have significant ecological effects on the environment and society (Hall et al., 2013). Failure to consider these aspects in relation to the high level of PA in a specific location can lead to project setbacks (Huijts et al., 2019). For example, conflicts during energy interventions between the community and the project managers, as contradictions between the project and the place can be perceived by the community as a threat to their identity, resulting in negative attitudes towards the project (Devine-Wright & Howes, 2010).

In this research, we examined a set of seven subdimensions of place meanings: *self- efficacy, individual identity, family identity, self-expression, community identity, economic meaning, and ecological meaning* (J. W. Smith et al., 2011). Each place of meaning is a relatively distinct way individuals ascribe importance or significance to the place as highlighted in the table 1. e opted to use these place meanings because previous research showed that this set is empirically valid and generalizable in diverse social and geographic settings (J. W. Smith et al., 2011).

Table 1: Place attachment

Place attachment	
Self-expression	Closely connected with the experience of the social actor who links positive or negative experiences in a given place during their life, to an evaluation of that territory
Individual identity	It reflects the potential that individuals assigned to a place based on the ability of place to to shape their personal identity
Family identity	It's a surplus of individual identity that is formed from the idea that a particular natural context is able to influence the perception of the family and the population of that place, which indirectly is reflected in the values and beliefs of the individual
Self-efficacy	Ability of a place to represent part of the identity of the individual who resides in it
Community identity	Allows the individual to broaden their individual and family identity by incorporating into their identity perspective the rest of the community with which the people shares tradition and culture
Economic meanings	The monetary value of a territory and how much the population gains from the sale ability of that geographical area
Ecological meanings	The natural importance of a given environmental and landscape context

Source: Based on J. W. Smith et al. (2011).

2.3 Retrofitting of existing historical building and community participation

Energy retrofitting as a crucial strategy to address energy inefficiency and reduce carbon emissions (Brooks et al., 2014). The adaptive reuse of existing buildings presents a viable strategy to gradually mitigate climate change (Aigwi et al., 2023). However, this reuse practice continues to encounter numerous challenges. In countries in fast development, there is often a preference for building new buildings rather than retrofitting existing or historic buildings (Yang & Lo, 2024).

Increasing community participation in the retrofitting process is one way to make the retrofitting of existing buildings more appealing (Menassa & Baer, 2014). However, retrofitting historic buildings comes with several challenges, particularly in terms of technology and cost, since initial investment can require substantial financial resources (Iwuanyanwu et al., 2024). Retrofitting, defined as a series of interventions aimed at improving the energy

efficiency and functionality of existing buildings, significantly benefits from active local community participation. Therefore, community participation is a crucial factor that should not be overlooked (Kibwana et al., 2023). In addition, involving the community helps ensure that interventions meet the needs and expectations of residents, fostering a sense of belonging and shared responsibility.

In rural areas, historic buildings serve not only as architectural landmarks, but also as tangible reflections of local culture and traditions (Goggins et al., 2022). Engaging the community in the retrofitting process helps ensure that the interventions respect and enhance the historical and cultural significance of these structures, thus preserving local identity. This is especially important in regions where traditions and cultural practices are deeply connected to physical spaces and existing buildings (Hadda et al., 2022). When it comes to abandoned rural historic buildings, community participation plays a vital role in their revitalization and reintegration into the local social and economic fabric. Retrofitting such buildings through participatory approaches not only adds value to architectural heritage but also contributes to the regeneration of rural communities, which are often impacted by depopulation and economic decline (Khoja et al., 2021).

Recent studies emphasize several essential factors in participatory retrofitting processes within rural contexts. One key aspect is early community engagement, where involving residents from the project's initial stages helps gather input and build consensus (Abouaiana & Battisti, 2023). Another crucial element is leveraging the community's local knowledge, particularly their understanding of architectural features, which is vital for preserving heritage (Varagnoli et al., 2020). Furthermore, considering a building's original purpose is important, as it directly influences its structural characteristics. For example, a former farmhouse typically features a higher roof and larger outdoor spaces—critical elements to consider during retrofitting (Vitiello et al., 2022). The local community often holds valuable insights into these details. In addition, participatory retrofitting should prioritize the preservation of both cultural heritage and the intrinsic values of rural spaces. Many buildings are deeply tied to a sense of identity and belonging, fostering a strong connection between the community and the place (Ferrando Ortiz & Viñals Blasco, 2023; Rosetti et al., 2022). Understanding the cultural dimensions ensures the long-term usability of retrofitting existing buildings and helps prevent their secondary abandonment in the future.

Currently, few studies examine community participation in the retrofitting of abandoned historic buildings in rural areas (Tantau, 2020; Vaeliverronen et al., 2017). Furthermore, the existing research tends to focus on new buildings. In contrast, this study adopts the concepts of social capital and PA—highlighted as key factors in previous sections—to explore the roles of these two concepts in community participation in retrofitting processes. By applying these two concepts, this study also seeks to investigate the role of both architectural and cultural knowledge in shaping a retrofitting of historical building. The goal is to introduce an approach that combines theoretical frameworks (CDSC and PA) to better understand appropriate participation in the retrofitting of place meaning.

The analysis of community participation in the retrofitting of ex-tobacco farm will be guided by the framework proposed by White (1981), with a specific question formulated for each dimension of participation:

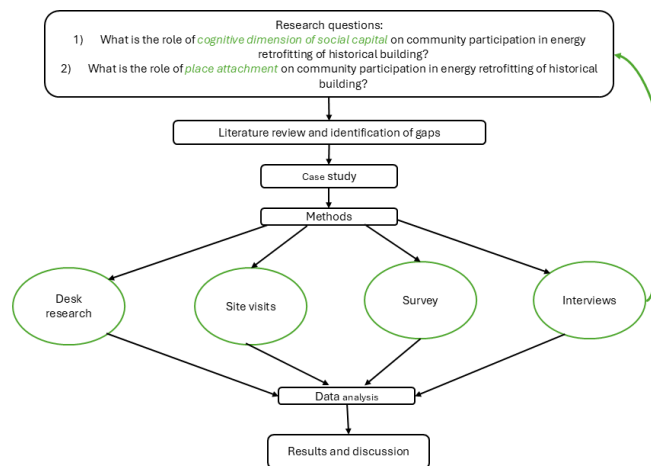
- the intrinsic value of the building for the participants;
- the potential of specific sustainable project to incentivize other sustainable initiatives;
- the role of participation in fostering a sense of responsibility for the project;
- the perception of the participation as a fundamental need;

- the ability of participation to ensure that the projects is carried out effectively;
- the importance of leveraging valuable community knowledge;
- the role of participation in increasing community awareness of their contribution to project's success.

3. Methodology and data

This study uses a mixed-method approach to address the research questions introduced in Section 1. The following figure (2) provides an overview of the research design, describing the entire process, from formulating research questions to identifying gaps through a literature review analysis. To answer the research questions, this study applies four different methods within the case study: desk research, site visits, a questionnaire, and interviews. The data analysis brings about the results and discussion.

Figure 2: Overview of research design.



3.1 Case study and community engagement in the retrofitting of historical building at Col Ventidueore

The building of Col Ventidueore, originally a tobacco farm, was significantly impacted by the monopolization of tobacco in 1861, which led to its closure. In the early 1950s, the shutdown of a major shoe manufacturing company further contributed to economic challenges, prompting many residents to migrate to larger cities about 30 km away in search of employment. As a result, the Valstagna area experienced significant depopulation (Varotto et al., 2004) driven by mass migration as families sought better opportunities. Col Ventidueore stands as a symbol of these changes that have shaped the community. The surrounding area, known as *le casarette*, also represents the local history and heritage. A significant contribution to landscape conservation has been provided by a local association, founded in 2010 to support the maintenance and restoration of *terracing*⁹. The initiative to preserve the historical landscape was promoted by the University of Padua, the municipality of Valstagna (now Valbrenta) and the Italian Alpine Club. The *terracing* covers the lower parts of the Valbrenta slopes and is a collective form of architecture. Another element

⁹ *terrazzamenti* in the original language, refers to a sloping landscape that has been transformed into stepped, flat areas to facilitate agriculture.

that this association has sought to protect and enhance over time is the dry stone walls, *masière*, from the Latin "maceria", which divide the rural area into different levels and create boundaries for cultivation.

In 2018, this association initiated a participatory process aimed at revitalizing Col Ventidueore, involving significant engagement from the community, public administration, university, local associations and local businesses.

After years of efforts by this more actively local association to secure funding for the retrofitting of Col Ventidueore, the European project (SHELTER project) provided the necessary funds for a redevelopment strategy, emphasizing both community engagement and sustainable, energy-efficient solutions. The project, which began in September 2019 and ended in December 2022, aimed to address the challenges of preserving and retrofitting the building at Col Ventidueore. The participatory process, initiated in 2018, involved different phases:

- the proactive engagement of stakeholders, including public administration;
- The engagement of universities and researchers assessed local needs;
- The engagement of energy experts turned the community's needs into sustainable, and energy-efficient retrofitting solutions.

Despite efforts and research conducted, retrofit work has not yet started. Today, the community is seeking new funding to implement the building retrofit proposal developed by the energy experts as a result of the community's participation in the project.

3.2 Procedure and sample

Two distinct criteria were used to select the sample of individuals for questionnaires and interviews. Initially, a brainstorming session was conducted with key community members, during which they were asked to identify community actors important to involve, according to three criteria (Reed et al., 2009; Vogler et al., 2017):

- Interest in the project;
- Importance in the project;
- Influence in the project.

From this session, 24 potential stakeholders emerged, categorized as scientific experts (5), association members (8), community members (4), local enterprises (3), and community administrations (4). Although attempts were made to contact all 24 people identified as important, not all were willing to participate in the investigation. Ultimately, 14 stakeholders made up the final sample for the questionnaire (see Figure 3). A second method was used to select the sample for interviews, based on different criteria. This method aimed to identify, among the 14 stakeholders mentioned above, those most likely to be interested in Col Ventidueore for personal, professional, or social reasons (i.e., volunteer activities developed in this area). As a result, 8 community members emerged as important for semi-structured interviews. Therefore, the sample encompasses various types of social actors and can contribute to the collection of information and perspectives from the social context within the local community of Valstagna.

Figure 3: Sample distribution.

Sample distribution			
Associations	Interviewers and questionnaires	Questionnaires	Total
	INT. B INT. E INT. O	INT. A INT. F	5
Experts	0	INT. C INT. M	2
Actives members of community	INT. D INT. I INT. N	INT. L INT. P	5
Public administrations	INT. H	0	1
Local enterprise	INT. G	0	1

3.3 Questionnaire

3.3.1 Cognitive dimension of social capital

RStudio (2018) is used for the data analysis of the questionnaires. The questionnaire investigates the CDSC that connects the local community to the ex-tobacco farm building in Col Ventidueore. As said in Section 2.1, to understand the cognitive dimension we use the reconceptualization of the concept elaborated by Devine-Wright (2009). The questions to investigate the CDSC were 5: the first question was about the possibility that the community would be willing to be achieve involved to insure the project in successfully concluded; the second was about the possibility that the community accepts positively the changes in the building at Col Ventidueore; the third was related to the capacity of new building to reflect the identity of the community; the fourth was related with the idea that the changes associated with the project are positive for the community; ; the last question was related with the possibility that the community is aware of the changes occurring during the retrofit project (for more details see figure 4 - Section 4.1.), are exactly the questions that were submitted to the stakeholders. The questions seek to explain the perception of the community about the energy retrofitting of the historical building and the possibility that the retrofitting building can identify the shared identity of the community. For each response, the option of answering *yes*, *no*, or *I don't know/Undecided* is given. It was decided to add *I don't know/Undecided* as a response option because respondents

often did not have a strong opinion about the perception of the entire community of Valstagna that would allow them to respond positively or negatively.

During the administration of the questionnaire, the respondents provided additional information to clarify their responses. In the following, this information is presented, as it is useful for better understanding the position with respect to the project.

3.3.2 Participation in retrofitting of an ex-tobacco farm

In addition, we asked stakeholders to answer seven questions about community participation in the historic building energy retrofitting project at Col Ventidueore based on the work of White (1981) (see Section 2.3). Table 2 shows the questions as they were administered to the respondents.

Table 2: Participation protocol

Participation in retrofitting of an ex-tobacco farm	
1.	How important do you think it is to involve the community, the public administration, the local association, the local enterprise, the new generation, and the Veneto Region in the retrofitting project?
2.	How much do you believe that the Col Ventidueore project will inspire other sustainable projects in the future?
3.	How important do you think the Col Ventidueore retrofitting project can be in increasing the sense of responsibility towards this building by the community, the public administration, the local association, the local enterprise, the new generation, and the Veneto Region?
4.	How satisfied are you with your involvement in the project?
5.	How well do you think the participation of the community, the public administration, the local association, the local enterprise, the new generation, and the Veneto Region, will enable the work to run smoothly?
6.	How do you think local knowledge contributes to the success of the project?
7.	To what extent do you think that community involvement in the project will make residents feel more responsible for the "fate" of the building in the future?

Participation in retrofitting of historical building

The range is on a scale of 1 to 4, with 1 being the lowest and 4 being the highest.

3.4 Interview

3.4.1 Interview protocol

The interview is designed to analyze in detail the concept of PA related to the existing historical building for the reasons expressed in Section 2.3. The concepts considered in the interview protocol refer to the seven sub-dimensions of PA elaborated by J. W. Smith et al. (2011) (Table 1). The formulated questions are designed to systematically collect comprehensive information, with a specific focus on their relationship with the building at Col Ventidueore, exploring facets of individual and group attachment. The questions reported in the table 3 were used to measure each of the seven subdimensions of PA. To examine the potential connection between the case study and a CDSC, we asked stakeholders about their specific ideas about the future use of the existing historical building, particularly their preferences to ensure its sustainability (see Tab. 3).

3.5 Participants in interview and questionnaire

The interview and questionnaire were administered between May and July 2022 in the village of Valstagna, Veneto. This study collected 8 face-to-face interviews and 14 face-to-face questionnaires. In the questionnaires, 7 of the participants are men and 7 women. Regarding the age of respondents, 1 member of the sample is between 30 and 39 years old, 2 members of the sample between 40 and 49 years old, 5 members of the sample between 50 and 59 years old, 2 members of the sample between 60 and 69 years old, and the remaining 4 are older than 69 years old. The level of education is quite high, with 7 members of the sample having completed post-secondary university preparatory, 5 members of the sample secondary school, and 2 members of the sample middle school. Regarding how long participants have lived in Valstagna, 8 members of the sample were born there, 2 members of the sample do not live in Valstagna, and the remaining 4 members of the sample have lived in Valstagna for 2 to 10 years. 11 members of the sample of participants reported being affiliated to an association, 3 of those affiliations are environmental and territorial, 4 cultural, 1 social, and the remaining 3 belonged to an environmental association (the coding is based on the definition given by the interviewee, mainly the environmental association is related to the protection of the territory). The distribution of the sample selected for the interviews is more or less the same.

4. Results

The following section presents the results of the questionnaire related to the concept of CDSC, followed by an in-depth analysis of the PA through interviews. Finally, the results of the questionnaire on community participation in the Col Ventidueore rehabilitation project are presented.

Table 3: Interview protocol

Interview protocol	
	Place attachment sub-dimensions (Based on J. W. Smith et al. (2011))
<i>Self-expression</i>	Could you tell me a memory related to Col Ventidueore?
<i>Individual identity</i>	What is the role of Col Ventidueore in your daily life?
<i>Family identity</i>	Do you usually spend time with your family or close friends in Col Ventidueore?
<i>Self-efficacy</i>	Do you think Col Ventidueore enhances culture and traditions? If so, how?
<i>Community identity</i>	Are there activities at Col Ventidueore that enable the younger generations to learn about local traditions and culture?
<i>Economic meanings</i>	Are there any particular activities taking place at Col Ventidueore or that have taken place in the past that attract people from outside?
<i>Ecological meanings</i>	Could you describe the most important natural aspects that characterise the Col Ventidueore?
	Development of the project
<i>Future use</i>	Could you describe what you would like to see added/modified/corrected with the energy retrofitting project?

Place attachment

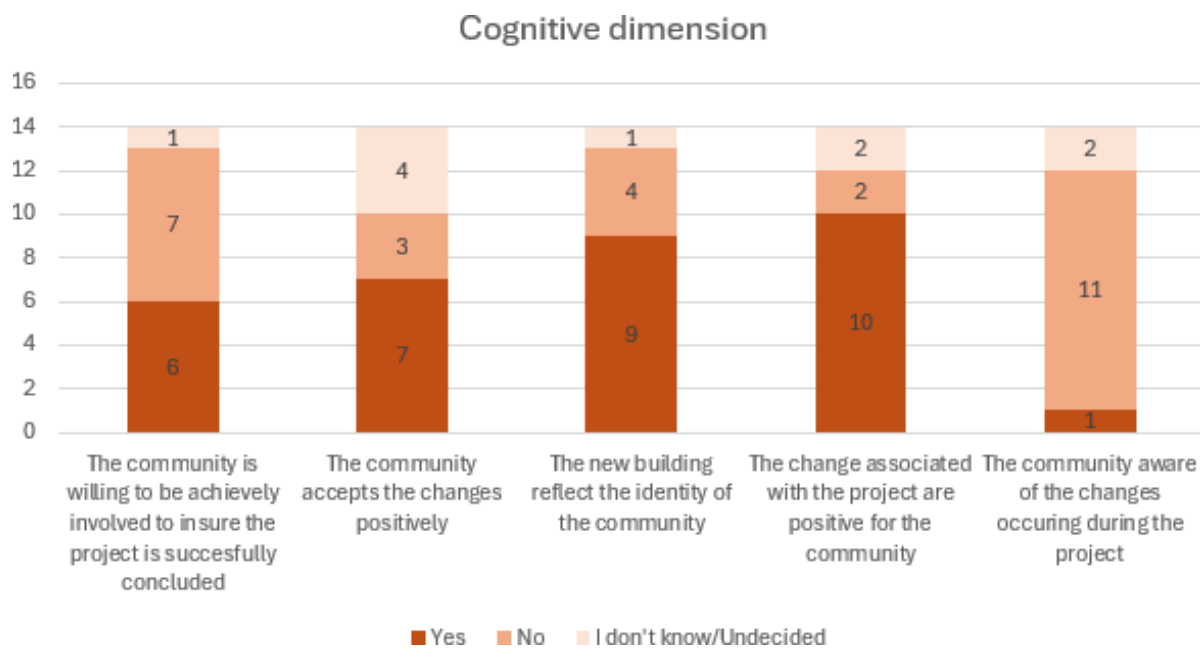
4.1 Cognitive dimension

The following section shows part of the results of the questionnaire in which the role of CDSC in community participation in the retrofitting of historic buildings of energy is investigated. Based on the analysis of CDSC questionnaires, this study investigated the perception of interest of the local community in the retrofitting of the ex-tobacco farm building and how this interest has influenced the local community participation in the design of the energy retrofitting of the building. During the administration of questionnaire has emerged a different perspectives. On the one hand, there is a portion of the community sensitive to the ongoing changes in Col Ventidueore, while on the other hand, there is a part of the community that is uninterested in the changes and the ongoing retrofitting project.

In fact, according to the answers collected through the questionnaire, some community members prioritize other local issues (e.g., traffic, waste management). However, respondents to the questionnaire acknowledge that the changes promoted by the ex- tobacco farm building project are positive and reflect the identity of the local community (Figure 4). However, 7 of 14 respondents declared that members of the local community would not take action within the project design and that members of the community are not aware of the ongoing project. In fact, during the administration of the questionnaire, it emerged that participation in this project is particularly active among those who already regularly

contribute to community activities. This limit on the part of the community respects taking action and being aware of the ongoing project. The analysis of CDSC proves beneficial, as it significantly shapes the capacity of the energy retrofitting project to reflect the values, codes, and attitudes of the local community. On the other hand, CDSC highlights the low level of trust in active community participation in the project. In general, the perception is that the connection between this building and the community has decreased in recent years and that modern society is more sensitive to other types of local issues. Despite this, there is hope in the future, changes are perceived as positive and could create a new connection between the Col Ventidueore and the community. The CDSC affects the interpretation of such changes, thus shaping the bond between the place and the community as positive or negative (Moloney & Walker, 2007).

Figure 4: Cognitive dimension analysis.



4.2 Place attachment

The interviews were fully transcribed and analyzed using NVivo (2018) software. The coding process used the codes listed in Table 1 (Place Attachment), with the addition of a specific code to explore the idea of future use of Col Ventidueore. The results for each dimension of PA and future use are given below.

- *Self-expression* of the individual, through memories of the place. It was possible to divide the answers into 3 different categories according to the type of memory elicited by this building: social gathering memory, collective memory, and wild

heritage memory.

- a) The memory of social gatherings refers to specific events during the year that brought people from the community together in Col Ventidueore, as indicated by the interviewee N: "On Ash Wednesday we used to go there to eat this sardine sandwich it was a friendly meetup every year".
 - b) Collective memory linked to aspects on which historical legends have been built, as interviewee B tells: "One day I was on the Col Ventidueore, I had heard about a cistern that was above the houses, and when I slipped through the *terracing*, I found this old dry cistern that no longer had water".
 - c) The memory of the wild heritage refers the memory of the natural heritage, which includes the added value of the ecological aspect of this place, as indicated by the respondent H: "I remember being there as a boy about 12 years old that on such a hike with friends". Interviewee B says: "When I was a child, there were not many activities for the young generation to do, some of them took advantage of the walk to Col Ventidueore for nature adventures with friends".
- *Individual identity* includes the potential that individuals attribute to a place in terms of its ability to shape their personal identity. The interviews reveal a different opinion, with some believing that it is a very important physical element for the community "...Col Ventidueore is a landmark when you look up..." says interviewee B; other respondents see potential in the building as interviewee C says: "...could be a great resource for the community when it finds its definition as a place", but at the moment there are only expectations. In fact, INT. B tells: "...at the moment, if I am honest, it is a place that could have potential when it finds its definition...". Many of the people who live in the valley seem to have lost hope in the effective management of this place. Col Ventidueore is a reminder of a bygone era.
 - *Family identity* is formed in relation to a specific place, reflecting the values and beliefs of the individual. Col Ventidueore served as a focal area for more than 40 families who lived in the area. During the period of tobacco production, the building housed about 100 people and played an important role in shaping their family identity. Today, however, it is mainly used as a meeting place for associations. The interviewee B tells: "...I spend time at Col Ventidueore with friends from (appoints a local association) working together - cutting grass on the terraces or hiking...". It is a place of community relevance and aggregation, especially in reference to local associations and their members. At a family level, nobody goes to this place with close relatives. In fact, only the interviewee E claims to have brought her mother

to this place: "... I brought my mum, who is now 83 years old, she can't come anymore. But 10 years ago she also came to see...". This excerpt from the interview is particularly intriguing as it highlights a reversal of the traditional flow of values. Here, we see values being passed from a younger generation to an older one, which is typically the opposite of what occurs in conventional settings.

- *Self-efficacy* represents the ability of a place to represent part of an individual's identity. The material used to the construction of Col Ventidueore and the characteristics of the building, are reminiscent of the traditional structure of this place. Most of the dwelling was built of stone by tradition and necessity. Concerning the potential of Col Ventidueore to represent cultural values and traditions, interviewee G responds as follows: "It could but as of today I would say no". In reference to the anthropogenic activities that have been in this place in the past, interviewee I tells: "...those of my age would remember something. Now they see it more as a place of passage of excursion and could revive or remember something if there was a chance to enhance it and then maybe it would has a meaning". Currently there are no activities taking place there that enhance local culture and tradition. Today, it is considered a building that serves as a passageway for different activities, mostly events outside the community (e.g. bicycle races).
- *Community identity* extends individual and family identity. The path that leads to the Col Ventidueore was of great historical importance during First World War, the time when women and men joined forces to build it from the valley to the summit in order to defend their territory from invaders. According to the interviewees, some activities take place at Col Ventidueore, but they are not strictly related to the identity of the community: "There are activities with schools sometimes" says interviewee B; "there was even a jazz festival" adds interviewee D. In addition, these activities are often not well publicized so the participants are often those who already attend events held there.
- *Economic meanings* linked with the monetary value of a territory. In the valley, there are two distinct types of tourism activities: one primarily related to the Brenta River (e.g., rafting) and another focused-on hiking. Local associations have made the Col Ventidueore accessible by maintaining the path, the respondent D argues that: "there are bicycle races"; "There are maintenance of activities on the path leading to Col Ventidueore that involve people and associations from outside the province" says interviewee G. Despite this area attracting visitors throughout the year, these activities do not generate direct economic revenue for the building.
- *Ecological meanings* that influence the natural importance of a place. The term "Ventidueore" (Twenty- Two Hours) refers to the rocky ridge that rises toward Sasso Rosso, and has functioned as a natural landmark/meridian for the township of Valstagna. For several decades, this place has attracted people from research centers

and universities, including foreign ones, who study the environmental characteristics of this place. In addition, some anthropogenic elements, such as *terracing*, are recognized by the community as belonging to the natural landscape: “paths that are definitely an anthropogenic element but now embedded” says interviewee D. Biodiversity remains a key feature of this area, although the species present have changed over time and the biodiversity has changed. Interviewee I tells: “when I was growing up, there were a lot of partridges and I used to go hunting with my cousin, or rather hunting with a sling”.

- *Future use*: in the past, local projects were designed to make this place usable, but the interventions were never implemented. In fact, water is a problem for the usability of the of building at Col Ventidueore, as interviewee D tells: “right now the main problem is water. Then, for energy I think with a generator, or the use of the sun I think it would be enough”. In particular, there was a project to bring water to this place, which was never realized. The ideas of the community about the future use is different, interviewee B says: “a support point for the activities of the associations, for hikers, that’s kind of what I think is the best destination”. Interviewee C adds: “to have a place where you can do workshops even inside the house, offer food and drink to the people who come and let them sleep”; “a natural eco-village” says interviewee G. The general idea is to make this place accessible for non-mass tourism, and to allow local entities such as associations to use it. The problems associated with the historical building the place mainly related to the availability of drinking water and non-drinking water.

4.3 Community participation in the energy retrofitting of Col Ventidueore

To assess the level of community participation in the design of the energy retrofit project for the building at Col Ventidueore, we use seven dimensions of community participation based on White (1981) (see Section 2.3). The most interesting results are given below the ad shown in Fig. 5.

The first dimension of community participation concerns whether this type of project could be the impetus for similar retrofitting projects in the future, making the community more sensitive to the retrofitting projects and increasing the value of sustainability. 3 stakeholders in our questionnaire expressed that this sustainable project has moderate importance in facilitating others retrofitting projects in the future; 6 stakeholders indicated that this project will not facilitate other projects in the future or will do so only minimally. This expresses a lack of confidence in the possibility of spreading in the community sustainability value, even through practical actions such as the energy retrofitting project. This result is consistent with the findings of the PA analysis, which highlight that the community is more interested in interventions that could improve the sustainability of this rural area, such as better waste management or more efficient traffic control during tourist seasons. Waste-related issues, in fact, have more direct consequences on the community, such as the presence of small rodents such as mice.

Figure 5: Importance attached to the three dimensions of community participation

Community participation



Another question is focused on the need for community participation to be involved in the design of the project. Figure 5 shows that not all people are satisfied with the community participation in the remodeling of Col Ventidueore. 3 stakeholders indicated that they were *moderately satisfied*, and another 3 stakeholders said they were *highly satisfied*; 8 stakeholders (more than 60%) are distributed between *not satisfied at all* and *low satisfied*. During the administration of the questionnaires, additional information emerged that the actions considered most important by stakeholders to improve community participation are: dialogue between project managers and the community; and sharing progress of the project with the community. In fact, the perception is that despite efforts to engage the community, it has not often been updated on developments or informed in time to actively participate in the revitalization process, contributing ideas and potential needs.

The most crucial aspect of community participation for stakeholders is the emphasis on using local knowledge, materials, and local enterprises to develop the project sustainably. Most of the respondents indicated that the incorporation of this knowledge into the project is considered *moderately important* and *highly important*. Traditions are considered highly significant by respondents, as they also contribute to local economic development. In fact, this energy retrofit project could serve as a valuable tool to promote the local economy. In economically depressed areas such as Valstagna, support for local businesses is essential in order to limit migration and depopulation. In addition, to promote community sustainability, it is essential to utilize materials currently available on site, which are waste products from a previous refurbishment project. These materials were never removed due to practical issues related to mobility.

5. Discussion

This study explores the role of CDSC and PA in community participation in energy retrofitting projects for historical buildings, using the example of Col Ventidueore in Valstagna. The findings reveal a nuanced relationship between the level of attachment of the local community to the area and their participation in the retrofitting project. Despite efforts to involve the community, stakeholders express skepticism about the project's ability to reflect the community's identity and adequately inform the community. In particular, the CDSC dimensions of awareness and alignment with community identity were particularly low. This skepticism can be attributed to the current focus of the community

on more pressing issues such as traffic, pollution, tourism, and waste management, which overshadow the retrofit project. In addition, some interviewees suggest that the community is no longer invested in the future of the building, a sentiment that further complicates efforts to gain broad support for the project.

The role of CDSC is to provide a better understanding of the dynamics of community participation and to guide strategies to promote community participation based on local values and priorities. The questionnaire revealed that understanding the values and attitudes of the local community is critical to determining their participation in the retrofitting project. These insights help to design interventions that meet the expectations and needs of the community and encourage active and informed participation. Participation can vary according to factors such as interest in sustainability and the effectiveness of communication. The local social and cultural dynamics shape the community's perception of the project. Recognizing the identity and traditions of the place allows for solutions that respect local culture and promote inclusivity. If the community is emotionally involved, it is more likely to support the initiative; however, perceptions of alienation or threat to local culture may hinder participation. An integrated approach is needed to address local priorities without neglecting long-term sustainability. Stimulating future interest in the project means creating a lasting connection between the community and the building. Energy retrofitting projects should be seen as an opportunity for both environmental and social improvement, promoting the recovery of local heritage and community ties. A shared vision of a sustainable future, linked to the history and identity of the place, can increase engagement and make changes more acceptable and sustainable.

The results of the interviews indicate that PA plays a crucial role in promoting community participation in energy retrofitting projects. A strong emotional connection to the place, coupled with clear community priorities and concerns, can significantly influence the success of such initiatives. However, the lack of effective communication and the need for greater participation of younger generations are key factors that must be addressed to improve community participation (Mwei, 2016; Otieno, Maria et al., 2020). The interviews revealed that the sense of attachment of individuals and families to the place where they live plays a key role in determining their participation in projects for Col Ventidueore. Many interviewees emphasized the historical and social significance of the building, linked to personal events and memories, but opinions on its potential as a community resource varied. Some saw it as an opportunity, while others felt that it was underutilized. Individual and family identities are strongly tied to the site, but a lack of involvement by the younger generation and a lack of knowledge about the building hinder its improvement. Community identity, influenced by historic construction during the First World War, is an important element, but current activities do not strengthen community ties. For the future, the community has proposed several uses for the building, such as a base for clubs and hikers or as an ecological space. However, practical issues such as the availability of water and energy sources remain challenges to be addressed. The interaction between CDSC and PA can foster participation in the energy retrofitting of historic buildings by creating an environment of shared values and visions, stimulating collective engagement that strengthens community identity and connection to place. CDSC is based on shared meanings among community members, with attachment to place helping to build and share common values. By integrating local identity, the energy retrofitting of historic buildings such as Col Ventidueore provides an opportunity to align environmental and cultural values and gain community support. Additionally, CDSC promotes the creation of a shared vision for the future, where PA motivates the community to preserve the heritage and turn it into an opportunity for improvement. The interaction between CDSC and PA fosters reciprocity, as involvement brings shared benefits. Finally, clear and engaging communication based on shared values facilitates active community participation in energy retrofitting.

Additionally, the research revealed a lack of economic benefit for the municipality despite the site attracting visitors due to local activities. This contradiction between the social and economic impact underscores the importance of aligning the project with both the cultural and economic interests of the community. The ecological significance of the terraces, while noted by interviewees, also highlights a gap in how local ecological and faunal elements are valued differently by the community.

This paper provides scholars with a qualitative toolkit to explore the contrasting positions within the community, which, while generally supportive of retrofitting existing buildings, expresses more complex opinions regarding the possibility of the entire community actively participating in a project that directly involves them. In this context, the importance of a participatory and inclusive approach emerges, as demonstrated in the case of Col Ventidueore, which highlights how the engagement of the community, local administrations, and various social actors can foster a more sustainable and shared energy transition. Furthermore, complementing this approach with an understanding of community identity through CDSC and the personal connection each individual has with PA can offer valuable insights for developing participatory processes that address the specific needs of each community, thus making retrofitting not just a technical operation, but also a social and emotional process.

However, it is important to acknowledge some limitations of this research. The sample of interviewees (8 interviews and 14 questionnaires) is relatively small, which may limit the generalization of the results. A larger number of participants could provide a more comprehensive and representative view of the diverse opinions and attitudes within the community, particularly regarding complex concepts such as place attachment and social capital. Furthermore, the chosen case study, Valstagna, is highly specific and represents a rural reality with unique characteristics that may not be easily applicable to other contexts, especially in urban areas or those with significant socio-cultural differences.

6. Conclusions

The article delves into the analysis of the role of CDSC on community participation in energy retrofitting projects on the local scale. This study focuses on an Italian local community, placed in the municipality of Valstagna, that sees its participation in the design of the retrofitting of an ex-tobacco farm. By examining the contents of 14 questionnaires and eight interviews conducted with local stakeholders with an integrated framework based on seven subdimensions of PA, and 5 stages of the CDSC, this study analyzes the dimensions of the local community participation in the energy retrofitting project design.

This research underscores the critical role of PA and CDSC in facilitating effective community participation in energy retrofitting projects for historic buildings. Despite the low levels of PA and CDSC in the Valstagna case study, these factors remain indispensable for the project success. The study demonstrates that active participation, informed by the cultural and identity needs of the community, can enhance the sustainability and acceptance of retrofit initiatives. By incorporating local materials, respecting traditions, and ensuring that the project is aligned with the values of the community, the chance of long-term success increases.

One key conclusion is that the community remains divided, with two distinct groups emerging: one that is more attached to the place and willing to engage, and another that has lost its connection and is less likely to be invested in preserving the area post-retrofit. This divide emphasizes the importance of addressing the needs

and perceptions of both groups to foster a more inclusive and cohesive approach to participation.

The research highlights the need for flexible social capital frameworks that can evolve over time and adapt to changing community dynamics. CDSC, in particular, provides valuable insight into how energy retrofitting projects can be structured to create new shared identities between communities and their historic buildings, fostering a sense of ownership and pride. The five-step approach to understanding the cognitive relationship between the community and the building presented in this study can guide future energy retrofitting projects, ensuring more collaborative and sustainable outcomes.

In conclusion, this research contributes to a better understanding of the role of CDSC in energy retrofit projects for historic buildings, emphasizing the importance of integrating the cultural and ecological values of the community. It also opens opportunities for future research on new indicators of CDSC that can facilitate the greater acceptance of such projects. By highlighting the transformative potential of energy retrofitting in historic buildings, this study contributes to the broader goals of environmental sustainability, cultural heritage preservation, and rural retrofitting, aligning with global initiatives such as the United Nations Sustainable Development Goals.

Given the increasing number of abandoned buildings in rural areas (Hadda et al., 2022; Varagnoli et al., 2020), to improve understanding of the role of PA and CDSC in community participation in historical building energy retrofit projects, it is essential to extend the study to other geographic and social contexts. It would be useful to explore how these dimensions behave in different types of communities, such as urban, suburban, or other rural areas with characteristics different from those of Valstagna. Furthermore, a larger and more diverse sample of participants could provide valuable insight to identify whether there are common trends in various communities and whether participation practices can be adapted based on the context.

Ultimately, although the results of this study are valuable in understanding the role of PA and CDSC in participation in energy retrofitting design in a rural context, future studies should include larger and more diverse samples and extend the analysis to other areas with different cultural and socioeconomic characteristics to improve the generalization of the results.

**Third paper - Analysis of social network dynamics to increase the community participation
in energy retrofitting projects**

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Abstract

Active community participation in decision-making processes related to energy use is crucial to achieving Europe's sustainability goal by 2050. General guidelines often overlook local specificity, making effective community involvement essential. This study aims to understand how social networks within communities and individual characteristics of actors can facilitate the participation of less inclined members in energy sustainability projects. Using an innovative analytical approach based on social capital and autologistic actor attribute models, the study incorporates both individual and relational characteristics to enhance participation. This study examines how social networks and individual characteristics of community members can engage less inclined members in energy sustainability projects, using a case study in Vicenza (Valstagna) focused on retrofitting a historic building. The results show that highly participative actors form bidirectional ties with less participative members. This network knowledge can facilitate the engagement of less active members through existing links, with social contagion suggesting that fostering these connections can increase overall participation.

¹⁰ ***Declaration of generative AI and AI-assisted technologies in the writing process.**

During the preparation of this work, the author used DeepL and ChatGPT in order to improve language. After using these tools, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

¹¹ This paper was presented at the First Conference of Young Sociologists of the Environment and Territory 'Permanent crises: the territorial dimension of socio-environmental challenges', Bari 2024, with the title "Capitale sociale e partecipazione comunitaria in progetti di sostenibilità" (author: G.Giacobelli). Part of this paper will be presented at the conference the 16th ESA Conference in Porto, August 27-30, 2024, with the title "The role of trust in relationships within the community to inhibit the participation in energy refurbishment project: a case study in Italy"(authors: G.Giacobelli, J. Balest, N. Magnani, F. Buffa.

Keywords: Retrofitting energy project, community participation, Autologistic actor attribute models, social network, social capital.

1. Introduction

Innovation and the energy transition represent fundamental challenges to sustainability and community well-being. However, the success of such initiatives does not depend solely on technical or economic aspects but also on the ability to activate cohesive social networks capable of supporting the dissemination of innovations and fostering local community participation. Currently, there are different definitions of innovation. One of the most widespread is that of the European Commission. It considers innovation to be "the renewal and expansion of the range of products and services and the associated markets; the establishment of new methods of production, supply, and distribution; the introduction of changes in management, work organization, and the working conditions and skills of the workforce" (European Commission, 2004) (p.23).

In this context, energy renovation building initiatives, such as the use of sustainable materials, energy-saving technologies, and renovation practices, constitute a form of innovation in construction. These initiatives not only improve energy efficiency, but can also stimulate new markets, including sustainable tourism, agritourism, and real estate redevelopment, especially in rural and peripheral regions.

Some ongoing studies suggest that innovation in rural areas requires a different perspective and tailored policies to effectively support rural development (Martens et al., 2021). A growing number of studies have adopted a social network approach to analyze how innovation emerges and spreads, particularly in rural areas where traditional infrastructures may be lacking, but where social capital can be a decisive asset (Eder, 2019).

Social capital is increasingly recognized as a key factor for rural development and innovation (Gava et al., 2017; Guerrero-Ocampo & Díaz-Puente, 2023; G. Reed & Hickey, 2016). The concept of social capital does not have a single definition, as it depends on the author's perspective. However, the most widely accepted interpretation of this concept is based on the connections between people who know each other and the sharing of common interests (Rivera et al., 2019). Three primary categories of social capital have been identified: (a) Bonding, which refers to trust and cooperation among individuals within a network that shares similar sociodemographic characteristics. It is characterized by strong trust, dense networks with tight connections, informal collaboration, and long-term reciprocity; (b) bridging, which involves connections between different networks to foster collaboration and coordination. These networks are larger but less dense, with weaker ties, less trust, and interactions structured through explicit, formal, or institutionalized levels of power or authority in society; (c) Linking, which pertains to weak ties (Granovetter, 1983) that facilitate access to resources, ideas, and information from formal institutions outside the community. This type of social capital is connected to open networks, enabling access to new knowledge sources and promoting the adaptation of innovations. To investigate how these relationships influence energy renovation building initiatives, Social Network Analysis (SNA) has been used to map interactions among key actors and to understand how positions within the network can foster trust and collaboration. This approach is particularly useful for analyzing participation in energy renovation building initiatives and to identify relational mechanisms that support or hinder the energy transition in rural contexts.

Although participation in the energy transition is a well-studied theme (Fiander et al., 2024), earlier models - such as

NIMBY - have often oversimplified the complexities of citizen participation (Bauwens & Devine-Wright, 2018; Devine-Wright, 2011).

However, existing SNA-based studies on social capital and innovation often overlook individual-level factors, such as willingness, perceptions, and values, that can influence participation within networks. This research seeks to bridge this gap by integrating both relational and individual dimensions, using the three forms of social capital, structural, cognitive, and relational, to explore the mechanisms through which energy innovation spreads within rural communities. The aim is to investigate the role of social networks in facilitating or hindering participation in energy transition initiatives, examining how their characteristics influence attitudes, values, and identities through specific social mechanisms. Unlike existing studies, which tend to overlook individual factors in the relationship between social capital and innovation analyzed through SNA, this research seeks to integrate these aspects to provide a more comprehensive understanding of the phenomenon. The research thus pursues two objectives:

- (i) (i) to explore the local participation of rural communities in energy renovation building initiatives through various dimensions of social capital;
- (ii) to understand the probability of transmitting the propensity to participate of community members in energy retrofitting projects through the relational network.

The article begins by examining how social network configuration impacts participation in energy renovation building initiatives and then formulates hypotheses regarding network effects. The following section outlines the methodology and data collection through questionnaires, detailing the use of SNA techniques. The results indicate that network characteristics and activities are the only predictors of high-level participation in all model specifications, while individual attributes do not have a significant impact. The discussion and conclusion emphasize the importance of the network context in understanding local participation and connect the findings to the existing literature on energy transition.

2. Analytical framework for studying the influence of network configuration on participation

To fulfill our research objectives, particularly to understand the probability of contagion of participation in energy renovation building initiatives, we use an innovative approach of social network analysis, the autologistic actor attribute model (ALAAM). The potential of ALAAMs remains unexplored (Stivala et al., 2020) and its empirical application is very recent and relatively limited (Parker et al., 2022). Although the use of these models is not widespread, they are commonly used in organizational and management research to understand certain behaviors within a company (Borgatti & Foster, 2003; Brass et al., 2004; Robins et al., 2001). In this study, ALAAMs are used in innovative sociological research to understand the participation of the local community in energy renovation building initiatives. The ALAAMs model is used in this research through specific contagion hypotheses, such as the individual characteristics of actors, and the social capital attributes of actors can influence other actors within the network. This method was selected because, unlike other models used in SNA, it offers the possibility to study not only the characteristics of the relationships, but also the characteristics of the relationships related to a specific attribute of interest (Gallagher, 2019). In this case, the model makes it possible to understand how participation in energy-renovation building initiatives could be the result of social mechanisms. ALAAMs allow one to test alternative hypotheses about social contagion mechanisms, by predicting the presence of an individual attribute (or behavioral outcome) in relation to specific social mechanisms (Daraganova & Pattison, 2013; Robins et al.,

2001). Social mechanisms are arguments based on specific theories that could explain the underlying reason for the presence of a specific statistical tendency, propensity, or disposition (Borgatti et al., 2022; Robins et al., 2001). In this research, social mechanisms are investigated considering reciprocity and conjugation mechanisms. Our study draws inspiration from research conducted by Ocelik et al. (2021) on participation in activist movements related to coal mining and adapts the relational approach employed in that study to a different context. Specifically, we apply the ALAAMs framework to analyze participation in an energy renovation building initiative. Traditional social contagion models have historically drawn parallels with biological contagion, assuming that the probability that an individual is influenced by contagion increases steadily with the size of their 'contact neighborhood', which refers to the number of affected individuals they interact with (Ugander et al., 2012). ALAAMs offer a significant advancement for empirical investigations of social contagion by moving beyond the simplistic 'contact neighborhood' hypothesis. Instead, ALAAMs allow for the exploration of intricate dependencies, such as those arising from shared network positions (as proposed by Burt (1978)), framing them as competing theoretical predictions regarding the underlying mechanisms that sustain social contagion.

In the context of applying the ALAAM, there is no strictly defined minimum number of nodes. However, it is understood that a too small number of nodes may limit data variability, hindering the identification of meaningful patterns. However, in our case study, which is characterized by a relatively small number of actors and a limited network size, we believe that this number is sufficient to provide useful descriptive conclusions.

3. Research hypotheses

In our study, we investigate two key hypotheses to understand the social mechanisms driving community participation in energy renovation building initiatives. Specifically, we examine the distinctions between these hypotheses, as outlined below. In the first hypothesis, the focus is on the actor, in particular the probability for an actor with a high level of participation in the project to have a higher number of ties.

H1: A high level of participation of a community member in energy renovation building initiatives is associated with the probability of having a higher tendency to have reciprocated social relations (reciprocity effect).

The aspect of reciprocity is an element that has been widely studied to understand relationships within networks. In particular, it has been considered a significant factor in determining the growth, structure, and ability of the network to influence interactions within communities (Squartini et al., 2013). Reciprocity has also been considered an interesting aspect that influences social participation (Schoene, 1957). Reciprocity studies have initially focused on understanding how it generally influences networks. Subsequently, more specific models in network analysis have been considered to understand how the degree of reciprocity can significantly impact network dynamics. Given the importance attributed to reciprocity in social science studies, this study aims to examine the effect of reciprocity within the network. Starting from the premise that relationships are based on shared elements among individuals, we begin with the idea that despite different levels of participation, two individuals in the community can still interact and establish strong relationships. This interaction may increase the probability of sharing an attribute of interest, such as high participation in energy renovation building initiatives.

In the second hypothesis, the subject is the attribute, in particular the probability of finding the same attribute (high

level of participation) in two connected actors. The following hypothesis has been formulated:

H2: The probability of having a high level of participation in energy renovation building initiatives is influenced by the level of participation of the individuals they interact with (contagion effect).

Many studies demonstrate how certain specific behaviors traditionally considered individual, such as emotions (Barsade, 2002), attitudes (Erickson, 1988), and participation (Teo, 2011), are influenced by networks. Specifically, they are shown to result from a process of behavior diffusion through social contact. In fact, social participation has been measured primarily by the number of social contacts (Grootaert, 2004; Keis et al., 2002). Despite the extensive study of social influence within communities, the social mechanisms that govern contagion within a network are not yet clear (Parker et al., 2022). This is precisely why this study focuses on understanding how the attribute (participation in energy renovation building initiatives) depends on the network structure. In particular, we start with the idea that the attribute is present and shared in two community members connected by a directional relationship (contagion effect). Given that the position of actors is crucial to increase participation opportunities (Borgatti et al., 2022), we hypothesize that the contagion in this and other sustainable energy projects is positive.

4. Methodology

4.1 Case study

The case study analyzed in this paper concerns the European Interreg SHELTER project (2019-2022), focused on enhancing rural heritage along tourist routes. The subject of the study is Col Ventidueore, a building located in the Valstagna mountain valley, in the municipality of Valbrenta (Vicenza) in northern Italy (Figure 1). Accessible only on foot, the area has experienced significant depopulation since the 1950s, leading to the abandonment of cultivated land and consequent environmental and landscape degradation (Istituto Nazionale di Statistica, 2022). Energy renovation building initiatives emerge as a strategic opportunity to combine cultural heritage preservation with the adoption of sustainable and innovative solutions.

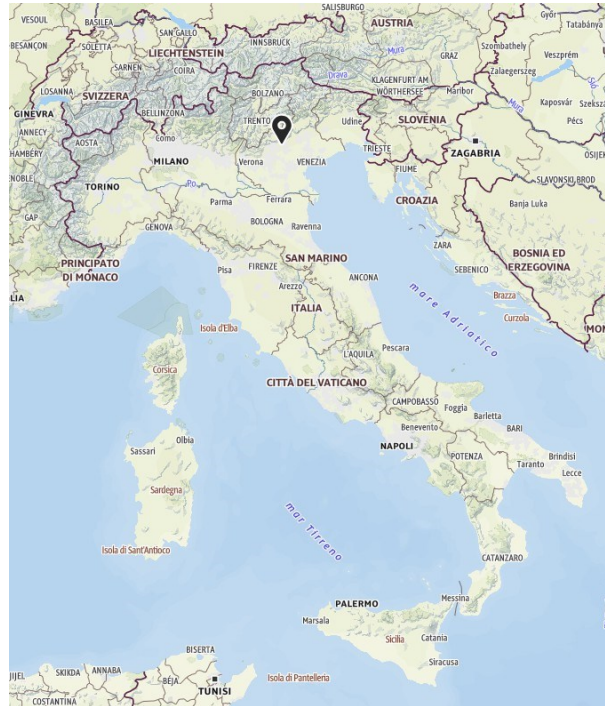
Originally, the building placed on Col Ventidueore was a tobacco farm, which was shut down following the establishment of the state monopoly in 1861. The local economic decline, further exacerbated by the closure of a major shoe factory in the 1950s, led to population migration and the deterioration of cultural heritage. A local association has been working for years to preserve the terraced landscape¹² and the characteristic dry stone walls (masière)¹³, seeking support from the public administration, which, however, lacked sufficient funds for a concrete intervention.

The project, initiated in September 2019 and concluded in December 2022, aimed to tackle the challenges of preserving and retrofitting the building at Col Ventidueore. The participatory process, which began in 2018, included several stages:

¹² terrazzamenti in the original language, refers to a sloping landscape that has been transformed into stepped, flat areas to facilitate agriculture.

¹³ ²from the Latin maceria—which divide and subdivide the landscape into different leveled sections suitable for cultivation.

Figure 1: Geographic overview of Italy and the Valstagna village.



- Actively involving stakeholders, including public administration;
- Engaging universities and researchers to evaluate local needs;
- Collaborating with energy experts to convert the community's needs into sustainable and energy-efficient retrofitting solutions.

Despite extensive efforts and research, the renovation project work has not yet begun. Currently, the community is seeking new funding to implement the retrofit proposal developed by the energy experts, which was shaped by the community's participation in the project.

4.1.1 Data collection

In the initial phase of the project, project partners were asked to indicate the most important stakeholders within the community. The project partners were members of associations with high knowledge about the local community and individuals usually involved in activities for local development and general improvements at the local scale through various actions, e.g., landscape conservation, preservation of architectural heritage, protection of flora and fauna, improvement of tourist attractions, etc. Initially, a brainstorming session was conducted with the project partners, during which they were asked to identify the important community actors to involve, according to three criteria (M. S. Reed et al., 2009; Vogler et al., 2017):

- (i) interest in the project;

- (ii) influence in the project;
- (iii) importance in the project;

From this session, 24 potential stakeholders emerged, categorized as scientific experts (5), association members (8), community members (4), local enterprises (3), and community administrations (4). Although all were contacted, only 15 agreed to participate in our investigation. The questionnaire was administered between May and July 2022 in the village of Valstagna. We collect data using face-to-face administration of the questionnaire and participatory observation in community activities (e.g., popular festivals and association festivals).

The questionnaire was divided into three parts, mainly consisting of closed questions. The first part was dedicated to understanding the three dimensions of social capital (structural, relational, and cognitive) and was composed of 24 questions. The second part focused on delving deeper into participation in the renovation of an ex-tobacco farm, consisting of 9 questions. The last part consisted of 9 socio-demographic questions.

The administration of the questionnaire was a very lengthy process that led the respondent to open up more and more. Several field notes (Emerson et al., 2011) were also taken during the questionnaires, allowing both contextualization of the responses of the respondents for later analysis and a better understanding of the role each respondent played within the community. As a very small and confidential community, it was often difficult to reach the respondents directly, so some respondents were reached using other community members as intermediaries.

4.1.2 Analytical strategy: Autologistic actor attribute model

In our analysis, we utilize ALAAM (Daraganova & Pattison, 2013). ALAAM are used with cross-sectional network data to model the probability of observing a binary node attribute (dependent variable; in this study, level of participation, see Section 2) depending on the node ties within a social network and the other node characteristics (independent variables). In particular, ALAAMs are used to model network processes that affect the outcome of interest. The network effects for reciprocity and contagion are included in our models (presented in Figure 2). The names of the effects and the notation in the table are taken from Ocelik et al. (2021).

Figure 2: Parameters investigate.

Parameters	Configuration	Explanation
Reciprocity		Is an ego with a target attribute more likely to entertain reciprocated social relations in the network?
Contagion		What is the propensity for each pair of nodes in the network to have a target attribute?

The probability of observing the binary node attribute Y (level of participation) for each possible node in the network X is (Daraganova & Pattison, 2013):

$$Pr(Y = y | X = x) = \frac{1}{k(\theta_l)} \exp \left\{ \sum_l \theta_l \mathbb{Z}_l(y, x) \right\}$$

Where θ_l and z_l are network attribute parameters that involve an interaction between the dependent variable (y) and the network variable (x); $k(\theta_l)$ is a normalization quantity that ensures the sum of probabilities equals 1. Since Y is a binary variable, if there are no network effects, the model is reduced to logistic regression (Daraganova & Pattison, 2013). However, considering the network X allows us to assess the dependence among the observations of the attribute Y induced by the network.

The equation presented above describes the probability distribution of the attributes across the N nodes of graph X . Based on the frequency of various configurations and the values of the parameters, a specific probability is assigned to each possible attribute vector. In our study, the dependent variable represents participation in the project, as described in Section 3.5. The network configurations considered, namely reciprocity and contagion, allow us not only to observe the relationship between those who exhibit the same attribute (high level of participation) but also between those with a high level of participation and those who are less inclined to participate. Given the small sample size, we opted not to incorporate all variables of the control attributes into a single model (Ocelik et al., 2021). Instead, we have delineated three distinct models that align with theoretical expectations regarding network effects; these models focus on (1) structural, (2) social capital, and (3) sociodemographic factors.

4.2 Dependent variable

The study participants provided their responses through a face-to-face questionnaire administered in person. The dependent variable, the level of participation in retrofitting an ex-tobacco farm, was formulated based on the approach proposed by White (1981), which includes various dimensions of participation that motivate participation in the project or not. A question was developed for each of the following dimensions of participation:

- the intrinsic value of the energy renovation building initiatives for the participants
- the potential of renovation an ex-tobacco farm to inspire other sustainable energy projects;
- participation can foster a sense of responsibility regarding the energy renovation building initiatives;
- viewing participation as a necessity;
- participation ensures that tasks are completed correctly;
- the importance of leveraging the valuable knowledge of the community;
- participation increases community awareness of its role in the project's success.

For each question, the questionnaire provided a scale from 0 to 3, where 0 represented the lowest value and 3 the highest value. We dichotomize the dependent variable. Specifically, we chose to assign a low level of participation to values 0 and 1 for each specific dimension, and a high level of participation to values 2 and 3. After dichotomizing the seven questions on participation dimensions, we summed the obtained values over all dimensions and assigned a value of 0 to those who scored less than 4 and 1 to all others. To simplify the application of the autologistic model, the value 0 was indicated as a low level of participation, and the value 1 as a high level of participation.

4.3 Actor attributes

We collect data on individual variables for the three dimensions of social capital. To measure the structural dimension of social capital, we ask the following question:

- "Could you name three people you think are the most important members of the community in Valstagna for

the community?"

For each person indicated, their role in the community was considered, assigning a value of 1 to those who were identified as members of the municipality. A value of 1 was assigned because, based on the literature, trust in institutions (Guillen et al., 2011).

To measure the cognitive dimension of social capital, two questions about important community events were used.

- "Could you indicate the three most important events/festivals/fairs in Valstagna?"

The second question instead referred to the participation of the interviewee in community events:

- "Can you tell me the three most important events/festivals/fairs in Valstagna that you participate in?"

In the model, the responses were coded by assigning a value of 0 if the events the individual participates in are the same as those considered important for the community and a value of 1 otherwise. In the literature, with respect to energy transition, a high level of attachment to the values and codes of a particular place can often lead to conflicts (Devine-Wright, 2009; Obydenkova & Salahodjaev, 2017; Yang & Huang, 2021). The last question on social capital concerns the relational dimension and in particular the type of trust, specifically aimed at understanding whether the community is more inclined toward generalized trust or personal trust. To evaluate the relational dimension of social capital, we ask the following question:

- "Could you indicate three people with whom you have the strongest bond of trust within Valstagna and the type of bond (e.g., friendship, family, work)?"

The responses were coded with a value of 1 for generalized trust and 0 for personal trust. In the literature, generalized trust, which is trust in others, even if not personally known, increases the level of participation in the energy transition because, precisely due to trust, it is believed that others will also do the same (Macias, 2015).

The responses to the remaining sociodemographic variables (sex, residence) were analyzed with binary values.

4.4 Descriptive measures

To understand the network, descriptive measures were used to capture its key properties. In particular, density was used to represent the proportion of observed ties to the maximum possible number of ties in the network given the number of nodes (Bhattacharya et al., 2023). The second measure used is normalization of centrality, which measures the average centrality of all nodes within a network. The over of value ranges of centrality from 0 to 1, where 1 suggests that there are few participants who are at the centre of the network, indicating a centralized network (Borgatti et al., 2024). In contrast, when the value is closer to 0, the network is more decentralized, and it is assumed that the information flows more freely between multiple participants (Borgatti et al., 2024). The last measure used is Louvain modularity, which indicates the proportion of the density of the ties within the detected subgroups (communities) to the tie density outside (i.e., between) the detected subgroups (Ocelik et al., 2021). It has a value ranging from -0.5 to

1. A value of -0.5 indicates that the network cannot be divided into communities because it is not modular. Instead, a value of 1, indicates that it can be divided so that all ties are within the network (Dugué & Perez, 2015). In order to illustrate the theoretical framework of network theory as it applies to our study of community participation in energy

renovation building initiatives, we have included a summary of key network metrics and their definitions. These metrics are fundamental to understanding the structural properties of social networks. Table A1 in the Appendix provides the definitions of these proprieties.

4.5 Model estimation

The dependent variable in all three models presented in this article is a binary variable that differentiates between lower and high levels of participation. Thus, high-level participation is a target attribute. Due to the limited size of the sample, we have not included all control attribute variables in a single model, but three separate models were defined. Specifically:

(1) structural, (2) social capital, and (3) socio-demographic. These three models have been applied to the same network (see Section 2.4). ALAAM models, derived from Exponential Random Graph Models (ERGMs), can be estimated by stochastic approximation methods based on the Monte Carlo likelihood of the Markov chain (Koskinen & Daraganova, 2022; Parker et al., 2022). To produce the results reported in the next section, we relied on two

different software packages for social network analysis. We used the 'RStudio' statistical program (R Core Team, 2024) for the descriptive analysis of our network through the

.igraph package (Csardi & Nepusz, 2006), and MPNet (Wang et al., 2014) for ALAAM. MPNet is specialized software for multilevel ERGM analysis that can also be used to estimate ALAAM parameters. The software for stochastic approximation utilizes the Robbins & Monro (1951) algorithm. When the parameters are significant, it implies that the corresponding configuration of network ties and attributes estimates has a higher probability of occurrence than expected by chance alone. The significant parameter can have a positive value (higher frequency) or a negative value (lower frequency).

5. Results

The section presents the results of research in two different parts: in the first part, we describe the network and the descriptive analysis of each dimension of social capital; in the second part, we describe the results of ALAAMs. The sample includes 5 local associations, 2 scientific experts on the territory of Valstagna, 5 active community members, 2 members of the municipality, and 1 local enterprise. Seven of the participants are men and eight are women. Most of the participants have a university degree. Regarding their residency in Valstagna, most were born there. There is significant involvement in local associations with various local development objectives (for more details, see Table 1).

Table 1: Distribution of sample.

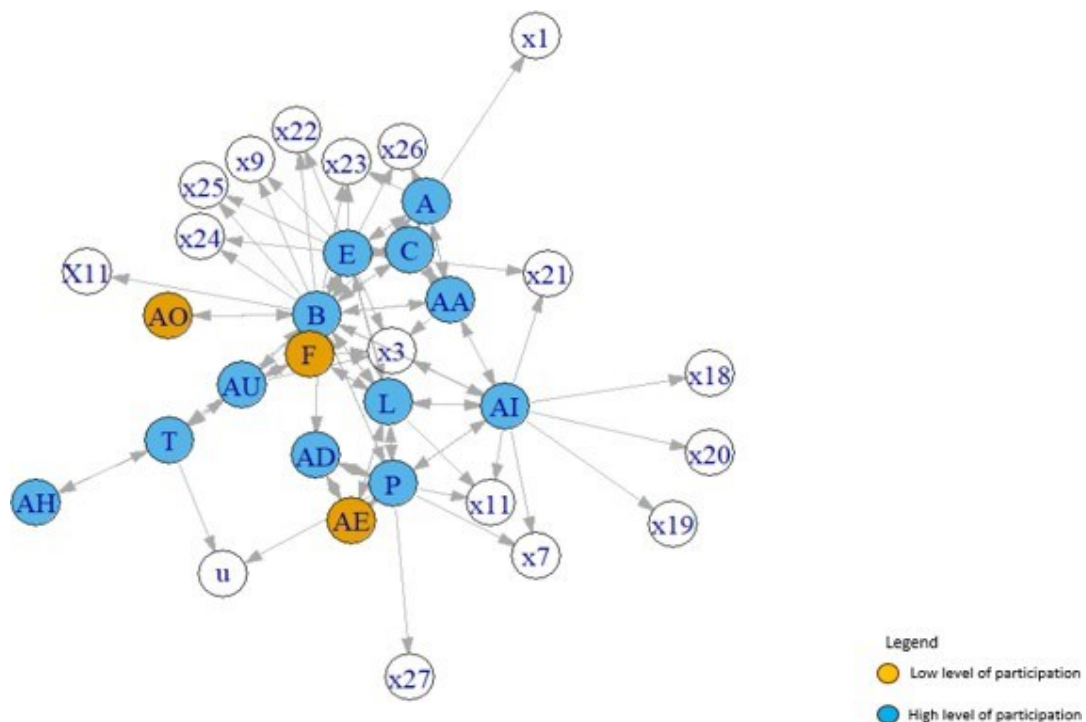
Socio-demographic characteristics of sample		N.
Gender	Male	7
	Female	8
Age in class	30-39	1
	40-49	3
	50-59	5
	60-69	2
	Over 69	4
Education	University	8

Associationism (11 are members of associations)	Secondary school	5
	Middle school	2
	Cultural	4
	Social	1
	Environmental and territorial	3
	Environmental association	3
Residency	Born in Valstagna	8
	Not reside in Valstagna	3
	Lived in Valstagna for 2 to 10 year	4

5.1 Description of local community network

To investigate participation in energy renovation building initiatives within the local community, we use descriptive measures to capture key properties of the network. The network includes 31 members identified from responses during a questionnaire administered to 15 members. The network has 65 edges, resulting in a directed binary network with 33 edges. Among the 15 nodes that filled the questionnaire, five are association members, two are municipality members, five are active community members, two are scientific experts, and one is a local business owner. The network density is 0.2952, indicating a low probability of ties. Figure 3 represents the network among the sample nodes and those nominated by the questionnaire respondents.

Figure 3: Community network and level of participation



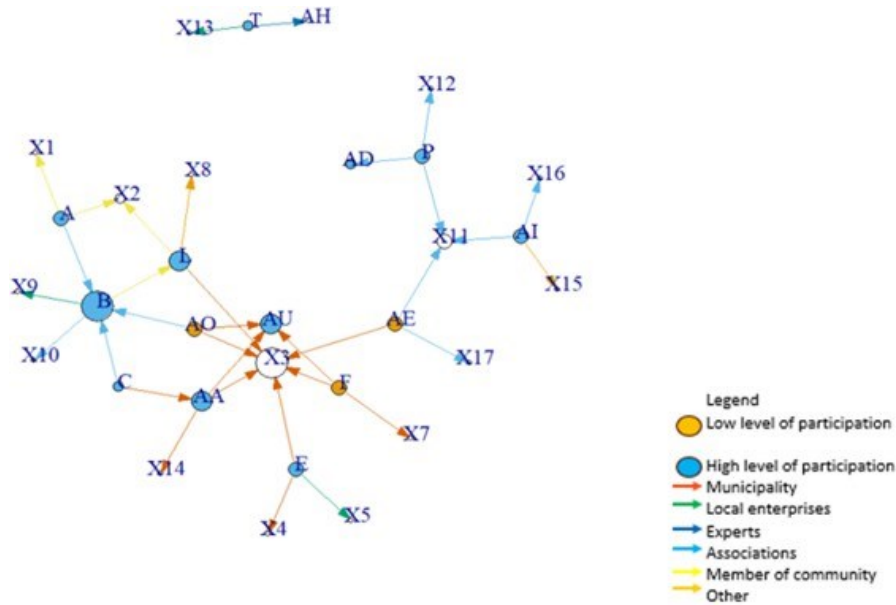
Note: Orange nodes are the members of the community with low levels of participation. Blue nodes are the members of the community with high levels of participation. White nodes represent the remaining member of the community nominated by the

As it is possible to observe from the graph (Figure 3) there are 3 nodes with a low level of participation in the project, while all the rest have a high level of participation within the project. The remaining 16 nodes are community members who are currently not participating in the project, thus their level of involvement can be considered low. Through their connections within the network with other community members who have a high level of participation, their involvement could be encouraged. Observing the network, it's noticeable that both F and AE (respectively 5 and 3) have enough relationships within the network that position them to easily interact with other community members who have a high level of participation in the network. Almost all nodes that are not participating in the project at this stage generally have 2 or more connections within the network. The most popular node within the network is definitely node B, followed by L, P, and E (respectively 19, 7 and 9). The pivotal role of B within the network is not only important but also intriguing. B actively engages in various activities within the Valstagna community, and her presence is highly regarded by its members. Despite having joined the community only a few years ago, B's powerful contributions and genuine interest in its growth have elevated her significance. In the context of the renovation of an ex-tobacco farm, her importance is underscored, and she is frequently referenced during discussions, owing to her comprehensive understanding of the community and her specific focus on the air quality under examination. The nodes with a higher value of betweenness centrality are B (227) and AI (114). B is a member of an association and plays an active role in the community. She participates in many local organizations, through which he has met many people from Valstagna. Also AI is a member of associations connected with 7 actors outside of our network but important for the community. T plays a pivotal role in my network, acting as a bridge between AH and the rest of the nodes. Without T, AH would become an isolated node, disrupting the network's connectivity. Also, AO would be an isolated node without the presence of B. In fact, often the importance of a node is not only determined by its active position within the network but also by its ability to connect networks with individual nodes that would otherwise be isolated. There is an interesting aspect worth noting about these nodes; B and E are both very important nodes in the community, but node B specifically has been part of the Valstagna community for less than ten years, while node E doesn't even reside in the community. This role played by B within the community is also confirmed by its level of closeness centrality, which is the highest within our network at 0.02; in fact, this node appears to be the one that greatly facilitates the exchange of information within the community. Other important nodes are L (0.018), E (0.018), and P (0.018). Interestingly, our network exhibits a notable prevalence of triangles, a triangle is a complete sub-graph of three nodes. With a transitivity value of 0.27 (where 1 represents the maximum possible triangle connections and 0 signifies none), almost one third of our nodes are connected through triangles, meaning each node maintains relationships with two others closely linked to it. This statistic reveals robust interconnections among network members, fostering shared ties among pairs of nodes interconnected with each other. Considering the characteristics of our network, particularly the connections between individuals with high and low levels of participation, regardless of whether they were included in the questionnaire administration, the application of the ALAAMs model would allow us to understand how these three individuals could be involved in the project. This would increase their level of involvement by leveraging the social network they belong to. This process could also be extended to all other network members who are currently not included in the sample but could be reached.

5.2 Social capital

The following graph (Figure4) represents the importance of some community members with respect to the roles they play within the community (see Section 2.7).

Figure 4: Structural dimension and level of participation

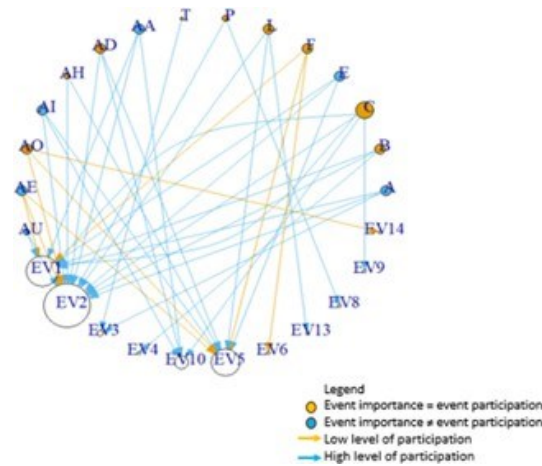


In this case, the blue nodes are the members of the community with a high level of participation, and the orange nodes are the members of the community with a low level of participation. The different color of the ties is associated with the different roles of the person indicated by stakeholders: red for members of the municipality; green for members of local enterprises; blue for scientific experts about the territory; turquoise for members of associations; yellow for active members of the community; and orange for the other (ex: Church). It can be seen that the most prominent individuals are X3, B, and AU. In this case, both X3 and AU are members of the municipality. In fact, the number of ties indicates that the interviewees have mentioned 13 edges with municipal members (red ties) and then 11 edges with association members (turquoise ties). In addition, in 4, it is interesting to note that individuals who have shown a low level of participation, AE, F, and AO, have mostly expressed a high level of importance among those who have a legitimate role within the community as the municipality.

The second dimension considered in 5 is the cognitive dimension, specifically referring to the traditions, norms, and codes of the community through local events organized by the community (see Section 2.7).

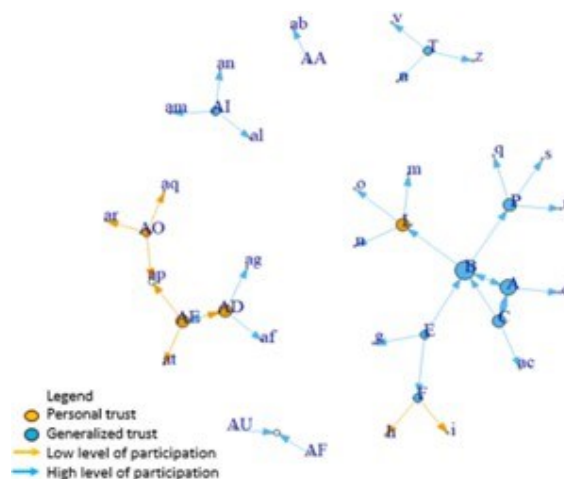
The orange nodes represent stakeholders who have stated their participation in the same events considered important for the community. In contrast, the blue nodes have expressed their participation in some events while acknowledging other events for the community. By associating these different responses with the level of participation in the renovation of an ex-tobacco farm, it is possible to notice that 2 out of the 3 nodes with a low

Figure 5: Cognitive dimension and level of participation



level of participation in the project (F and AO) have indicated equal importance between the events they attend and those important for the community. This highlights how in the case study, a low level of participation coincides with a high level of cognitive dimension, encompassing the set of norms, values, and shared legends within a community. The last dimension of social capital considered is the relational dimension, where the focus is on the difference between personal trust and generalized trust (Marcia, 2015). Personal trust refers to our closest circle and includes family and intimate friends, while generalized trust refers to trust towards people further from us with whom we share membership in associations, work, etc. Figure 6 represents the individuals identified by the interviewees.

Figure 6: Relational dimension and level of participation



The orange nodes represent individuals who have indicated family members as those toward whom they have a higher level of trust, while the blue nodes are those who have indicated friends with whom they share participation in associations or work colleagues. Orange arrows indicate nodes that have indicated a low level of participation in the project, while blue arrows indicate those that have indicated a high level of participation.

By associating the level of participation with the type of trust expressed, it can be observed that AO and AD, who have a low level of participation, have indicated family members as individuals with a high level of trust. Scientific research conducted so far on the type of trust and commitment to sustainability projects shows that often those with a higher level of generalized trust tend to be more active in the community, believing that others will also do the same.

5.3 Results of autologistic actor attribute models

To achieve our second research objective of evaluating how participation in energy renovation building initiatives in rural areas is affected by the local community network, we employed the ALAAM (see section 2.5). Our analysis encompassed diverse network effects, actor reciprocity, and contagion. Three different models were used: the structural model where only the distribution of the attribute in the network was considered through the parameters of reciprocity and contagion; the social capital model where the three dimensions were considered first with reference to reciprocity and then contagion; the last model is the socio-demographic model where gender and residence were considered by applying the parameters of first reciprocity and then contagion. All the results shown in Table 2 are those that converge in the model. Detailed parameter estimates are presented in Table 2. The effects of individual control variables fall within the 95% confidence interval, indicating a limited influence of individual attributes on high-level participation. This pattern remains consistent across all three effects considered: density, reciprocity, and contagion. The convergence t-ratio values in the model is < 0.1 , indicating excellent fit (Robins & Lusher, 2013). The results of the model applied to the case study are reported in Table 2.

At the top of the table are the results of applying the model to our network, including our attribute of level of participation. As evident from the results, there is a positive effect between the two parameters considered regarding the level of participation. In particular, both the effect of contagion and reciprocity appear to be significant within our network. Unfortunately, the sociodemographic indicators and social capital dimensions yielded not-significant results, and in some cases, the model did not converge. The parameters reported in the model for contagion and reciprocity are those that converge. Even though, as we have mentioned, the results concerning socio-demographic and social capital variables are not significant, it is interesting to note that the inclined results still exhibit values that represent a strong effect within the analyzed phenomenon. Specifically, the reciprocity of the relational and structural dimensions of social capital. This does not allow us to formulate any hypotheses due to the limited size of our sample, but these results are likely due to the important role played by these two elements within our network. Furthermore, the results show us that the relationship between our network and the variables considered is even negative, except in the case of the cognitive dimension of social capital. This would mean that the structural effect of reciprocity and contagion in the presence of socio-demographic variables and the structural and relational dimension of social capital decreases. The reciprocity effect within our network appears to be positive. In fact,

Community participation in the energy renovation building initiatives of ex-tobacco farm						
Level of participation in the refurbishment of an ex-tobacco farm						
Variables	Structural effect	Standard error	Social capital effect	Standard error	Socio-demograph effect	Standard error
Contagion	0.22	0.10				
Reciprocity	0.38	0.18				
<i>Contagion</i>						
Contagion relational dimension			0.92	0.93		
Contagion structural dimension			0.19	0.09		
Contagion cognitive dimension			-0.009	0.11		
<i>Reciprocity</i>						
Reciprocity relational dimension			-1.15	1.52		
Reciprocity structural dimension			-1.91	1.50		
Reciprocity cognitive dimension			0.86	0.89		
<i>Contagion</i>						
Gender contagion					-0.28	0.87
Residency contagion					-0.38	1.35
<i>Reciprocity</i>						
Gender reciprocity					-0.28	0.87
Residency					-0.36	1.37

Table 2: Parameter estimates of the autologistic actor attribute model for high-level of participation

within our network, this effect and the level of participation exhibit a positive relationship. However, the strength of reciprocity diminishes, as previously mentioned, when we add our socio-demographic factors (gender, residence). However, these results provide solid support for the reciprocity hypothesis (H1). The contagion effect within our network is slightly weaker than that of reciprocity (0.23), but it still shows a positive relationship with participation. This suggests that connections with

high-level participants increase the likelihood of high-level participation. Therefore, these results also support the contagion hypothesis (H2).

6. Discussion

. This study contributes to the literature by examining the role of relational structures and social dynamics in participation in energy renovation building initiatives. Specifically, it focuses on two key aspects: the configuration of the local relational network and its impact on the spread of local community participation. The findings highlight that an individual's position within the network directly influences their opportunities to participate in sustainability projects. Social networks facilitate the exchange of information and ideas, which are crucial mechanisms to encourage participation (Borgatti et al., 2022). However, engaging those who are less inclined to participate remains a challenge, as outreach efforts often target people who are already active and aware of sustainability issues. By applying SNA and the ALAAM model, this study demonstrates that participation is not primarily determined by individual characteristics but rather by network position and relational dynamics.

Relational dynamics seem to be crucial for engaging the community in energy transition initiatives in Valstagna. With suitable strategies, even disengaged individuals can be integrated and encouraged to participate. A key finding is the role of associations and the so-called "bridging nodes," individuals who, despite having fewer direct connections, play a crucial role in linking otherwise isolated members of the community. This underscores the importance of identifying and involving these strategic figures to enhance participation in sustainability projects. Furthermore, an interesting trend emerged regarding the participation of new residents: Many of the most active participants had lived in the community for less than ten years and were often members of local associations. This indicates that integration into the network is not solely dependent on the length of residence but also on the nature of relationships formed and the roles recognized within the community. In addition, the association plays an important role.

The research also highlights the importance of local associations in fostering collective engagement, even among those who initially exhibited little interest in sustainability initiatives. However, it reveals that some individuals with lower participation levels perceived renovation funding as less of a priority compared to other community needs. This suggests that for energy renovation building initiatives to be effective, it is essential to understand how they are perceived within the community and to tailor communication and engagement strategies accordingly. More research is needed to support the wider participation of the community in energy renovation building initiatives.

Despite these valuable insights, the study has some limitations. First, the sample size is relatively small, which may affect the generalizability of the findings. A larger dataset could provide a more comprehensive understanding of network dynamics and participation network. Second, there is a possibility that the respondents share similar characteristics in terms of participation, potentially limiting the diversity of perspectives captured in the analysis. This could result in an over-representation of already engaged individuals, underestimating the barriers faced by less active community members. Lastly, the method used to measure participation could be refined to provide a more robust assessment of engagement levels. Incorporating additional qualitative data or alternative metrics could strengthen the analysis and offer a more nuanced perspective on how participation spreads within the community.

However, these findings offer valuable information not only for the specific case analyzed but also for other energy transition and social innovation initiatives in small communities. Recognizing the importance of relational networks and social capital dynamics can help design more effective interventions that reach a broader audience, including those less inclined to

participate. In addition, the methodology used in this study can be applied to other contexts to examine the spread of participation and the role of social relationships in sustainable innovation processes.

7. Conclusion

This study highlights how innovation and energy transition initiatives depend not only on technical or economic aspects but also on the activation of cohesive social networks that facilitate the dissemination of innovations and community participation. The findings align with research suggesting that social capital particularly bonding, bridging, and linking ties plays a fundamental role in fostering engagement and knowledge exchange within rural communities. By applying SNA we were able to map these relationships and assess their impact on participation in energy renovation building initiatives. Moreover, our study contributes to the broader discussion on citizen involvement in the energy transition. Instead, it underscores the need for strategies that leverage existing social networks to engage community members who may otherwise remain uninvolved. The integration of individual factors within the network analysis further provides a more nuanced understanding of participation dynamics. These insights can inform future policies and initiatives aimed at promoting sustainable energy practices, particularly in rural areas where social capital plays a crucial role in local development. While this study focuses on a small community engaged in an energy renovation building, its findings offer insights that can be extended to similar contexts. Rural communities often share structural characteristics, such as strong local networks, high levels of social capital, and a reliance on trust-based relationships. Understanding how participation in sustainability initiatives spreads within these networks can inform engagement strategies for other small communities undergoing energy transitions. Additionally, the role of key social actors, such as associations, community leaders, and bridging individuals emerges as a critical factor in mobilizing participation, a dynamic that could be leveraged in broader policy frameworks aimed at fostering local sustainability efforts.

Future research could explore how these mechanisms function in different geographical and cultural settings, further validating the role of social networks in accelerating the community participation in the energy transition. While this study serves as a starting point, it provides a solid foundation for applying network models in other sociological contexts. The insights gained from this approach can improve community engagement strategies, inform policy decisions, and optimize resource allocation. Over time, these strategies could enhance local development and strengthen community.

8. Appendix A: Supplementary Tables

8.1 Table A1: Network Theory

Network Theory	
Network theory	Definition
Network	It consists of a set of nodes joined together by ties
Direct graph (Digraphs)	It is possible to take the direction of the ties into account. This is precisely why the ties in this type of graph are called edges
Direct links	Refers to edges that have direction (e.g., advice relations). A tie going from one node to another, but not necessarily returned
Indegree	The number of incoming ties a node has in a directed network
Outdegree	The number of outgoing ties a node has
Incident	An edge coming from or going to a node
Density	The number of ties in a network, expressed as a proportion of the total number possible
Path	A sequence of adjacent vertices and edges that does not revisit a vertex or edge. For example, the presence of ties A—B and B—C forms a path A—B—C
Measures of centrality	Definition
Closeness centrality	The sum of geodesic distances from a node to all other nodes. Commonly normalized in such a way that larger numbers indicate more centrality. With regard to flow, it is interpreted as the minimum time until arrival at a given node of something flowing through the network
Betweenness centrality	Loosely, a measure of the number of times a given node falls along the shortest path between two other nodes
Other measures	Definition
Transitivity	A measure of the extent to which triads in a network are transitive
Louvain modularity	Proportion of tie density inside detected subgroups (communities) to tie density outside (i.e. across) detected subgroups

Source: Based on Borgatti et al. (2022) and Hanneman & Riddle (2005)

Conclusions¹⁴

This study highlights the success of energy retrofit initiatives¹ depend not only on technical or economic aspects, but also on cultural and relational aspects that facilitate the diffusion of innovations and community participation. The results are consistent with research suggesting that social capital, particularly bonding, bridging, and linking ties, plays a crucial role in fostering engagement and knowledge exchange within rural communities. Using Social Network Analysis (SNA), we were able to map these relationships and assess their impact on participation in energy retrofit initiatives. building.

In the literature review on the role of social capital in the energy transition, several points emerge as recommendations to improve the use of social capital in the energy transition. Social capital is not simply a by-product of energy transitions; it is an essential enabler (Anglada, 2022). Policymakers should promote initiatives that strengthen trust, reciprocity, and networks within communities. Such strategies can empower local groups to adopt and support renewable energy projects, ensuring inclusive and long-term success (Boonstra & Soederberg, 2024). Recognizing and integrating traditional knowledge and spiritual beliefs can significantly improve disaster preparedness and community resilience (Koopman, 2023). Expanding these practices to energy planning can build trust and align energy goals with community values. Models based on shared interests, supported by flexible policies, can expand the reach and effectiveness of energy cooperatives (Hearn, Foth, Camelo Herrera, & Caldwell, 2023). These can cater to diverse demographics and amplify the impact of collective energy efforts. Governments should prioritize equitable access to these technologies, especially in rural and marginalized regions, to ensure that the most vulnerable populations benefit from the digital revolution. Social innovation can transform environmental conflicts into opportunities for sustainability. Policymakers should support initiatives that promote grassroots innovation, allowing communities to collaboratively address challenges and create social value (ZHANG, CHEN, YAN, & LI, 2023). Urban regeneration projects should integrate green social capital and the principles of circular economy (Saidin & O'Neill, 2022). These approaches can promote sustainability, improve urban resilience, and serve as models for future industrial transformations. Programs like Farmer Field Schools demonstrate that education fosters not only knowledge co-creation, but also social capital (Charatsari, Lioutas, & Koutsouris, 2022). Adapting these programs to prioritize community networks can increase agricultural resilience and sustainability. Energy policies should prioritize vulnerable populations by providing targeted subsidies, education, and infrastructure support. This ensures a fair transition, leaving no one behind in the shift to renewable energy. Collaboration between cities and regions can amplify the impact of innovative policies. Shared best practices and synergies between urban centers can accelerate the transition to sustainable and green economies. Policies should incentivize the participation of diverse demographic groups to strengthen energy justice and democratize access to energy (Li & Sunikka-Blank, 2023). Embracing these recommendations, stakeholders can create more resilient, inclusive, and sustainable energy systems, ensuring that social and environmental goals go hand in hand. In conclusion, it is interesting to note that the number of articles published in the last two years

¹⁴ In some cases, the case study is referred to by different names depending on the specific focus or emphasis of the article. Terms such as energy retrofit initiatives or energy retrofit projects for historic buildings should be understood as synonyms. In all cases, they refer to the same case study.

(43 articles) has increased significantly compared to the previous two decades (Giacovelli, 2022). In particular, there is a growing interest in exploring social capital as a key factor in understanding various phenomena related to the energy transition, such as trust, innovation, and community engagement in renewable energy projects. Studies focusing on the spatial dimension to understand energy transitions have increased along with research proposing alternative directions for further investigation. However, the three dimensions of social capital have not yet been uniformly used in studies, which likely represents a limitation in its application to certain phenomena. Many authors refine and apply this concept selectively, often focusing only on certain aspects, which can be considered a limitation in itself.

The second article delves into the crucial role of PA and CDSC in facilitating effective community participation in energy retrofit projects for historic buildings. The study demonstrates that active participation, informed by the cultural and identity needs of the community, can enhance the sustainability and acceptance of retrofit initiatives. Incorporating local materials, respecting traditions, and ensuring that the project is aligned with community values increases the likelihood of long-term success. A key conclusion is that the community remains divided, with two distinct groups: one more connected to the place and willing to engage, and another that has lost connection and is less inclined to invest in the preservation of the area post-retrofit. This division underscores the importance of addressing the needs and perceptions of both groups to promote a more inclusive and cohesive approach to participation. The research highlights the need for flexible social capital frameworks that can evolve over time and adapt to changing community dynamics. CDSC, in particular, provides valuable information on how energy retrofit projects can be structured to create new shared identities between communities and their historic buildings, fostering a sense of belonging and pride. The five-phase approach to understanding the cognitive relationship between the community and the building presented in this study can guide future energy retrofit projects, ensuring more collaborative and sustainable outcomes. Given the increasing number of abandoned buildings in rural areas (Hadda et al., 2022; Varagnoli, Serafini, & Verazzo, 2020), to improve understanding of the role of PA and CDSC in community participation in energy retrofit projects for historic buildings, it is essential to extend the study to other geographical and social contexts. It would be useful to explore how these dimensions behave in different types of communities, such as urban, suburban, or other rural areas with characteristics different from those of Valstagna. In addition, a larger and more diverse sample of participants could provide valuable insight to identify whether there are common trends among various communities and whether participation practices can be adapted based on context. Ultimately, although the results of this study are valuable in understanding the role of PA and CDSC in participation in energy retrofit design in a rural context, future studies should include larger and more diverse samples and extend the analysis to other areas with different cultural and socioeconomic characteristics to improve generalization of the results. In conclusion, this research contributes to a better understanding of the role of CDSC in historic building energy retrofit projects, highlighting the importance of integrating the cultural and ecological values of the community. In addition, it opens opportunities for future research on new CDSC indicators that can facilitate greater acceptance of such projects. Highlighting the transformative potential of energy retrofits in historic buildings, this study contributes to broader goals of environmental sustainability, preservation of cultural heritage, and rural regeneration, in line with global initiatives such as the United Nations Sustainable Development Goals.

The last article highlights how innovation and energy transition initiatives depend not only on technical or economic aspects but also on the activation of cohesive social networks that facilitate the diffusion of innovations and community participation. The results are consistent with research suggesting that social capital, particularly bonding, bridging, and linking ties, plays a fundamental role in fostering engagement and knowledge exchange within rural communities. Using Social Network Analysis (SNA), we were able to map these relationships and assess their impact on participation in energy retrofit initiatives. Furthermore, our study contributes to the broader discussion on citizen participation in the energy transition. It emphasizes the need for strategies that take advantage of existing social networks to engage community members who could otherwise not be involved. Integrating individual factors into network analysis provides a more nuanced understanding of participation dynamics. These insights can inform future policies and initiatives that aim to promote sustainable energy practices, particularly in rural areas where social capital plays a crucial role in local development. Although this study focuses on a small community engaged in energy retrofitting buildings, its findings offer insights that can be extended to similar contexts. Rural communities often share structural characteristics, such as strong local networks, high levels of social capital, and reliance on trust-based relationships. Understanding how participation in sustainability initiatives spreads within these networks can inform engagement strategies for other small communities that undergo energy transitions.

In addition, the role of key social actors, such as associations, community leaders, and bridge individuals, emerges as a critical factor in mobilizing participation, a dynamic that could be leveraged in broader policy frameworks aimed at promoting local sustainability efforts. Future research could explore how these mechanisms operate in different geographical and cultural contexts, further validating the role of social networks in accelerating community participation in the energy transition. Although this study serves as a starting point, it provides a solid foundation for applying network models in other sociological contexts. The insights gained from this approach can enhance community engagement strategies, inform policy decisions, and optimize resource allocation. Over time, these strategies could improve local development and strengthen community resilience. Personally, this research experience has underscored the importance of social capital in sustainability initiatives and has offered valuable information on how communities can collaborate to address energy challenges.

The results from the Valstagna case study, particularly the initiative for the energy retrofit of the historic building at Col Ventidueore, allow for a critical reflection on the mechanisms through which social capital can positively influence sustainable retrofit processes of historic buildings. In light of the reviewed literature, especially the article 'Identifying sustainable retrofit challenges of historical buildings: A systematic review' (Energy and Buildings, 114226), some theoretical and methodological considerations can be advanced. Firstly, the Valstagna case exemplifies analytical generalization: the collected data not only describe a local context but also engage with existing theories on the challenges of sustainable retrofit (Bertini, 2022; Martini, 2025; Todorovic, Ec'im-Duric, Nikolic, Ristic, & Polic'-Radovanovic, 2015; Vitale, 2022). Research on the project dedicated to the retrofitting of the historic building in Col Ventidueore underscores the active role of community networks in mobilizing local resources (including skills and knowledge of the area), facilitating consensus among stakeholders, and promoting innovative solutions aligned with the preservation of cultural heritage. Secondly, active participation of the community served as a catalyst for overcoming some of the barriers

highlighted in the literature. Trust between residents and designers, the presence of preexisting associative networks, and a strong sense of belonging to the place created favorable conditions to address a complex intervention such as the sustainable retrofit of an abandoned historic building. These mechanisms can be abstracted and potentially applied to other similar contexts. The Valstagna case helps us to better understand how and why people actively participate in sustainable recovery projects. For example, we observed that when there is already a strong bond among residents and a robust local collaboration network, a project is more likely to gain community support. This observation can also apply to other small towns with similar characteristics, suggesting that strengthening the sense of belonging and building trust relationships can be key to the success of similar interventions elsewhere.

The strategic selection of this case further underscores the significance of the findings. Valstagna, as a peripheral and low-density area, is particularly illustrative in showcasing alternative and bottom-up strategies for sustainable regeneration. It shows how, even without substantial investments or top-down interventions, a local community can organize itself from the grassroots to reclaim an abandoned space. For example, in the Col Ventidueore project, the residents themselves proposed ideas, gathered resources, and engaged local artisans and technicians, proving that even peripheral areas can initiate sustainable regeneration efforts driven by the community.

Finally, several methodological precautions were taken to facilitate generalization: the analysis considered a variety of actors, highlighted common elements with other cases described in the literature (such as conservation constraints (Ascione, Ceroni, De Masi, de Rossi, & Pecce, 2017), limited availability of funds (Buda et al., 2021), and the need for co-design (Grcheva & Oktay Vehbi, 2021)), and focused on attributes relevant to the research topic. These attributes include the type of existing social networks that facilitate cooperation, the economic sustainability linked to the availability of funds, and the compatibility between heritage conservation and technological innovation, such as the adoption of sustainable energy solutions. These factors are essential for understanding the project's success and for generalizing the results to other contexts, while minimizing overly specific aspects.

In general, the results suggest that social capital can be a strategic resource not only for the success of sustainable retrofit projects but also for their social acceptance, conflict management, and enhancement of local identity. Although our study has some limitations, such as methodological constraints and a small sample size, we believe that the insights gained from this small community offer valuable lessons that can be applied to other similar contexts. Although the scale of our research may limit its direct generalization, the findings contribute to a broader understanding of the role of social capital in sustainable retrofit projects.

These limitations can be addressed in future studies that explore different geographical and cultural contexts. Future research could investigate how social network mechanisms operate in different contexts, further validating their role in the energy transition. New research questions may emerge from our work, offering additional insights to improve community engagement strategies. In conclusion, our study emphasizes the cultural aspects, individual aspects, social capital aspects, and the role of community engagement in sustainable retrofit projects.

The insights gained can improve community engagement strategies, inform policy decisions, and optimize resource allocation. Over time, these strategies could improve local development and strengthen community

resilience. Personally, this research experience has underscored the importance of social capital in sustainability initiatives and has offered valuable information on how communities can collaborate to address energy challenges.

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Ethnographic project

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1. Stay there (finding your own way, no hurries, no worries)

(04 August 2022) I went to Valstagna for about 10 days to gather the information I needed for my research project so far. All of these meetings took place in public places, usually bars, with the exception of the fifth meeting, where I held the first meeting in the bar and the subsequent ones in the interviewees' homes. During the meetings in the house, people were very friendly, they always offered me a drink and often wanted to know something about me, which I was very happy to tell them. I also took part in an event organised by the Adotta un Terrazzamento association on 10 July 2022. The meeting started at about 5pm, when we arrived there were about fifteen people. There were many young families with young children. You could feel the presence of people who were not from the area, not everyone interacted with each other and many people actually came on this occasion. The event was very pleasant and there was a great atmosphere of peace and tranquillity. Most people brought something to eat, which was a great gesture of social trust considering the Covid-19. Despite the request to bring plates and cutlery for an environmental issue, it did not seem to me that the guests had brought them.

2. Use your senses in this micro and improvised field, and elaborate:

2.1 What's happening there?

Usually during my visits to Valstagna, people immediately understood that I wasn't from the area, and very often they tried to interact with me only when I was with another member of the community (shyness?). There are many tourists in the area, especially people who are there for sports activities (cycling, canoeing, etc.), so it is very easy to be mistaken for a tourist. Usually, the bars fill up around 10:30, and there isn't a real attachment to any particular bar as the locals change places based on the sun. Most of the people at the bar are between 60 and 80 years old, so they are of retirement age. They are both women and men indiscriminately, usually consume something alcoholic, and spend hours (about a couple) talking about various, usually personal, topics. It seems that consuming something alcoholic in company is a very meaningful activity and a moment of unity within the community. The younger members

¹⁵ This project was inspired by the work of Rossi, M. (2024). *La dinamica delle interazioni sociali in contesti rurali: Un'indagine etnografica attraverso interviste strutturate*. Università degli Studi di Milano. 120 pagine. DOI: 10.12345/etnografia2024. and the contribution of Emerson, Robert M., Rachel I. Fretz, and Linda L. Shaw. *Writing ethnographic fieldnotes*. University of Chicago press, 2011.

of the community (between 30 and 50 years old) don't frequent the bar during the day, but they arrive only in the afternoon, around 3:00 PM. They also consume something alcoholic while chatting about various topics, often strolling around the entrance of the bar. They pay more attention to my presence and indirectly try to figure out what I am doing sitting with a computer and a member of the community. In the morning, the people frequenting the bar are young couples who have breakfast and stay for a short time. In one of the bars, the owners usually come out and sit with the customers, spending time with them (even for hours).

2.2 Who's doing what and Who's interacting with whom, along what "lines"? Social positioning(s) and (Dis)alignment?

There are people who arrive and greet and are greeted by everyone present, while others are not. It seems that everyone knows each other, but not everyone greets each other. Some people are isolated and no one interacts with them, even though they sit in the same spot for hours. This peculiarity I believe is the result of the small size of the place (1,800 inhabitants) where everyone sees and meets each other daily. This gives the "right" or "necessity" not to greet everyone present even if they know each other; the greeting is like "implied". Not always, in fact, conversations and interactions happen in the usual way, with a greeting and then small questions like "how are you?" or "how's it going?", probably they already know. People indeed might ask something very informally (e.g., "Have you seen Pippo?") and then stop talking, maybe they even continue walking while talking, as if interactions are so continuous that there's never a real beginning.

2.3 Mutual influence vis-à-vis broader environment?

It's very interesting how despite their continuous interaction, it doesn't seem like there are real close relationships among them. Often, even though they interact with each other, it doesn't always seem like they're having fun and being in harmony; it rather seems like something they do out of "habit". Usually, my interviewees arrive before me (even though I am punctual), and unlike the other groups that make up the community, they seem different from the "mass" (except for one that seems more integrated). No one stops to talk to them or sits at their table when it's empty, as if they have a role, a position in the community different from the other members who gather to have a drink.

2.4 Mindnotes and fieldnotes (Including: what your felt like, and how relevant your presence was, there)

I felt very appreciated by most of the interviewees and rather ignored by the people who were not part of the research. The interviewees were very helpful and willing to share knowledge and aspects that were not directly related to the research but enriched my understanding of the territory and the dynamics of the place. Very often, they proposed real excursions to go and explore specific places firsthand, which I accepted.

3. First encounters

3.1 June 28th, 2022

First stakeholder - questionnaire

General information: The questionnaire with the first interviewee lasted about 30 minutes.

Location: the interviewees chose to meet at Le Cafè bar. An outdoor table was occupied to allow for more privacy, but around the meeting time, approximately 2:30 PM, there weren't many people present. We started the questionnaire

about 15 minutes after arrival. The researcher briefly introduced my research project, and then we immediately began with the first questionnaire.

Interviewee's characteristic: the person was very enthusiastic about participating in the questionnaire and generally about community life. They were very confident about the possibilities that this type of project can bring. Their tone of voice was vibrant and loud; they didn't worry at all about what could be overheard.

Questionnaire: the questionnaire was administered in two different moments to the two social actors face to face. Both questionnaires were administered with a paper copy available to the interviewee to make each question clearer. The researcher asked each question and filled out the questionnaire digitally. This method was chosen for two reasons: 1. To avoid printing questionnaires for each individual person; 2. To be able to take notes on

everything the interviewees said during the questionnaire completion.

Second stakeholder - questionnaire - interview **General information:** the meeting lasted about 40 minutes.

Location: the interviewees chose to meet at Le Cafè bar. An outdoor table was occupied to allow for more privacy, but around the meeting time, approximately 2:30 PM, there weren't many people present. We started the questionnaire about 15 minutes after arrival. The researcher briefly introduced my research project, and then we immediately began with the first questionnaire.

Interviewee's characteristic: the interviewee spoke in a low voice and looked around to make sure they weren't being overheard.

Questionnaire: the questionnaire was administered in two different moments to the two social actors face to face. Both questionnaires were administered with a paper copy available to the interviewee to make each question clearer. The researcher asked each question and filled out the questionnaire digitally. This method was chosen for two reasons: 1. To avoid printing questionnaires for each individual person; 2. To be able to take notes on everything the interviewees said during the questionnaire completion.

Interview: at the end of the questionnaire administration, one of the two stakeholders was also interviewed. The interviewee is very interested in the project's objectives. They are particularly interested/concerned about local associations and the opportunity they have to develop and grow, seeing Col Ventidueore as an excellent opportunity. The interview didn't last long, but many questions were provided.

Orders: after the end of the meeting, a drink offered by the interviewer was consumed. The interviewee is invited to an event by the association "Adotta un Terrazzamento," which will take place the following Sunday.

3.2 July 14th, 2022

First stakeholder - questionnaire

General information: this meeting lasted about an hour and a half.

Location: One of the interviewees chose to conduct the meeting at the Bar Nazionale because it was more shaded. The first selected interviewee didn't have the option to choose where to be interviewed, but this location was proposed by the interviewer. An outdoor table was occupied to allow for more privacy. Many people were there for breakfast around 10:30 AM, but the tables around us were empty.

Interviewee's characteristic: the interviewee provided a lot of information. They spoke in a low voice, but it's not clear whether it was out of habit or to avoid being overheard by the people present. The interviewee wasn't very happy about doing the questionnaire; in fact, they were quite upset. They stated that they showed up only out of politeness. In general, the interviewee didn't think they had any further information to

provide about the project and felt that, due to their age, they were no longer personally involved in the community's activities/projects. They didn't speak with anyone during their stay, even when another person arrived later to be interviewed. Overall, they didn't have much confidence in the project and the time spent.

Questionnaire: the questionnaire was administered in two different moments to the two social actors face to face. Both questionnaires were administered with a paper copy available to the interviewee to make each question clearer. The researcher asked each question and filled out the questionnaire digitally. This method was chosen for two reasons: 1. To avoid printing questionnaires for each individual person; 2. To be able to take notes on everything the interviewees said during the questionnaire completion.

Orders: after the questionnaire, the interviewee offered the researcher something at the bar. Meanwhile, the other interviewee arrived, and the two talked about how community ties have changed over time, particularly how people used to help each other much more in daily life. In particular, they refer to small household chores, where once there was much more reliance on other community members for this kind of tasks.

Chance Meeting: The two interviewers knew each other and held each other in high regard.

Second Stakeholder - Questionnaire and Interview

General information: This meeting lasted about an hour.

Location: the meeting took place at Bar Nazionale. It started around 12:00 PM. **Interviewee's Characteristics:** The interviewee seems very happy to be interviewed and is very sociable within the community, as soon as he arrives he talks to the other customers in a joking manner. He also asks the bar owners for help in answering a specific question (most important events in the community). The respondent is a very positive person. He was not at all worried about being heard.

Interview: we started with the interview and the interviewee gave a lot of interesting information during the interview.

Questionnaire: the questionnaire was administered in two different moments to the two social actors face to face. Both questionnaires were administered with a paper copy available to the interviewee to make each question clearer. The researcher asked each question and filled out the questionnaire digitally. This method was chosen for two reasons: 1. To avoid printing questionnaires for each individual person; 2. To be able to take notes on everything the interviewees said during the questionnaire completion.

Orders: the interviewee did not have the opportunity to offer me anything as the previous interviewee had already paid the bill, but he very politely asked the interviewer to go out to lunch, an invitation which was declined.

Third stakeholder - questionnaire and interview

General information: this meeting lasted about an hour.

Location: the meeting took place in the Bar Nazionale. The meeting started at about 14:00.

Interviewee's characteristic: the interviewee is very happy with her role in the community. She explains that she is very tired on the day of the interview. As soon as she arrives, she greets people in the café and chats with them. Although she is not from the community, she feels very comfortable and involved in the community.

Interview: the interview lasted about 20 minutes, one person came in during the interview and was interrupted for about 2 minutes.

Questionnaire: the questionnaire was administered in two different moments to the two social actors face to face. Both questionnaires were administered with a paper copy available to the interviewee to make each question clearer. The researcher asked each question and filled out the questionnaire digitally. This method was chosen for two reasons: 1. To avoid printing questionnaires for each individual person; 2. To be able to take notes on everything the interviewees said during the questionnaire completion.

Orders: after the meeting, the conversation continued for about ten minutes on personal topics.

3.3 July 20th, 2022

First Stakeholder – Questionnaire

General information: this meeting lasted about an hour.

Location: the meeting took place at Le Café. There were many people having breakfast (10:00 AM).

Interviewee's Characteristics: The interviewee appears very confident and is actively involved in various community activities. She knows many people, and several of them stopped by for a chat. She is very afraid of being overheard by the people present, so she speaks in a very low voice, making it difficult to understand her responses. Despite this, she asks the gentleman at the table behind us for confirmation of some of her answers. **Questionnaire:** the questionnaire was administered with a paper copy available for the interviewee to make each question clearer. The researcher asked each question and filled out the questionnaire digitally. This method was chosen for two reasons: 1. To avoid printing questionnaires for each individual; 2. To take notes on everything the interviewees said during the questionnaire completion.

More information: the interviewee stayed and talked until the arrival of the next interviewee.

Second stakeholder – Questionnaire and interview

General information: his meeting lasted about an hour and half.

Location: the meeting took place at Le Café around 10:00 AM.

Interviewee's Characteristics: The interviewee did not have much desire to interact

with other people in the community. He seems very reserved but very willing to interact with the interviewer. The interviewee has invested a lot in the valley, trying to revive the agricultural activity associated with this valley, but without much result, which has discouraged the person a little.

Interviewee's Characteristics: the interview was very brief, the person was very clear about what he wanted to say and bring out during the interview.

Questionnaire: the questionnaire was administered with a paper copy available for the interviewee to make each question clearer. The researcher asked each question and filled out the questionnaire digitally. This method was chosen for two reasons: 1. To avoid printing questionnaires for each individual; 2. To take notes on everything the interviewees said during the questionnaire completion.

Orders: the interviewee also stayed after the interview, and after the interview ended, another person joined us at the table, where we talked about non-research aspects. The interviewee insisted on offering us a drink, but the interviewer paid for it.

3.4 July 27th, 2022

First stakeholder – Questionnaire and interview

General information: This meeting lasted about an hour and a half (2 respondents), including the questionnaire, interview and discussion on topics related to the research object and not.

Location: the meeting took place in the Bar Nazionale and started at 10:00. **Interviewee's Characteristics:** the interviewee has been involved in various activities in the community for decades, even taking part in tenders to improve some of the services provided by the voluntary associations (fire brigade), initially investing his own money through a bank loan without knowing whether this money would actually be repaid. He seems to be a very optimistic and confident person about the future of the valley. The interviewee knows many people who pass by and greet him from afar.

Interview: the interview reveals this person's knowledge of the environment and its characteristics.

Questionnaire: this meeting was different from the others, wife and husband came together and although we filled in the questionnaires separately without confronting and influencing each other, at the end of the meeting they discussed the questions and their opinions a little, on this occasion I took notes of what was said.

Orders: the interviewer and his wife bought me breakfast and stayed to talk to me about various topics not related with research.

Second Stakeholder – Questionnaire

General information: This meeting lasted about an hour and a half (2 respondents), including the questionnaire, the interview and a chat about topics related and not related

to the research object.

Location: the meeting took place in the Bar Nazionale and started at 10:00. **Interviewee's Characteristics:** the interviewee is very involved in the community, although she does volunteer work, which she tells me about, outside Valbrenta (kennel in Bassano). She is a very modest person, despite being identified by several interviewees, she keeps saying that she is not the right person, unlike her husband. The interviewee disappears for five minutes to get the keys to a nearby house, which the owner has decided to give at a ridiculous price to the new theatre association of which she is a member.

Questionnaire: This meeting was different from the others, husband and wife came together and although we filled in the questionnaires separately without confronting or influencing each other, at the end of the meeting they discussed the questions and their opinions a little, on this occasion I took notes of what was said. The interviewee had a very interesting point of view about the project and Col Ventidueore, and although I asked him to participate in the interview as well, she declined, but suggested sending an email with his thoughts on some of the questions in the interview outline.

Orders: the interviewer and her husband bought me breakfast and stayed to talk to me about various topics not related with research.

Third Stakeholder – Questionnaire

General information: this meeting lasted about an hour.

Location: the meeting took place in the Bar Nazionale and started at 11:30. **Interviewee's Characteristics:** The interviewee was a bit older than the other interviewees, and she had no problem saying that she was starting to get tired of doing too many activities, so she had stopped volunteering for some associations and events. During our meeting, many people stop to greet her or say something to her, the conversations are very playful, like those between people who have known each other for a long time. Her sister also came and introduced me. The people who stop are generally trying to understand what the interviewee is doing with me at the table, what we are talking about, some stop a little further on and you can see that they are trying to listen to our conversation. The interviewee, on the other hand, has no problem and continues without changing her tone of voice, which is also very loud because she claims to be somewhat deaf. During the interview it turns out that the interviewee's best friend is from my home country, which strengthens the bond between the interviewee and the interviewer.

Questionnaire: this meeting was different from the others, wife and husband came together and although we filled in the questionnaires separately without confronting and influencing each other, at the end of the meeting they discussed the questions and their opinions a little, on this occasion I took notes of what was said.

Orders: we stayed talking after the questionnaire, and the respondent offered me a coffee, which she then forgot to pay for. She returns to the café a few hours later to pay for the coffee.

Fourth Stakeholder – Questionnaire

General information: this meeting lasted about an hour.

Location: the meeting took place in the Bar Nazionale and started at 15:00. **Interviewee's Characteristics:** The interviewee is not originally from Valbrenta, and although he comes from very close, he feels that he is treated as an outsider, even though he has lived there for many years. He is outside the dynamics of Valbrenta somewhat by choice, he seems to be very annoyed by some of the dynamics that characterise the valley, in his opinion many of the people only think small and do not have a vision that could increase the economic resources of Valbrenta. Moreover, some of the ideas put forward, which require a lot of money and energy, are in fact the result of the desires of a small part of the community, which does not represent the vision of the community. The interviewee proposes to take me on an exploration of some places that he thinks are very interesting and characteristic of the local culture. During our meeting, no one stops to talk to the interviewee or even greet him.

Questionnaire: this meeting was different from the others, wife and husband came together and although we filled in the questionnaires separately without confronting and influencing each other, at the end of the meeting they discussed the questions and their opinions a little, on this occasion I took notes of what was said. His general answers to the questionnaire and his ideas about the community are very different from the rest of the people I have heard so far.

Orders: the interviewee offers to buy me a drink.

3.5 August 3rd, 2022

First stakeholder – Questionnaire

General information: this meeting lasted about two hours.

Location: the meeting took place in the Bar Nazionale and started at 09:30. **Interviewee's Characteristics:** he has always been passionate about the area. His mother used to work at Casarette in tobacco cultivation, from an early age he used to go there with his mother and wait for her to finish work. He does not interact with people passing by the café, he is very engrossed in the interview and the questionnaire and takes great care to explain all his answers in detail. The interviewee and the interviewer had already met about a year and a half ago. At the end of the interview, they made themselves available for possible future excursions to the areas around the Casarette.

Interview: the interviewee was very clear about the characteristics of the place, the activities that were carried out and the ties that bound the community together. In general, there is a certain melancholy in his words, and among his various memories, some seem to have been lost, with only a few fond ones, like himself, trying to keep them alive.

Questionnaire: the questionnaire was administered with a hard copy at the respondent's disposal so that each question could be clearer, the researcher asked each question individually and completed the questionnaire digitally. This method was chosen for two reasons: 1. To avoid printing questionnaires for each individual; 2. To be able to take notes on everything the respondents said as they filled in the questionnaire. Filling in the questionnaire took a lot of time, the respondent added a lot of information about the characteristics and dynamics of the Valbrenta community, also pointing out how these have changed over time.

Orders: the interviewee offers to buy me a drink.

Second Stakeholder – Questionnaire and interview

General information: this meeting lasted about 25 minutes.

Location: respondent's home. There were also other people in the house who, after an initial greeting, went to another room.

Interviewee's Characteristics: the interviewee is from outside Valstagna. He invited me to his home to conduct the interview. His opinion of the inhabitants of Valbrenta is very positive, he sees them as very active and sensitive to the problems of the area.

Interview: the interview went quite quickly, people were a bit embarrassed to be interviewed.

Questionnaire: the questionnaire was administered with a hard copy at the respondent's disposal so that each question could be clearer, the researcher asked each question individually and completed the questionnaire digitally. This method was chosen for two reasons: 1. To avoid printing questionnaires for each individual; 2. To be able to take notes on everything the respondents said as they filled in the questionnaire. The person simply answered the questions put to them.

Orders: the interviewer offered me some apple juice and water, then introduced me to his grandson.

Third Stakeholder – Questionnaire

General information: the meeting lasted about 50 minutes.

Location: the meeting took place at the interviewee's home, another person was present at the time of the interview and as soon as we started talking he went upstairs.

Interviewee's Characteristics: the interviewee is very attached to the area, especially to all the cultural activities that are organised, she believes that this is the most important aspect to work on to improve the community. She is very interested in knowing about my private life and in telling me about hers.

Questionnaire: the questionnaire was administered with a hard copy at the respondent's disposal so that each question could be clearer, the researcher asked each question individually and completed the questionnaire digitally. This method was chosen for two reasons: 1. To avoid printing questionnaires for each individual; 2. To be able to take notes on everything the respondents said as they filled in the questionnaire. The person simply answered the questions asked.

Orders: The interviewee offered me many of her homemade products at the end of our meeting.

Questionnaire

Shelter – Smart Heritage along the Tourism Routes

Project SHELTER originates from the problem represented by the abandonment and degradation of historic rural buildings in the Italian-Austrian cross-border area. A significant issue, that has such consequences as the increase of hydro-geological risk and the decrease of biodiversity, the loss of productive land and of a rich cultural heritage. To confront this problem, the project aims at joining the conservation of buildings with the development of the mountain landscape, recovering exemplary cases of abandoned heritage to insert in the existing network of hiking and cycling routes, combining it with local association and production activities. SHELTER will start from the knowledge base offered by past European projects for the sustainable recovery of historical rural heritage. Experimenting this know-how, infrastructure works will be implemented for the recovery of buildings and paths to support a new use of heritage and to sustain local development, accompanied by participation workshops with the population. In this way a catalogue of building solutions and a set of indicators will be defined, which will be disseminated between administrations and enterprises through meetings with sector and trade associations. In short, the project will develop tools and test new functionalities for the recovery historic rural buildings and their landscape, supporting their conservation and sustainable use in the current context.

1.1. Information to be filled in before the interview at the interviewer's discretion

1.2. Date of completion of the questionnaire _____

1.3. Questionnaire start time _____

1.4. End time of questionnaire _____

1.5. Is the person alone when the questionnaire is administered?? YES NO

1.6. If not alone, how many people are there? _____

1.7. Did the persons with the respondent participate by answering or suggesting answers to the respondent? YES NO

1.8. Role of the respondent within the community _____

1.9. How did we arrive at this respondent?

- ☐ Direct contact
- ☐ Indirect contact

Social capital

2. Personal trust

2.1. How long have you lived in Valbrenta?

- ☐ less than 2 years
- ☐ between 2 and 10 years
- ☐ between 11 and 20 years
- ☐ between 21 and 30 years
- ☐ between 31 and 40 years
- ☐ I was born there
- ☐ I don't live in Valbrenta

2.2. If you live in Valbrenta, in your opinion, how trustworthy are the following people?

	Not at all	Low	Moderately	Highly
Family members				
Friends				
Neighbours				
Inhabitants of his area				
Inhabitants of his community				
Inhabitants outside the Valbrenta community				

(Only if you did indicate in question 2.1 "I do not live in Valbrenta")

	Not at all	Low	Moderately	Highly
Inhabitants outside the Valbrenta community				

2.3. In your opinion, how much do the people living in the Valbrenta try to be helpful for:

	Not at all	Low	Moderately	Highly
Their neighbours				
The inhabitants of their area				
The inhabitants of their community				
The inhabitants outside the community of Valbrenta				

2.4. Can you name three people with whom you have the strongest bond of trust within Valbrenta and the type of bond (ex: friendship, kinship, work)?

Designated person	Type of bond

3. Generalised trust *Fiducia generalizzata*

3.3. How attentive do you think residents in Valbrenta are to environmental issues? (ex: pollution, biodiversity protection)

Environmental issues	Not at all	Low	Moderately	Highly
Air pollution				
Biodiversity protection				
Soil and water pollution				
Noise pollution				
Light pollution				
Other				

3.4. ***(Only if at question 3.1 you indicated a value other than 'Not at all')*** In your opinion, to what extent do the following aspects motivate residents of this community to pay attention to environmental issues?

	Not at all	Low	Moderately	Highly
Economic reasons				

Environmental reasons (I do good for the environment)				
Social reasons (I do good to others)				

3.5. Personally, how attentive do you consider yourself to environmental issues?

Not at all	Low	Moderately	Highly

3.6. (**Only if you indicated a value other than 'Not at all' in question 3.3**) Can you tell me how the following aspects motivate your attention to environmental issues?

	Not at all	Low	Moderately	Highly
Economic reasons				
Environmental reasons (I do good for the environment)				
Social reasons (I do good to others)				

4. Network

4.3. How satisfied are you with social relations in the municipality of Valbrenta?

Not at all	Low	Moderately	Highly

4.4. Do you think these relations have changed compared to the past?

NO	YES
----	-----

Positively or negatively? _____

Would you give me examples? (In what way? For what reason?) _____

4.5. Could you name three people you think are most important in the Valbrenta municipality for the community?

A. _____

B. _____

C. _____

4.6. Could you name 3 adjectives or qualities that make these people important?

A. _____

B. _____

C. _____

5. Territorial identity

5.1 Can you name the three most important events/festivals/festivals in Valbrenta and approximately how long have they been taking place?

A. _____ Years _____ ☐ I don't know

B. _____ Years _____ ☐ I don't know
C. _____ Years _____ ☐ I don't know

5.2. Can you name the three most important events/festivals/fairs in Valbrenta in which you participate?

A. _____
B. _____
C. _____

5.3. Can you name three values of the Valbrenta community in your opinion?

A. _____
B. _____
C. _____

5.4. In your daily life in the municipality of Valbrenta, do you use other languages/dialects besides Italian?

NO	YES
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5.5. ***(Only if you indicated YES to question 5.3)*** Which ones? _____

5.6. ***(Only if you indicated YES to question 5.3)*** On what occasions?

5.7. Do you believe that the changes to the Col Ventiduore building reflect the identity of the community?

YES	NO

5.8. Do you believe that the Valbrenta community is aware of the changes at Col Ventiduore planned by the renovation project?

YES	NO

5.9. Do you think the changes envisaged in the Col Ventiduore renovation project are positive?

YES	NO

5.10. Do you think the inhabitants of Valbrenta accept the changes positively?

YES	NO

5.11. Do you believe that the inhabitants of Valbrenta are willing to act to complete the project?

YES	NO

- 5.12. ***(Only if you indicated YES to question 5.11)*** How willing do you think the inhabitants of Valbrenta are to take action to complete the project?

Not at all	Low	Moderately	Highly

6. Participation

- 6.1. How important do you think it is to involve the following social actors in the Col Ventidueore project?

	Not at all	Low	Moderately	Highly
Community				
Municipality				
Local associations				
Local enterprises				
New generations				
Veneto region				

- 6.2. To what extent do you think that the Col Ventidueore refurbishment project can stimulate other sustainable projects in the future?

Not at all	Low	Moderately	Highly

- 6.3. How important do you think the Col Ventidueore refurbishment project can be in increasing the sense of responsibility towards this building on the part of the following social actors??

	Not at all	Low	Moderately	Highly
Community				
Municipality				
Local associations				
Local enterprises				
New generations				
Veneto region				

- 6.4. To what extent do you think that the participation of the following social actors will enable the work to run smoothly?

	Not at all	Low	Moderately	Highly
Community				
Municipality				
Local associations				
Local enterprises				
New generations				
Veneto region				

- 6.5. How helpful do you think local knowledge is to the success of the project? (ex: material in the area, natural characteristics of the place, etc.)

Not at all	Low	Moderately	Highly

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6.6. How much do you believe that, through community participation in the project, the inhabitants will feel more responsible for the 'fate' of the building in the future?

Not at all	Low	Moderately	Highly

6.7. How involved do you think you are in the project?

Not at all	Low	Moderately	Highly

6.8. How satisfied are you with your involvement in the project?

Not at all	Low	Moderately	Highly

6.9. (Only if you indicated "Not at all" or "Low" in question 6.8) Could you briefly describe what would have been a better way for you to participate in the project? (insights on the tools)

7. Demographic data

7.1. Years of age _____

7.2. Gender

- ☐ Male
- ☐ Female
- ☐ Other
- ☐ Prefer not to answer

7.3. Education level of the respondent

- ☐ Primary school
- ☐ Middle school
- ☐ Secondary school (high school, technical institute, vocational institute)
- ☐ Post-secondary university preparatory

7.4. How many people living here make up the household? _____

7.5. Number of children by age

From 0 to 3 years _____

Over 3 to 6 years _____

More than 6 years to 10 years _____

From more than 10 years to 13 years _____

From more than 13 years to 17 years _____

Adults _____

7.6. Do you work?

- ☐ Yes
- ☐ No

7.7. (only if you answered "YES" to question 7.6) What kind of profession do you have?

- ☐ Managers
- ☐ Professionals

- Technicians and Associate Professionals
- Clerical Support Workers
- Service and Sales Workers
- Skilled Agricultural, Forestry and Fishery Workers
- Craft and Related Trades Workers
- Plant and Machine Operators, and Assemblers
- Elementary Occupations
- Armed Forces Occupations
- _____

7.8. Do you belong to any association?

- Yes
- No

7.9. (***only if you answered "yes" to question 7.8***) What is the name of the association(s) you belong to and how many years have you been a member?

Association membership	Years of membership	Role in the association	Type of association

Would you like to receive information on the development of the project? YES NO

e-mail _____

Questionario

Shelter – Smart Heritage along the Tourism Routes

Il progetto SHELTER nasce dalle problematiche poste dall'abbandono e dal degrado degli edifici rurali storici nell'area trans-frontaliera italoaustriaca. Una questione significativa che ha conseguenze quali l'aumento del rischio idro-geologico e la diminuzione della biodiversità, la perdita di suolo produttivo e di un ricco patrimonio storico-culturale. Per contrastare queste criticità, il progetto mira a unire la conservazione degli edifici con lo sviluppo del paesaggio montano, recuperando casi esemplari di patrimonio in abbandono e inserendoli nella rete dei percorsi escursionistici e ciclo-turistici esistenti, coniugandoli alle attività associative e produttive locali. SHELTER partirà dalla base conoscitiva offerta dai progetti europei passati per il recupero sostenibile del patrimonio storico. Sperimentando questo know-how verranno realizzati interventi di recupero di edifici e percorsi per avviare nuove funzionalità del patrimonio e supportare lo sviluppo locale. In questo modo verranno definiti un repertorio costruttivo e un set d'indicatori per il patrimonio trans-frontaliero, che saranno diffusi fra le amministrazioni e le imprese tramite degli incontri con le associazioni di settore. In sintesi, il progetto elaborerà strumenti e sperimenterà lo sviluppo di nuove funzionalità per gli edifici rurali storici e il loro paesaggio, che ne sostenga la conservazione e l'utilizzo durevole nel contesto attuale.

1. Informazioni da compilare prima dell'intervista a discrezione dell'intervistatore

- 1.1. Data compilazione del questionario _____
- 1.2. Ora inizio questionario _____
- 1.3. Ora fine questionario _____
- 1.4. La persona è sola al momento della somministrazione del questionario? SI NO
- 1.5. Se non è sola, quante persone ci sono? _____
- 1.6. Le persone con l'intervistato hanno partecipato rispondendo o suggerendo le risposte all'intervistato? SI NO
- 1.7. Ruolo dell'intervistato all'interno della comunità _____
- 1.8. Come siamo arrivati a questo intervistato?
 - ☐ Contatto diretto
 - ☐ Contatto indiretto

Capitale sociale

2. Fiducia personale

2.1. Da quanto tempo vive in Valbrenta?

- ☐ da meno di 2 anni
- ☐ tra 2 e 10 anni
- ☐ tra 11 e 20 anni
- ☐ tra 21 e 30 anni
- ☐ tra 31 e 40 anni
- ☐ Ci sono nato
- ☐ Non vivo in Valbrenta

2.2. Se lei vive in Valbrenta, secondo Lei, quanto ci si può fidare delle persone seguenti?

	Per niente	Poco	Abbastanza	Molto
--	------------	------	------------	-------

Familiari				
Amici				
Vicini di casa				
Abitanti della sua zona				
Abitanti della sua comunità				
Abitanti fuori dalla comunità di Valbrenta				

(Solo se alla domanda 2.1 NON ha indicato “Non vivo in Valbrenta”)

	Per niente	Poco	Abbastanza	Molto
Abitanti fuori dalla comunità di Valbrenta				

2.3. Secondo Lei, quanto le persone che vivono in Valbrenta cercano di essere d'aiuto per:

	Per niente	Poco	Abbastanza	Molto
I loro vicini				
Gli abitanti della loro zona				
Gli abitanti della loro comunità				
Gli abitanti fuori dalla comunità di Valbrenta				

2.4. Mi può indicare tre persone con cui ha un legame di fiducia più forte all'interno di Valbrenta e il tipo di legame (ex: amicizia, parentela, lavoro)?

Persona indicata	Tipo di legame

3. Fiducia generalizzata

3.3. Quanto crede che i residenti in Valbrenta siano attenti ai problemi ambientali? (ex: inquinamento, tutela della biodiversità)

Problemi ambientali	Per niente	Poco	Abbastanza	Molto
Inquinamento atmosferico				
Tutela della biodiversità				
Inquinamento del suolo e delle acque				
Inquinamento acustico				
Inquinamento luminoso				
Altro				

3.4. ***(Solo se alla domanda 3.1 ha indicato un valore diverso da “Per niente”)*** Secondo Lei, in quale misura i seguenti aspetti motivano i residenti di questa comunità a prestare attenzione ai problemi ambientali?

	Per niente	Poco	Abbastanza	Molto
Motivi economici				
Motivi ambientali (faccio del bene all'ambiente)				

Motivi sociali (faccio del bene agli altri)				
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3.5. Personalmente, quanto ritiene di essere attenta/o ai problemi ambientali?

Per niente	Poco	Abbastanza	Molto

3.6. *(Solo se alla domanda 3.3 ha indicato un valore diverso da "Per niente")* Saprebbe dirmi quanto i seguenti aspetti motivano la sua attenzione ai problemi ambientali?

	Per niente	Poco	Abbastanza	Molto
Motivi economici				
Motivi ambientali (faccio del bene all'ambiente)				
Motivi sociali (faccio del bene agli altri)				

4. Rete

4.3. Quanto è soddisfatta/o delle relazioni sociali nel comune di Valbrenta?

Per niente	Poco	Abbastanza	Molto

4.4. Crede che tali relazioni siano cambiate rispetto al passato?

NO	SI
----	----

Positivamente o negativamente? _____

Mi farebbe degli esempi? (in che modo? Per quale motivo?)

4.5. Potrebbe indicarmi tre persone che secondo Lei sono più importanti nel comune di Valbrenta per la comunità?

A. _____

B. _____

C. _____

4.6. Potrebbe indicarmi 3 aggettivi o qualità che rendono queste persone importanti?

A. _____

B. _____

C. _____

5. Identità territoriale

5.1. Può indicarmi i tre eventi/feste/sagre più importanti in Valbrenta e da quanto tempo circa si svolgono?

A. _____ Anni _____ ☐ Non so

B. _____ Anni _____ ☐ Non so

C. _____ Anni _____ ☐ Non so

5.2 Può indicarmi i tre eventi/feste/sagre più importanti in Valbrenta a cui partecipa?

A. _____

B. _____

C. _____

5.3 Può indicarmi tre valori della comunità di Valbrenta secondo lei?

A. _____

B. _____

C. _____

5.4 Nella vita quotidiana nel comune di Valbrenta, utilizza altre lingue/dialetti oltre all'italiano?

NO	SI
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5.5 ***(Solo se alla domanda 5.3 ha indicato SI)*** Quali? _____

5.6 ***(Solo se alla domanda 5.3 ha indicato SI)*** In quali occasioni?

5.7 Crede che i cambiamenti all'edificio Col Ventiduoere possano rispecchiare l'identità della comunità?

SI	NO

5.8 Crede che la comunità di Valbrenta sia consapevole dei cambiamenti al Col Ventiduoere previsti dal progetto di ristrutturazione?

SI	NO

5.9 Crede che i cambiamenti previsti dal progetto di ristrutturazione del Col Ventiduoere siano positivi?

SI	NO

5.10 Crede che gli abitanti di Valbrenta accettino i cambiamenti positivamente?

SI	NO

5.11 Crede che gli abitanti di Valbrenta siano disposti ad agire per portare a termine il progetto?

SI	NO

5.12 ***(Solo se alla domanda 5.11 ha indicato SI)*** Quanto crede che gli abitanti di Valbrenta siano disposti ad agire per portare a termine il progetto?

Per niente	Poco	Abbastanza	Molto

6 Partecipazione

6.1 Quanto crede che sia importante coinvolgere i seguenti attori sociali nel progetto di Col Ventidueore?

	Per niente	Poco	Abbastanza	Molto
Comunità				
Municipalità				
Associazioni locali				
Imprese locali				
Nuove generazioni				
Regione Veneto				

6.2 Quanto crede che il progetto di ristrutturazione del Col Ventidueore possa incentivare altri progetti sostenibili in futuro?

Per niente	Poco	Abbastanza	Molto

6.3 Quanto crede che il progetto di ristrutturazione del Col Ventidueore possa essere importante per aumentare il senso di responsabilità verso questo edificio da parte dei seguenti attori sociali?

	Per niente	Poco	Abbastanza	Molto
Comunità				
Municipalità				
Associazioni locali				
Imprese locali				
Nuove generazioni				
Regione Veneto				

6.4 In quale misura ritiene che la partecipazione dei seguenti attori sociali possa consentire il corretto svolgimento dei lavori?

	Per niente	Poco	Abbastanza	Molto
Comunità				
Municipalità				
Associazioni locali				
Imprese locali				
Nuove generazioni				
Regione Veneto				

6.5 Quanto crede che le conoscenze locali possano essere d'aiuto per la buona riuscita del progetto? (ex: materiale presente sul territorio, caratteristiche naturali del luogo, etc.)

Per niente	Poco	Abbastanza	Molto

6.6 Quanto crede che, attraverso la partecipazione della comunità nel progetto, gli abitanti si sentiranno più responsabili in futuro delle “sorti” dell’edificio?

Per niente	Poco	Abbastanza	Molto

6.7 Quanto crede di essere coinvolta/o nel progetto?

Per niente	Poco	Abbastanza	Molto

6.8 Quanto è soddisfatta/o del Suo coinvolgimento nel progetto?

Per niente	Poco	Abbastanza	Molto

6.9 ***(Solo se alla domanda 6.8 ha indicato “Per niente” o “Poco”)*** potrebbe descrivermi brevemente quale sarebbe stata per Lei una migliore forma di partecipare al progetto? (approfondimenti sugli strumenti)

7 Dati demografici

7.1 Anni compiuti _____

7.2 Genere

- ☐ Maschio
- ☐ Femmina
- ☐ Altro
- ☐ Preferisco non rispondere

7.3 Livello di istruzione dell’intervistato

- ☐ Licenza elementare
- ☐ Licenza media
- ☐ Diploma di maturità (liceo, istituto tecnico, istituto professionale)
- ☐ Diploma di laurea

7.4 Da quante persone residenti qui è composto il nucleo familiare? _____

7.5 Numero di figli per età

Da 0 a 3 anni _____

Da più di 3 a 6 anni _____

Da più di 6 anni a 10 anni _____

Da più di 10 anni a 13 anni _____

Da più di 13 anni a 17 anni _____

Maggiorenni _____

7.6 Svolge un’attività lavorativa?

- ☐ Sì
- ☐ No

7.7 ***(solo se alla domanda 7.6 ha risposto “Sì”)*** Che tipo di professione svolge

- ☐ Managers (dirigente)
- ☐ Libera/o professionista

- Dipendente altamente qualificata/o (ingegnere/a, tecnico di laboratorio, etc.)
- Impiegata/o
- Addetto/a alle vendite e assistenza alle persone (cameriere/a, infermiere/a, etc.)
- Operaia/o specializzata/o in agricoltura, silvicoltura e pesca
- Operaia/o specializzata/o (muratore, idraulico, elettricista, etc.)
- Operaia/o di fabbrica e autista
- Manodopera non specializzata
- Forze armate
- _____

7.8 Fa parte di qualche associazione?

- Si
- No

7.9 (***solo se alla domanda 7.8 ha risposto "sì"***) Come si chiama/chiamano la/le associazione/i di cui fa parte e da quanti anni ne fa parte/è iscritta/o?

Associazione di appartenenza	Anni di appartenenza	Ruolo nell'associazione	Tipo di associazione

Desidera ricevere informazioni sullo sviluppo del progetto? SI NO e-mail_____

Il progetto SHELTER nasce dalle problematiche poste dall'abbandono e dal degrado degli edifici rurali storici nell'area trans-frontaliera italoaustriaca. Una questione significativa che ha conseguenze quali l'aumento del rischio idro-geologico e la diminuzione della biodiversità, la perdita di suolo produttivo e di un ricco patrimonio storico-culturale. Per contrastare queste criticità, il progetto mira a unire la conservazione degli edifici con lo sviluppo del paesaggio montano, recuperando casi esemplari di patrimonio in abbandono e inserendoli nella rete dei percorsi escursionistici e ciclo-turistici esistenti, coniugandoli alle attività associative e produttive locali. SHELTER partirà dalla base conoscitiva offerta dai progetti europei passati per il recupero sostenibile del patrimonio storico. Sperimentando questo know-how verranno realizzati interventi di recupero di edifici e percorsi per avviare nuove funzionalità del patrimonio e supportare lo sviluppo locale. In questo modo verranno definiti un repertorio costruttivo e un set d'indicatori per il patrimonio trans-frontaliero, che saranno diffusi fra le amministrazioni e le imprese tramite degli incontri con le associazioni di settore. In sintesi, il progetto elaborerà strumenti e sperimenterà lo sviluppo di nuove funzionalità per gli edifici rurali storici e il loro paesaggio, che ne sostenga la conservazione e l'utilizzo durevole nel contesto attuale.

1. Può parlarci di un ricordo legato al Col Ventidueore?
2. Che ruolo ha il Col Ventidueore per lei nella tua vita quotidiana?
3. Di solito passi del tempo al Col Ventidueore con la sua famiglia o con i suoi amici stretti?
4. Crede che il Col Ventidueore valorizzi la cultura e le tradizioni di questa comunità? In che modo?
5. Vengono svolte attività che permettono alle nuove generazioni di conoscere le tradizioni e la cultura del posto? (ex: scuola)

6. Ci sono attività particolari che si svolgono al Col Ventidueore o che si sono svolte in passato che attirano persone da fuori?
7. Può descrivere gli elementi naturali più importanti che caratterizzano questo luogo secondo lei?
8. Potrebbe descrivermi cosa sarebbe bello per lei venisse aggiunto/modificato/curato in questo luogo attraverso il progetto di ristrutturazione?

Project SHELTER originates from the problem represented by the abandonment and degradation of historic rural buildings in the Italian-Austrian cross-border area. A significant issue, that has such consequences as the increase of hydro-geological risk and the decrease of biodiversity, the loss of productive land and of a rich cultural heritage. To confront this problem, the project aims at joining the conservation of buildings with the development of the mountain landscape, recovering exemplary cases of abandoned heritage to insert in the existing network of hiking and cycling routes, combining it with local association and production activities. SHELTER will start from the knowledge base offered by past European projects for the sustainable recovery of historical rural heritage. Experimenting this know-how, infrastructure works will be implemented for the recovery of buildings and paths to support a new use of heritage and to sustain local development, accompanied by participation workshops with the population. In this way a catalogue of building solutions and a set of indicators will be defined, which will be disseminated between administrations and enterprises through meetings with sector and trade associations. In short, the project will develop tools and test new functionalities for the recovery historic rural buildings and their landscape, supporting their conservation and sustainable use in the current context.

1. Could you tell me a memory related to Col Ventidueore?
2. What is the role of Col Ventidueore in your daily life?
3. Do you usually spend time with your family or close friends in Col Ventidueore?
4. Do you think Col Ventidueore enhances culture and traditions? If so, how?
5. Are there activities at Col Ventidueore that enable the younger generations to learn about local traditions and culture?

6. Are there any particular activities taking place at Col Ventidueore or that have taken place in the past that attract people from outside?
7. Could you describe the most important natural aspects that characterise the Col Ventidueore?
8. Could you describe what you would like to see added/modified/corrected with the sustainable energy project?