Articles

Assessing the relevance of barriers to Energy Communities in Italy

Annamaria Bagaini[*], *Edoardo Croci*[**], *Alberto Mori*[***]

Abstract

Energy Communities (ECs) are increasingly recognised as key actors in the energy transition, combining renewable energy deployment with local participation and broader territorial benefits. In Italy, however, their diffusion remains limited, pointing to a persistent gap between policy ambition and implementation. The paper provides exploratory primary evidence on the perceived relevance of barriers affecting the development and operation of ECs in Italy and examines how barrier relevance varies across selected EC characteristics. The analysis is based on survey data collected from 26 representatives of Italian ECs and focuses on 26 individual barriers grouped into ten classes and four categories. The results show that *Institutional barriers* are perceived as the most relevant, followed by *Economic barriers*, *Socio-cultural and behavioural barriers*, and *Technical and technological barriers*. The findings also suggest that barrier relevance varies across territorial and organisational conditions, including geographic location, spatial context, maturity phase, and membership composition. Overall, the study contributes actor-specific evidence from the Italian context and indicates that more differentiated and context-sensitive policy approaches are needed to support the diffusion of ECs.

Keywords: energy communities, barriers, Italy, energy transition, policy design.

JEL classification: Q48, Q42, D58

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1. Introduction

The global energy system is undergoing a profound transformation, driven by the imperative to decarbonise energy production in response to climate change and environmental pressures. This transition entails overcoming long-standing dependence on fossil fuels while fostering new forms of energy production. Recent geopolitical disruptions reinforced this urgency, having increased the focus on energy autonomy and diversification. At the same time, technological progress in renewable energy sources (RES), declining costs of small-scale generation, and advances in energy storage systems are enabling increased decentralization of energy systems. Beyond emission reduction, this evolution reflects a broader ambition to redesign energy systems through the active involvement of citizens and local communities.

Within this evolving landscape, the European Union has articulated an ambitious policy framework. The European Green Deal (European Commission, 2019) set the climate neutrality by 2050, while the Fit for 55 package established a 55% GHG reduction target by 2030 compared to 1990 levels (European Commission, 2021). Directive (EU) 2023/2413 (RED III) introduced a binding 42.5% renewable energy target by 2030, building on Directive 2009/28/EC (RED I) and Directive (EU) 2018/2001 (RED II). In parallel, Directive (EU) 2019/944 (IEMD) strengthened the role of citizens and local actors in energy governance.

Within this policy framework, Renewable Energy Communities (REC) and Citizen Energy Communities (CEC), introduced by RED II and IEMD, have emerged as an innovative solution aimed at empowering local participation, promoting collective ownership of energy assets, and delivering environmental, social, and economic benefits. According to these directives, Energy Communities (ECs), including both configurations, are legal entities where citizens, private actors, and public authorities jointly organize energy production, consumption, and distribution, prioritizing the generation of collective values over purely financial returns. Participation is open and voluntary, and members retain access to competitive markets in both configurations. However, RECs are locally rooted and limited to RES, while CECs may operate at local or national levels and encompass any type of energy production (RED II; IEMD; Tarpani et al., 2022; Amin et al., 2025).

ECs play a multifaceted role in the energy transition by combining renewable energy deployment with territorial development and social participation. By enabling the aggregation of production and consumption across multiple users, ECs facilitate energy sharing beyond individual self-consumption and support decentralized grid balancing (Cotana *et al.*, 2025). Beyond their technical function, ECs embody collective ownership and participatory governance models that foster social cooperation, empower local actors, and allow shared benefits to be reinvested in social and energy-related initiatives, including actions to address energy poverty. Furthermore, ECs can provide additional services, such as demand response, storage management, aggregation, and educational initiatives (Cristóbal *et al.*, 2023).

Consistent with the broader European context, ECs are emerging as increasingly relevant in Italy due to abundant RES potential and a tradition of local energy cooperatives (Mori, 2013). More recently, the economic advantages of self-consumption and energy sharing have become increasingly salient for Italian households, a dynamic further reinforced by the Russian gas crisis and the growing interest in decentralized energy solutions.

Since 2019, Italy has progressively transposed EU directives through Decree-Law No. 162/2019, Legislative Decrees No. 199/2021 and No. 210/2021, and Ministerial Decree No. 414/2023 (CACER Decree), complemented by the Italian Regulatory Authority for Energy, Networks and Environment (ARERA) through the Integrated text for distributed self-consumption (ARERA, 2023). The Italian regulatory framework identifies three configurations: (i) collective self-consumption, (ii) distant individual self-consumption, and (iii) Renewable Energy Communities (RECs). A collective self-consumption configuration consists of a group of RES consumers located in the same building, which self-consume and share the electricity generated by their own plants through a private-law agreement. Distant individual self-consumption refers to a configuration in which a single final customer self-consumes electricity generated by RES plants located off-site with respect to the consumption point. All injection and withdrawal points are held by the same final customer and connected to the same primary cabin. Finally, the REC is defined as a legal entity whose members are located within the area served by the same primary cabin and may include natural persons, small and medium-sized enterprises (for which participation in the REC does not constitute the primary activity), associations, local administrations, etc.[1] These actors collectively share energy generated by the community's facilities. The primary purpose of a REC is not financial profit but rather the generation of environmental, economic, and social benefits for its members, shareholders, and the local community. The present study focuses exclusively on the REC configuration, hereafter referred to as EC for consistency.

Within the Italian regulatory framework, the EC incentive mechanisms consist of multiple components: remuneration for reduced grid use; a 20-year feed-in premium for renewable energy generated and shared on an hourly basis among EC members; capital grants covering up to 40% of RES investment costs in municipalities under 50,000 inhabitants; and a guaranteed withdrawal and remuneration of electricity managed by the Italian Energy Services Operator (*Gestore dei Servizi Energetici*, GSE).

Supported by this evolving regulatory and financial context, ECs in Italy have experienced steady growth since 2020. Active ECs increased from 21 in 2022 (0.407 MW; 160 users) to 597 in September 2025 (68 MW; 5,508 users) (GSE, 2022, 2025). However, the National Energy and Climate Plan targets 7 GW from ECs by 2030 (5 GW by 2027) within a broader 131 GW RES objective (Italian Ministry of the Environment and Energy Security, 2023). This target appears increasingly challenging to achieve given the current state of implementation. Despite recent progress, the development of ECs in Italy remains largely at a pilot stage. Their large-scale diffusion continues to be hindered by regulatory uncertainty, administrative complexity, financial constraints, and socio-cultural barriers.

The Italian academic literature has extensively examined the barriers hindering the development and operation of ECs, mostly focusing on specific categories such as regulatory (Campos *et al.*, 2020; Bonifazi *et al.*, 2022; Barbaro and Napoli, 2024), administrative (Moretti and Stamponi, 2023; Costa and Campanini, 2024), market (Delicado *et al.*, 2023), and socio-cultural barriers (Basilico *et al.*, 2025). Other studies have attempted to classify broader sets of EC barriers, but they remain predominantly descriptive and offer limited insight into the relevance of different barriers

[1] Social housing organisations, public welfare and charitable institutions, publicly owned service companies, land reclamation consortia, research and training institutions, religious bodies, third-sector organisations, environmental associations.

(Ceglia *et al.*, 2022; De Lotto *et al.*, 2022; Sarcina and Canesi, 2023; Tatti *et al.*, 2023; Khorrami *et al.*, 2025). Only a small number of studies quantitatively assess the relevance of barriers to the development of ECs in the Italian context. Caferra *et al.* (2024) rank barriers based on surveys of electricity consumers and expert evaluations, identifying administrative and financial barriers as the most critical, but without drawing on primary evidence from ECs themselves. Dioba *et al.* (2024) adopt a broader stakeholder approach and report institutional barriers as the most critical for Italy; however, the aggregation of highly heterogeneous respondents prevents the identification of which stakeholders consider specific barriers most relevant. Moreover, recent literature highlights the importance of assessing the relevance of barriers in relation to specific EC characteristics (De Franco *et al.*, 2023). This is particularly crucial in Italy, where ECs operate across diverse legal forms, spatial contexts, ranging from urban to rural areas (De Lotto *et al.*, 2022; Barbaro and Napoli, 2023; Shi *et al.*, 2024), and socio-economic environments, compounded by marked regional disparities (Sciullo *et al.*, 2021; Musolino *et al.*, 2023). A systematic analysis of how EC characteristics affect barrier relevance is still lacking.

This paper addresses these gaps by pursuing two objectives. First, it assesses the relevance of EC barriers, drawing on primary survey data from ECs across Italy. Second, it examines how barrier relevance varies according to EC characteristics, including the number of members, membership composition, geographical location, spatial context, installed capacity, and maturity phase. In doing so, the study contributes to the literature in two ways. First, it provides actor-specific evidence on barrier salience directly from EC representatives. Second, it explores whether perceived barrier relevance differs across selected territorial and organisational characteristics of ECs, thereby informing more differentiated policy design.

The paper is structured as follows. Section 2 describes the methodology and survey design. Section 3 presents the survey results on barrier relevance and its variation across EC characteristics. Section 4 discusses the findings in relation to existing literature and the policy implications. Section 5 concludes by outlining the key findings, the study's limitations, and directions for future research.

2. Methods

This study adopts a quantitative survey design to quantify the relevance of a list of barriers to the development and operation of ECs in Italy, as perceived by EC representatives.

2.1. Barrier Classification

First, a comprehensive list of the main barriers was developed. This list was derived from a semi-structured literature review aimed at identifying academic papers and technical reports that provide in-depth analyses of barriers to the development and operation of ECs. To ensure the inclusion of studies that explicitly focus on EC-related barriers, searches were conducted exclusively within author keywords in Scopus and Web of Science, as these databases are widely recognized as the most comprehensive and authori-

tative, and their combined coverage ensures broad representation of peer-reviewed literature. The following search string was applied:

("Energy communit*" OR "Community energy" OR "Local Energy Communit*" OR "Renewable Energy Communit*" OR "Energy Cooperative*" OR "Citizen Energy Communit*" OR "Renewable Energy Cooperative*" OR "Community Renewable Energy" OR "Smart Energy Communit*" OR "Community Solar" OR "Solar Communit*") AND ("Barrier*" OR "Obstacle*" OR "Challenge*" OR "Hurdle*" OR "Constraint*" OR "Hindering factor*").

The search was limited to studies published between 2014 and 2024 in order to avoid outdated findings. In total, 1037 papers were retrieved from the searches. Following a detailed examination of their content, only review papers and technical reports that had conducted a comprehensive collection and review of EC barriers, and that provided explicit barrier lists, were retained, resulting in 26 contributions. In addition, six relevant reports from EU-funded projects and European public agencies were identified through complementary searches in Google Scholar. Overall, 32 sources were analysed to identify barriers to EC development. Because the terminology used to describe EC barriers varies considerably across studies, a terminological harmonisation process was conducted to merge synonymous terms into a unified and comprehensive list of barriers. In total, 26 distinct barriers were identified and organised within a three-level hierarchical framework comprising categories, classes, and individual barriers, structured according to thematic coherence. At the upper level, categories encompass broad groups of barriers sharing common structural or functional dimensions. In total four categories (*Economic, Institutional, Technical and technological,* and *Socio-cultural and behavioural barriers)* have been identified (Bagaini *et al.*, 2020; Caferra *et al.*, 2024; Dioba *et al.*, 2024; Khorrami *et al.*, 2025). Each category includes multiple classes, which group barriers referring to associated topics. In total, ten classes have been identified. At the lowest level, the 26 individual barriers represent specific obstacles encountered by ECs during their development and operation. The list of categories, classes, and individual barriers, and their related recurrence and references, is reported in Table A.1 (Appendix A).

2.2. Survey Design

Building on this framework, a structured survey was designed, consisting of two thematic sections: (i) characteristics of ECs, and (ii) barrier relevance assessment. The first section included thirteen closed-ended questions collecting information on EC characteristics, such as geographical location and spatial context (urban or rural setting), year of establishment, development phase, number of members, types and roles of members, legal form, activities undertaken, installed capacity, and sources of revenue. These characteristics were included in the survey to profile the respondent ECs, as previous studies have identified them as relevant to EC development (Musolino *et al*., 2023; Sciullo *et al*., 2021; De Franco *et al*., 2023; Tatti *et al*., 2023; De Lotto *et al*., 2022), while also being readily available to EC respondents. The second section consisted of ten closed-ended questions, each corresponding to one of the identified barrier classes, and focused on assessing the perceived relevance of individual barriers within each class. The relevance of each individual barrier was rated on a six-point Likert scale (0–5), where 0 indicated the absence of, or insufficient information to evaluate the barrier, and 5 indicated very high relevance (Okunbanjo *et al*., 2024; Kusmaryono and Wijayanti, 2022). The survey was administered via the Qualtrics platform. The survey questionnaire is pre-

sented in Appendix B. All responses were anonymized, and no sensitive or personal data were collected.

The survey targeted representatives of Italian ECs, defined as individuals with managerial or organisational responsibilities and access to technical, administrative, or financial information. Contacts were retrieved from ECs' official websites, identified through the REScoop[2] and IFEC (Italian Forum of Energy Communities)[3] databases (REScoop.eu, n.d.; World Energy Council Italia, n.d.), and complemented with institutional lists of ECs made available by GSE[4] (2025) and RSE[5] (2024). No restrictions were imposed on the selection of ECs concerning their scale, number of members, technologies adopted, energy sources, legal form, or year of establishment.

Survey data were collected over a nine-month period, from October 2024 to June 2025. The survey invitation was distributed in five email rounds. Reminders were issued to mitigate the low initial response rate. A total of 130 Italian ECs were contacted, 121 via email and 9 via web forms. This list should not be interpreted as a census of Italian ECs active at the time of the survey, but rather as the subset of ECs for which contact details could be retrieved through public databases, institutional lists, official websites, and other publicly accessible channels. In the Italian context, this constitutes a significant practical limitation, as EC contact information is often incomplete or not publicly available. In addition, the survey was promoted through social media, including three LinkedIn posts (published in November and December 2024 and May 2025, generating 3, 11, and 10 reposts, respectively), one Instagram post (April 2025), and one X post (April 2025, with one repost).

A total of 26 complete responses were obtained, corresponding to a response rate of approximately 20%. Despite the limited number of responses, the dataset is considered robust, as six of the responding entities were umbrella organisations, defined here as legal entities that support, coordinate, or manage multiple EC configurations across Italy rather than representing a single EC. These organisations provided consolidated responses that capture the experiences of the broader networks they coordinate, thereby enhancing the empirical representativeness of the survey.

3. Results

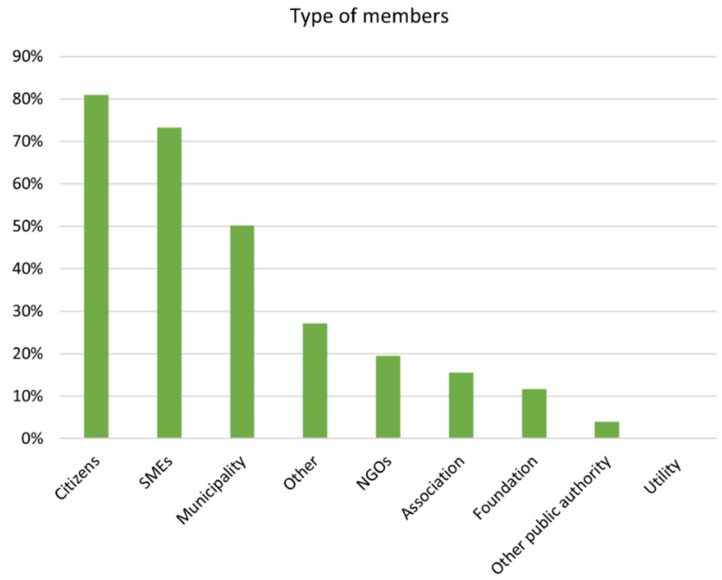
3.1. Sample Description

The sample includes ECs operating across different spatial and geographical contexts. Specifically, 60% of the surveyed ECs are located in urban areas, while 40% in rural settings. The majority of ECs (65%) are based in Northern Italy (Fig. C.1, Appendix C). In the sample, 73% of the ECs were established after 2020, particularly in 2021 (15%), 2023 (23%), and 2024 (42%), reflecting the recent emergence of ECs following targeted policy interventions introduced in Italy from 2019.

[2] https://www.rescoop.eu/network
[3] https://www.wec-italia.org/IFEC
[4] https://www.gse.it/servizi-per-te/autoconsumo/elenco-delle-configurazioni
[5] https://geoportale.rse-web.it/#/viewer/openlayers/769

The majority of ECs (62%) comprise fewer than 50 members, while 27% fall within the range of 50 to 200 members, and 12% exceed 200 members. Regarding membership composition (Fig. 1), citizens (81%) and Small and Medium Enterprises (SMEs, 73%) are the most frequently represented actors, followed by municipalities (50%). NGOs (19%), associations (15%), foundations (12%), and other public authorities (4%) are represented to a lesser extent. Utilities are not represented among the respondents, as Italian legislation excludes large enterprises and entities primarily involved in the production, transmission, distribution, or trading of electricity (Legislative Decree No. 199/2021; Ministerial Decree No. 414/2023). Regarding the roles of members[6] (Directive (EU) 2018/2001; Directive (EU) 2019/944; Legislative Decree No. 199/2021), ECs predominantly include consumers (88%) and prosumers (85%), while smaller shares involve producers (27%), promoters (19%), managers (15%), and aggregators or service providers (12%; Fig. C.2, Appendix C).

Figure 1 – Distribution of surveyed ECs by type of members



Most ECs rely on photovoltaic (PV) generation (88%), with limited use of other RES, including solar thermal energy, wind power, and hydropower (4% each). Additionally, 8% of ECs report no energy production, as they are in an early development phase and no energy production plant has been realised yet, and 4% did

[6] Consumers: members primarily consuming community-generated energy. Prosumers: members generating, self-consuming, and sharing renewable energy. Producers: actors operating renewable energy systems. Aggregators: entities coordinating members' production and demand for collective market or grid interaction. Promoters/Facilitators: actors supporting community establishment and engagement. Managers: entities responsible for daily operations and regulatory compliance. Providers: actors supplying technologies, platforms, and services.

not provide a response. In terms of installed PV capacity, 43% operate systems below 200 kW, 34% between 200 kW and 1 MW, and 13% exceed 1 MW (Fig. 2). In the sample, the most common legal form[7] (Italian Civil Code, 1942; Legislative Decree No. 112/2017) is the non-profit organisation (69%; of which 31% are associations), followed by cooperative (23%), social enterprise (12%; of which 67% are also cooperatives), and limited partnership (4%). The principal activities[8] include energy sharing (85%), self-consumption (69%), and energy production (54%) (Fig. C.3, Appendix C). In addition, 27% of ECs reported undertaking other, unspecified activities. A marginal share engages in energy services, electric vehicle (EV) services, energy supply, or energy distribution. ECs rely on multiple revenue sources[9], but primarily on public incentives (69%), followed by donations, membership fees, and energy sales (31% each) (Fig. C.4, Appendix C). Energy service fees, EV service fees, and revenues from other activities are marginal. Lastly, ECs in the sample are relatively evenly distributed across maturity phases[10]: development phase (35%), operation and management phase (38%), and evaluation and expansion phase (27%).

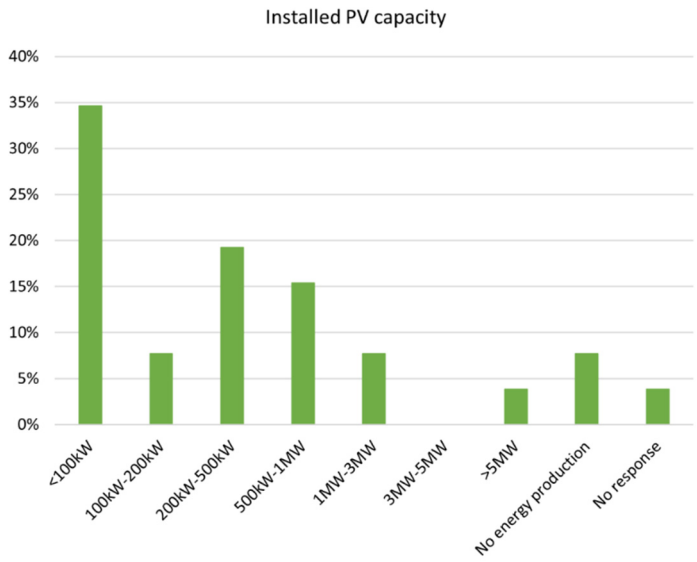
[7] Non-profit organization: entity pursuing general-interest purposes and barred from profit distribution. Association (Associazione): non-profit legal entity based on democratic member participation. Cooperative (Società cooperativa): member-owned entity with a mutualistic purpose and limited profit distribution. Limited partnership (Società in accomandita semplice, S.a.s.): partnership with general partners bearing unlimited liability and management powers, and limited partners liable only up to their capital contribution. Social enterprise (Impresa sociale): private entity conducting economic activities of general interest, subject to profit-distribution constraints.

[8] Energy production: generation of energy for community use. Self-consumption: members' consumption of community-produced energy. Energy sharing: exchange of surplus energy among members. Energy supply: provision of energy to meet members' demand. Energy distribution: ownership and/or management of energy distribution infrastructures. Energy services: renovation, auditing, demand response, storage, and energy management. E-mobility: integration of electric vehicles and charging infrastructure. Other activities: consultancy, information and awareness-raising, and measures addressing energy poverty.

[9] Public incentives: government financial mechanisms supporting ECs. Donations: voluntary contributions financing EC projects. Membership fees: one-off or recurring contributions by members. Energy sales: revenues from surplus electricity sold to the market or external actors. Energy service fees: income from services such as demand response, storage operation, and aggregation. EV service fees: revenues from EV charging services and e-mobility services.

[10] Development phase: initial stage involving concept design, strategic planning, and technical-economic feasibility assessment. Operation and management phase: operational stage involving day-to-day organizational, administrative, and managerial activities. Evaluation and expansion phase: post-implementation stage devoted to performance assessment, improvement, and the development of new initiatives.

Figure 2 – Distribution of surveyed ECs by installed PV capacity



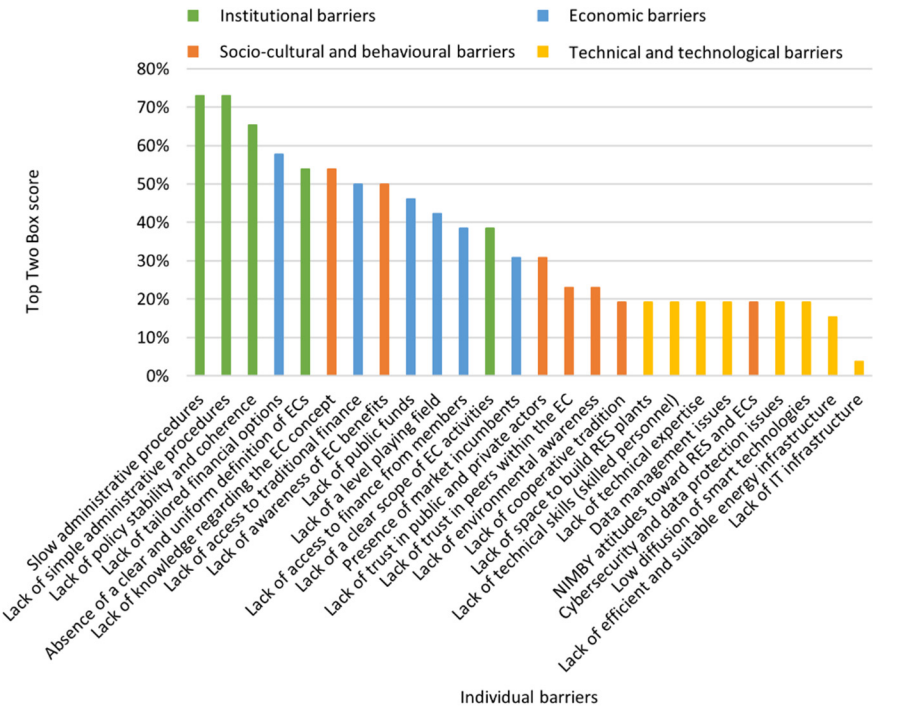
3.2. Assessment of Barrier Relevance

The relevance of the 26 individual barriers, grouped into ten classes and four overarching categories (Table A.1), was assessed employing the Top Two Box score (Sullivan and Artino, 2013; Koo and Yang, 2025). This metric represents the percentage of ECs in the sample that rated each individual barrier as having High Relevance (4) or Very High Relevance (5) on a six-point Likert scale (0–5). Class and category scores were computed as the average of the Top Two Box scores of their individual barriers.

Results indicate that *Institutional barriers* are perceived as the most relevant category for ECs in the sample (score of 61%), followed by *Economic* (44%), *Socio-cultural and behavioural* (31%), and finally *Technical and technological barriers* (17%).

Fig. 3 provides a comprehensive overview of the findings, ranking the 26 individual barriers according to the Top Two Box scores they achieved, colour-coded by category.

Figure 3 – Individual barriers ranked by Top Two Box score. The Top Two Box score indicates the proportion of ECs rating each barrier as having High or Very High Relevance on a six-point Likert scale. Individual barriers are color-coded by category: green for Institutional barriers; blue for Economic barriers; orange for Socio-cultural and behavioural barriers; yellow for Technical and technological barriers



Within the *Institutional barriers* category, the *Administrative and bureaucratic barriers* class (73%) exceeds the *Policy and regulatory barriers* class (53%). Within the first class, *Slow administrative procedures* and *Lack of simple and clear administrative procedures* are considered equally relevant (73%). In the *Policy and regulatory barriers* class, *Lack of policy stability and coherence* (65%) ranks highest, followed by A*bsence of a clear and uniform definition of ECs* (54%) and *Lack of a clear scope of EC activities* (38%).

Within the *Economic barriers* category, the *Financial barriers* class (48%) is perceived as more relevant than the *Market barriers* class. In the first class, *Lack of tailored financial options* (58%) and *Lack of access to traditional finance* (50%) emerge, followed by *Lack of public funds* (46%), and *Lack of access to finance from members* (38%). Within the *Market barriers* class, the *Lack of a level playing field* (42%) prevails over the *Presence of market incumbents* (31%).

Within the *Socio-cultural and behavioural barriers* category, the *Lack of knowledge and awareness* class (52%) outweighs the *Lack of trust* class (27%) and the *Lack of socio-cultural conditions* class (21%). In the first class, *Lack of knowledge*

regarding the EC concept (54%) and *Lack of awareness of EC benefits* (50%) emerge as similarly relevant. Within the *Lack of trust* class, *Lack of trust in public and private actors* (31%) exceeds *Lack of trust in peers within the EC* (23%). Within the *Lack of socio-cultural conditions* class, *Lack of environmental awareness* (23%) ranks above *Lack of cooperative tradition* (19%) and *NIMBY*[11] *attitudes* (19%).

Within the *Technical and technological barriers* category, the *Technical barriers* and the *Lack of enabling technologies* classes both score 19%, while the *Lack of efficient infrastructure* scores 10%. In the first class, *Lack of technical skills*, *Lack of technical expertise*, and *Lack of space to build RES plants* each score 19%. Within the *Lack of enabling technologies* class, a 19% score was attributed to the *Low diffusion of smart technologies*, *Data management issues*, and *Cybersecurity and data protection issues*. Finally, within the *Lack of efficient infrastructure* class, *Lack of efficient and suitable energy infrastructure* (15%) exceeds *Lack of IT infrastructure* (4%).

3.3. Variation in barrier relevance across EC characteristics

The variation in barrier relevance across EC characteristics was analysed based on a set of characteristics derived from the survey, including geographic location, spatial context, maturity phase, number of members, installed PV capacity, and the presence of SMEs or municipalities among members. Respondents self-classified their ECs by selecting among predefined options (e.g., ranges of installed PV capacity or number of members), subsequently used as comparison groups. Within these, the Top Two Box scores for each individual barrier were calculated and compared. This approach enables the identification of broad patterns in barrier perception across different ECs and highlights segments that may require differentiated forms of policy intervention or technical support. The results of these comparisons are visually represented through heatmaps. Given the limited sample size and the uneven distribution of observations across comparison groups, this analysis is exploratory and intended to identify descriptive patterns rather than statistically validated group differences.

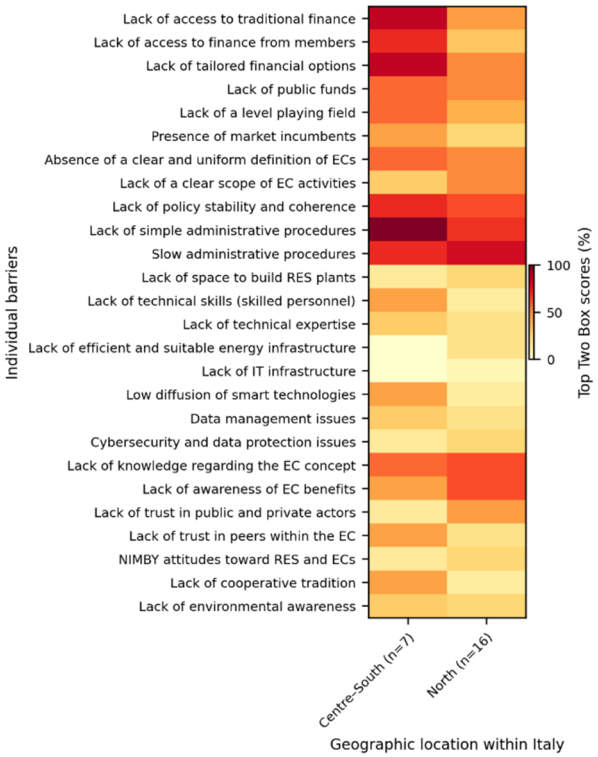
3.3.1. Barrier relevance across geographical locations

For the analysis of variation in barrier relevance across geographic locations in Italy, the conventional aggregation of Italian regions into Centre-South and North was adopted. The results reveal a clear territorial asymmetry, with ECs in the Centre–South systematically perceiving higher barrier relevance (Fig. 4), particularly for *Institutional barriers* (namely *Lack of simple and clear administrative procedures* and *Lack of policy stability and coherence*) and *Economic barriers* (namely *Lack of tailored financial options* and *Lack of access to traditional finance*). Similarly, southern ECs perceive as more relevant some *Socio-cultural and behavioural barriers* (particularly *Lack of trust in peers within the EC*, *Lack of cooperative tradition*, and *Lack of environmental awareness*) and *Technical and technological barriers* (including *Lack of technical skills* and *Low diffusion of smart technologies*). In contrast, Northern ECs

[11] Not In My Backyard.

express greater concern over *Slow administrative procedures*, specific *Socio-cultural and behavioural barriers* (including *Lack of knowledge regarding the EC concept*, *Lack of awareness of EC benefits*, and *Lack of trust in public and private actors*), and *Technical and technological barriers* related to *Lack of efficient infrastructure* class. Overall, geographical context appears to play a significant role in shaping the barriers faced by ECs. While the relevance of barriers is generally amplified in Southern ECs, Northern ECs are characterized by lower levels of knowledge and awareness regarding the EC concept and reduced infrastructural preparedness.

Figure 4 – Heatmap. Top Two Box scores (%) of individual barriers by geographic location within Italy. The Top Two Box score indicates the proportion of ECs rating each barrier as having High or Very High Relevance on a six-point Likert scale

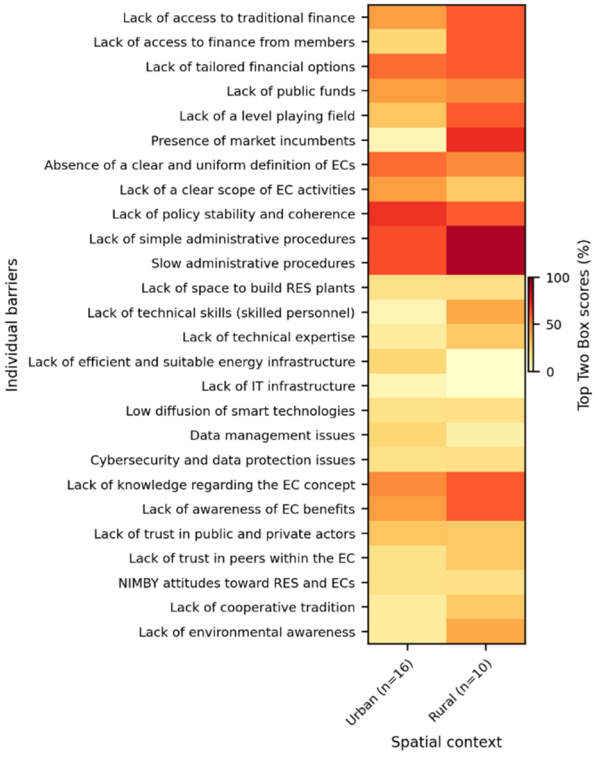


3.3.2. Barrier relevance across spatial contexts

Regarding spatial context, the results indicate that ECs in rural areas consistently report higher overall barrier relevance than those in urban areas (Fig. 5). In rural areas, *Institutional* and *Economic barriers* are more relevant, notably the *Lack of simple and clear administrative procedures*, *Slow administrative procedures*, and the *Presence of*

market incumbents. *Socio-cultural and behavioural barriers* are also more pronounced, especially the *Lack of knowledge regarding the EC concept*, the *Lack of awareness of EC benefits*, and, to a lesser extent, the *Lack of environmental awareness*. Within *Technical and technological barriers*, rural ECs highlight the *Lack of technical skills*. By contrast, urban ECs assign greater relevance to *Lack of policy stability and coherence* and *Absence of a clear and uniform definition of ECs*. Overall, the rural context appears to amplify the relevance of all identified barriers, underscoring the need for comprehensive support structures. Conversely, urban ECs are particularly hindered by policy uncertainty, which may stem from the higher concentration of competing interests in land and resource use and the consequent complexity and variability of regulatory requirements.

Figure 5 – Heatmap. Top Two Box scores (%) of individual barriers by spatial context. The Top Two Box score indicates the proportion of ECs rating each barrier as having High or Very High Relevance on a six-point Likert scale

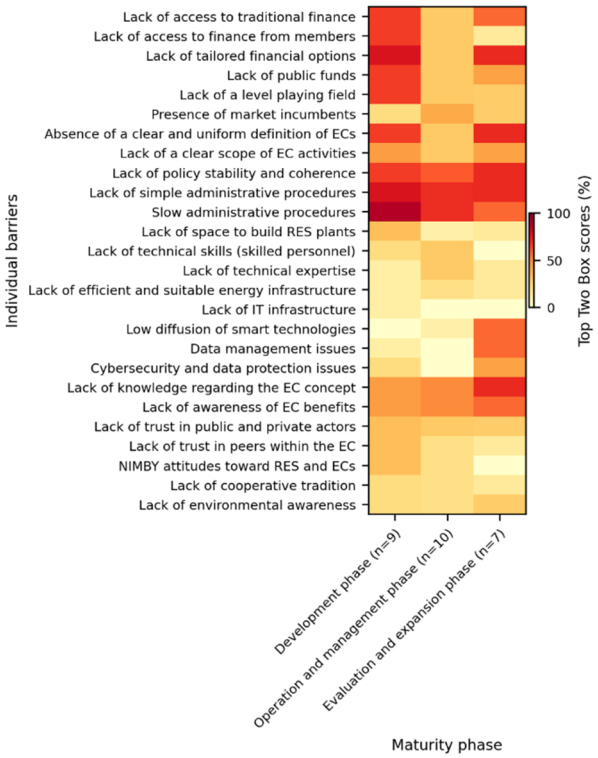


3.3.3. Barrier relevance across maturity phases

The results reveal variations in barrier relevance across maturity phases (Fig. 6). ECs in the development phase report considerably high *Economic barriers*, espe-

cially *Lack of tailored financial options*, *Institutional barriers*, most notably *Slow administrative procedures*, and barriers related to *Lack of trust in public and private actors*, *Lack of trust in peers within the EC*, and *Lack of space to build RES plants*. ECs in the operation and management phase report the lowest overall relevance of barriers. ECs in the evaluation and expansion phase instead emphasise the *Lack of tailored financial options*, *Low diffusion of smart technologies*, *Data management issues*, and the *Lack of knowledge regarding the EC concept*. Overall, the most significant challenges for ECs arise during the development phase, particularly in relation to accessing financial resources, navigating administrative procedures, and fostering trust within the community. During the expansion phase, the key challenges shift toward technological advancement and the acquisition of additional financial resources.

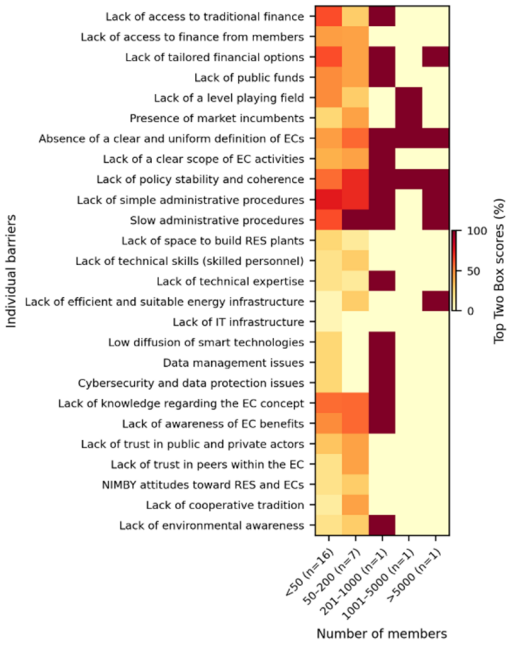
Figure 6 – Heatmap. Top Two Box scores (%) of individual barriers by maturity phase. The Top Two Box score indicates the proportion of ECs rating each barrier as having High or Very High Relevance on a six-point Likert scale



3.3.4. Barrier relevance across EC sizes

The results on the variation in barrier relevance across different member size categories (Fig. 7) indicate that small ECs (fewer than 50 members) primarily encounter *Economic barriers*, particularly *Lack of access to traditional finance* and *Lack of tailored financial options*, alongside *Institutional barriers* such as *Lack of simple and clear administrative procedures*. For medium-sized ECs (50–200 members), *Institutional barriers*, notably *Slow administrative procedures*, gain relevance, together with *Socio-cultural and behavioural barriers*, including *Lack of trust in public and private actors*, *Lack of trust in peers within the EC*, and *Lack of cooperative tradition*. Larger ECs (more than 200 members) attribute relevance to a narrower set of barriers: primarily *Institutional barriers* (particularly *Policy and regulatory barriers*), and, to a lesser extent, *Economic barriers*, selected *Technical and technological barriers* (mostly within the class of *Lack of enabling technologies*), and selected *Socio-cultural barriers* (*Lack of knowledge and awareness*). In particular, the largest ECs (over 5,000 members) consider all *Institutional barriers* to be highly relevant. Conversely, within *Economic barriers*, they identify only the *Lack of tailored financial options* as relevant, and, within *Technical and technological barriers*, relevance is assigned exclusively to the *Lack of efficient and suitable energy infrastructure*. Overall, the size of the EC determines the barriers encountered, as smaller ECs face economic and administrative issues, medium ECs face a lack of trust and administrative slowness, and larger ECs face technical and technological problems, and a lack of policy and regulatory clarity.

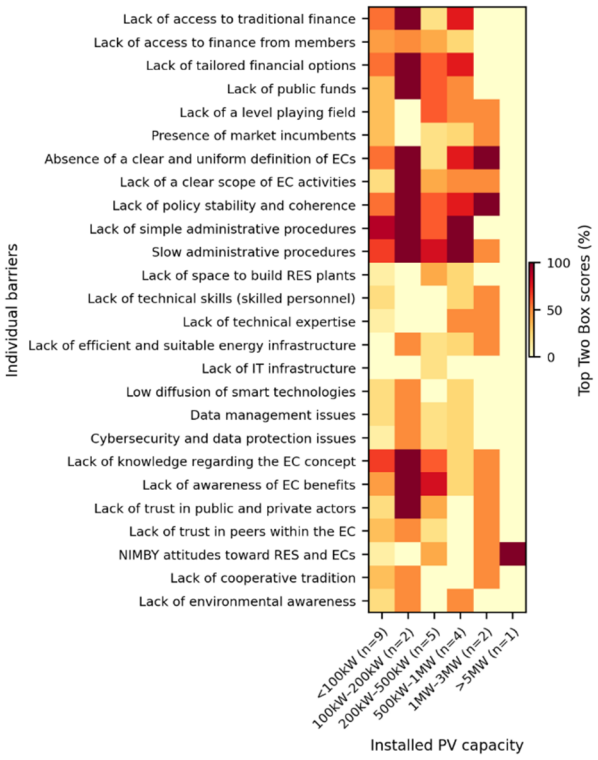
Figure 7 – Heatmap. Top Two Box scores (%) of individual barriers by number of members. The Top Two Box score indicates the proportion of ECs rating each barrier as having High or Very High Relevance on a six-point Likert scale



3.3.5. Barrier relevance across installed PV capacity levels

The results on the variation in barrier relevance across installed PV capacity levels (Fig. 8) show that *Socio-cultural and behavioural* and *Institutional barriers* display similar levels of relevance across capacity levels. ECs operating below 1 MW encounter more relevant *Economic barriers*, together with *Low diffusion of smart technologies*, *Data management issues*, and *Cybersecurity and data protection issues*. By contrast, ECs above 1 MW emphasise *Technical and technological barriers*, including *Lack of technical skills*, *Lack of technical expertise*, and *Lack of efficient and suitable energy infrastructure*. The only EC above 5 MW attributes relevance exclusively to *NIMBY attitudes*. Overall, greater PV capacity poses technical challenges and social acceptance issues, whereas lower PV capacity is associated with financial constraints and limited technological availability, underscoring the need for differentiated support.

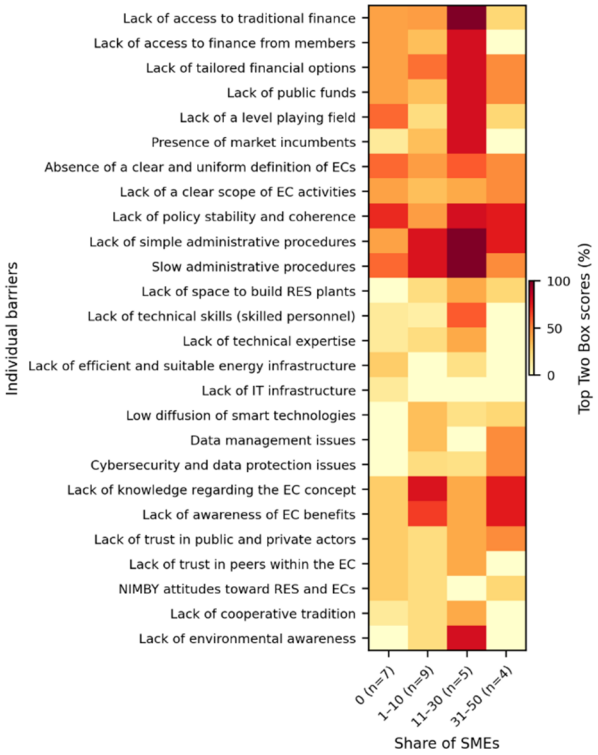
Figure 8 – Heatmap. Top Two Box scores (%) of individual barriers by installed PV capacity. The Top Two Box score indicates the proportion of ECs rating each barrier as having High or Very High Relevance on a six-point Likert scale



3.3.6. Barrier relevance across SME membership shares

The results show moderate variation in barrier relevance across the share of SMEs among members (Fig. 9). ECs without SMEs emphasise the *Lack of efficient and suitable energy infrastructure* and the *Lack of IT infrastructure*. ECs including SMEs assign greater relevance to *Slow administrative procedures*, *Lack of simple and clear administrative procedures*, *Lack of knowledge regarding the EC concept*, and *Lack of awareness of EC benefits*. They also report *Technical and technological barriers*, namely *Low diffusion of smart technologies*, *Data management issues*, and *Cybersecurity and data protection issues*. ECs with 11–30% SME participation display the highest relevance for both *Economic* and *Institutional barriers*. Overall, the presence of SMEs appears to increase barrier relevance, suggesting the need for more targeted support in mixed-member ECs.

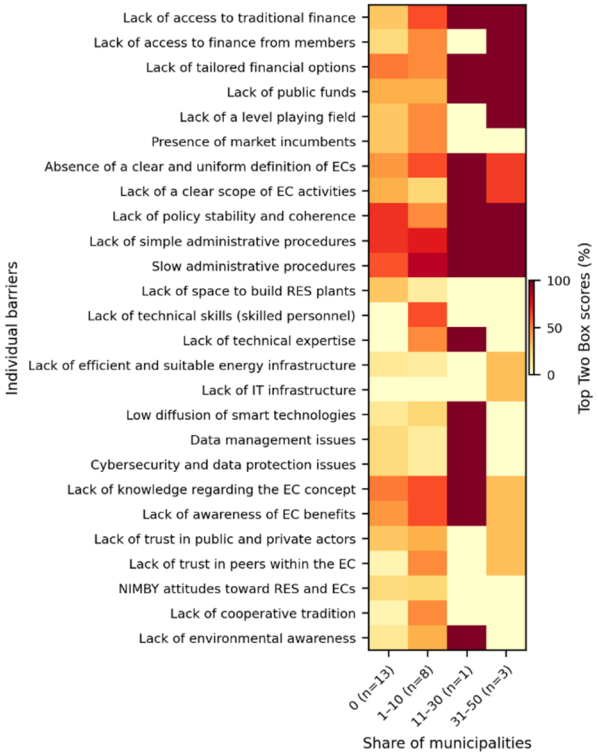
Figure 9 – Heatmap. Top Two Box scores (%) of individual barriers by share of SMEs. The Top Two Box score indicates the proportion of ECs rating each barrier as having High or Very High Relevance on a six-point Likert scale



3.3.7. Barrier relevance across municipality membership shares

The results on the variation in barrier relevance across the share of municipalities among members show a progressive increase in the relevance of *Institutional* and *Economic barriers* as municipal participation rises (Fig. 10). By contrast, when municipalities account for more than 10% of membership, ECs no longer report relevance for *Presence of market incumbents*, *Lack of technical skills*, *Lack of space to build RES plants*, *NIMBY attitudes*, and *Lack of cooperative tradition*. Overall, municipal involvement appears to have a dual effect: it amplifies *Economic* and *Institutional barriers* while mitigating several *Technical and technological*, and *Socio-cultural and behavioural barriers*, likely due to municipalities' role in facilitating project feasibility and social acceptance. These findings suggest a partial shortfall in municipalities' expected role as EC promoters and facilitators (Barbaro and Napoli, 2023; De Franco *et al.*, 2023; Losada-Puente *et al.*, 2023; Moretti and Stamponi, 2023; Musolino *et al.*, 2023; Tatti *et al.*, 2023).

Figure 10 – Heatmap. Top Two Box scores (%) of individual barriers by share of municipalities. The Top Two Box score indicates the proportion of ECs rating each barrier as having High or Very High Relevance on a six-point Likert scale



In conclusion, the results reveal a clear ranking of barriers affecting ECs in Italy, with *Institutional barriers* emerging as the most relevant, followed by *Economic*, *Socio-cultural*, and *Technical and technological barriers*. At the same time, the findings demonstrate that barrier relevance is highly context-dependent and varies substantially across EC characteristics and operating environments. Three broad patterns emerge. First, geographical and territorial factors play a key role, with Southern and rural ECs facing generally higher barrier intensity, while Northern and urban ECs experience more specific challenges related to awareness, infrastructural readiness, and policy clarity. Second, barriers evolve throughout the EC lifecycle, with financial, administrative, and trust-related constraints being particularly critical during the development phase, and technological and funding needs becoming more prominent during expansion. Third, organizational features, including community size, PV capacity, and membership composition, significantly shape the nature and severity of perceived barriers. These findings suggest that ECs should be treated according to their substantially different barrier profiles, rather than as a homogeneous category, and highlight the need for differentiated policy and support measures. The following discussion examines these patterns in light of the existing Italian and international literature on EC barriers and explores their implications for policy design.

4. Discussion

Despite extensive research on barriers to ECs in Italy, limited evidence exists on which barriers are perceived as most relevant by EC actors themselves and on whether barrier relevance varies across different territorial and organisational settings. This study addresses that gap by drawing on primary survey evidence from EC representatives and by assessing the relevance of 26 individual barriers, grouped into ten classes and four categories, i.e., *Economic*, *Institutional*, *Technical and technological*, and *Socio-cultural and behavioural barriers*. This analytical framework reflects the heterogeneity of barriers widely discussed in the literature and provides a structured basis for examining their relative relevance from the perspective of EC actors (De Lotto *et al.*, 2022; Barbaro and Napoli, 2024; Dioba *et al.*, 2024; Shi *et al.*, 2024; Khorrami *et al.*, 2025). The findings indicate that the main constraints are concentrated in the institutional and economic domains, pointing not only to informational deficits or technical bottlenecks, but more fundamentally to high transaction costs, regulatory uncertainty, and limited access to suitably designed financing and market arrangements. More specifically, *Institutional barriers* are perceived by ECs as the most relevant category, followed by *Economic*, *Socio-cultural and behavioural*, and, lastly, *Technical and technological barriers*. This ranking is consistent with existing national-level evidence. Dioba *et al.* (2024) identify regulatory, bureaucratic, and financial obstacles as the most critical barriers in the Italian context, while Caferra *et al.* (2024) likewise show that institutional barriers play a more decisive role than economic ones.

Within *Institutional barriers*, *Slow administrative procedures* and *Lack of simple and clear administrative procedures* emerge as the most relevant, in line with previous studies (Sciullo *et al.*, 2021; Barbaro and Napoli, 2023; Moretti and Stamponi, 2023; Khorrami *et al.*, 2025). ECs in Italy must comply with grid connection proce-

dures and obtain multiple authorisations. The process is frequently prolonged due to requirements related to spatial planning, environmental protection, or sector-specific norms, and due to the involvement of multiple poorly coordinated public authorities (Franco and Casanova, 2023). A step toward administrative simplification was taken with Decree-Law No. 175/2025, which clarified the criteria for identifying suitable areas for RES development, limiting the regional role.

The third highest-ranked barrier is the *Lack of policy stability and coherence*, reflecting the incremental and evolving nature of Italy's EC regulatory framework since 2019. While typical of emerging policy fields, this evolution has generated uncertainty for EC promoters, particularly regarding public funding, as illustrated by the 2025 reduction in allocated resources (Italian Ministry of the Environment and Energy Security, 2025). Multi-level governance incoherence and regional disparities in support schemes further exacerbate this uncertainty (Bonifazi *et al.*, 2022; Khorrami *et al.*, 2025).

Among *Economic barriers*, *Financial barriers* emerge as the most relevant, particularly the *Lack of tailored financial options*, in line with Barbaro and Napoli (2024), and the *Lack of access to traditional finance*. ECs remain largely dependent on public funding to cover high upfront RES investment costs (Bonifazi *et al.*, 2022; Barbaro and Napoli, 2023), while their small scale, innovative nature, volatile revenues, and often non-profit orientation reduce their bankability and increase perceived risk. *Market barriers* are less prominent but still relevant, particularly the *Lack of a level playing field*. Access to Italian electricity markets requires financial guarantees that disadvantage small actors, reflecting utility-oriented regulatory frameworks (Campos *et al.*, 2020; Delicado *et al.*, 2023). However, the guaranteed withdrawal and remuneration of electricity by the GSE mitigates this barrier. Delicado *et al.* (2023) further argue that market incumbents retain influence over policy design and benefit from superior resources and expertise to operate within such complex markets.

Within *Socio-cultural and behavioural barriers*, *Lack of knowledge regarding the EC concept* and *Lack of awareness of EC benefits* are the most relevant, consistent with previous studies (Musolino *et al.*, 2023; Basilico *et al.*, 2025). Despite growing interest, familiarity with the EC concept remains limited among Italian citizens and firms (Fondazione Symbola *et al.*, 2022), as well as among local administrations (Costa and Campanini, 2024). Insufficient understanding of ECs' social benefits (Ceglia *et al.*, 2022) and limited access to reliable energy-consumption information (De Franco *et al.*, 2023) further hinder participation. Other barriers, such as *Lack of trust in public and private actors*, *Lack of trust in peers within the EC,* and *Lack of environmental awareness*, appear less relevant but remain present. According to recent studies, Italy exhibits low levels of civic participation and interpersonal trust compared to other EU countries (Delicado *et al.*, 2023), although historic electric cooperative experiences offer a positive counterpoint (Sciullo *et al.*, 2021).

Technical and technological barriers show the lowest relevance, and, among them, *Lack of efficient and suitable energy infrastructure* and *Lack of IT infrastructure* emerge as the least relevant. Nonetheless, several studies focused on the Italian context identify grid congestion, particularly in urban contexts, as a significant constraint (Sciullo *et al.*, 2021; Barbaro and Napoli, 2023; Corsini *et al.*, 2023; Shi *et al.*, 2024). Other contributions highlight the low diffusion of key enabling technologies, such as smart grids, energy storage solutions, and energy management systems

(Khorrami *et al.*, 2025), the lack of technical expertise (De Lotto *et al.*, 2022; Musolino *et al.*, 2023; Tatti *et al.*, 2023; Dioba *et al.*, 2024), and the lack of space arising from competing land uses or environmental restrictions (Franco and Casanova, 2023; Moretti and Stamponi, 2023; Shi *et al.*, 2024).

Variation in barrier relevance across EC characteristics was observed, particularly for geographic location, spatial context, and maturity phase. This aligns with a broad body of national-scale literature emphasising that EC barriers are highly context-dependent and that effective policies must account for local resources, knowledge, and socio-cultural traditions supporting EC establishment (Sciullo *et al.*, 2021; Bonifazi *et al.*, 2022; Ceglia *et al.*, 2022; Musolino *et al.*, 2023).

ECs in the Centre-South report higher relevance of *Institutional* and *Economic barriers*. From an economic perspective, in this study, southern ECs assign higher relevance to the *Lack of public funds*, although, according to Bonifazi *et al.* (2022), some southern Italian regions receive higher per-capita public funding. This contrast suggests issues of limited absorption capacity or inefficient allocation. As an additional issue in public funding for southern ECs, in Italy, the feed-in premium includes a correction factor that compensates for lower solar irradiation in northern regions. According to Magni *et al.* (2025), this may further exacerbate macro-regional disparities by reducing incentives in southern areas. This suggests that the current correction factor may warrant reassessment in light of broader territorial constraints beyond solar irradiation alone. ECs in the Centre-South also report higher relevance of selected *Socio-cultural and behavioural barriers*, such as *Lack of trust in peers within the EC*, and *Lack of cooperative tradition*. This finding appears to contrast with evidence from Musolino *et al.* (2023), who find cooperative attitudes in the establishment of Southern ECs, where NGOs collaborate with local authorities. However, the difference may stem from the fact that Musolino *et al.* (2023) focus on successful EC initiatives, whereas our results capture broader perceptions across a wider sample of communities. ECs in southern regions also report higher relevance of *Technical and technological barriers*, including *Lack of technical skills*, *Low diffusion of smart technologies*, and *Lack of technical expertise,* compared to Northern initiatives. This finding is consistent with Musolino *et al.* (2023), who report the frequent inclusion within Northern ECs of technical partners, such as companies and universities, which likely reduce technical barriers. On the other hand, in this study, Northern ECs emphasise the *Lack of knowledge and awareness*. These findings suggest that Italy's socio-economic heterogeneity affects the development of ECs, shaping the institutional, economic, technical, and socio-cultural context and determining its readiness for ECs, in line with Sciullo *et al.* (2021). This reinforces the need for place-based policy approaches that account for regional differences in socio-economic and institutional capacity.

Spatial context further shapes the perceived barrier relevance. Rural ECs report higher overall barrier relevance, especially for *Institutional barriers*, partly due to the fragmented distribution of primary cabins, which complicates perimeter definition in low-density areas (Costa and Campanini, 2024). Urban ECs emphasise *Lack of efficient and suitable energy infrastructure*, consistently with evidence on urban grid overstraining (Khorrami *et al.*, 2025), and *Lack of policy stability and coherence*, consistently with Barbaro and Napoli (2023), who find that urban ECs operate within complex spatial environments, characterised by high building density, mixed

land uses, and planning constraints, which expose them to stronger regulatory barriers. Divergent regional policy approaches, such as support for rural ECs in Sicily versus urban-focused measures in Lazio, further contribute to differentiated barrier perceptions (Magni *et al.*, 2025).

The maturity phase of ECs strongly shapes barrier perception. For Italian ECs, the development phase results as the most critical for *Economic* and *Institutional barriers*, reflecting high upfront costs, lack of access to finance, and complex authorisation procedures, as highlighted by De Lotto *et al.* (2022) and Barbaro and Napoli (2023). According to Moretti and Stamponi (2023), at this stage, ECs can overcome barriers through the support of public administrations for feasibility assessments, governance definition, member identification, and early engagement. During the operation and management phase, *Institutional barriers* persist, particularly administrative burdens, in line with evidence on slow administrative procedures and delayed incentive provision (Barbaro and Napoli, 2023). During the evaluation and expansion phase, *Institutional barriers* continue to play a critical role, while barriers from other categories gain prominence. This evolution indicates that, as ECs move beyond the initial stage, challenges diversify rather than diminish, pointing to the need for sustained and adaptive policy support over time.

The results of this study have implications for policymakers and managers involved in the design and implementation of ECs in Italy. Given the predominance of *Institutional* and *Economic barriers*, policy action should primarily focus on administrative simplification and targeted financial support. From an economic perspective, the findings highlight the need to improve access to both traditional and tailored financial instruments, including green and social bonds, sustainability-linked loans, leasing schemes, and crowdfunding mechanisms. Dedicated financial solutions, such as on-bill financing, community-based revolving funds, and public or third-sector grants, are especially relevant to enable the participation of vulnerable households and social or public housing entities (Delicado *et al.*, 2023; Sarcina and Canesi, 2023). Although *Socio-cultural and behavioural barriers* are less prominent overall, limited knowledge and awareness of ECs suggest the importance of early territorial activation through information campaigns and dedicated support structures, such as one-stop shops, technical assistance offices, and permanent information desks, guiding members and stakeholders throughout the EC lifecycle. From a technical perspective, public support in assessing local load profiles and renewable energy potential can help overcome local capacity gaps, while potential future saturation of primary cabins may require targeted infrastructural investments. Finally, the observed heterogeneity in barrier relevance across geographic areas, spatial contexts, and maturity phases highlights the need for differentiated policy interventions. In southern regions, this primarily entails prioritising improvements in the allocation and effective use of existing public funds. In addition, a revision of the feed-in premium correction factor appears necessary to account for broader context-related challenges beyond differences in solar irradiation. In northern regions, investments in infrastructure readiness, including grid reinforcement and upgrades to primary cabins, seem to rise in significance. Rural ECs could benefit from dedicated advisory hubs providing technical expertise, whereas urban ECs suffer from much less availability of space for RES installations. Regarding the maturity phase, variations in the perceived relevance of barriers across the EC life cycle suggest the need for differenti-

ated policy interventions, ranging from greater administrative and financial support, alongside information and awareness campaigns, during the development phase, to more tailored financial instruments and infrastructure support during the expansion phase. Policymakers should also account for variations in EC characteristics, including size, membership composition, and installed PV capacity. Municipalities may require capacity-building programmes to strengthen their ability to act as effective EC promoters. Finally, EC size and installed PV capacity determine different needs: smaller ECs require financial and administrative support and community-building activities, while larger ECs would benefit from enhanced digital solutions for data management, supported by public investment. ECs with greater PV plants could be supported through the formation of dedicated personnel and continued improvements in energy infrastructure.

5. Conclusion

This study provides exploratory primary evidence from Italian EC representatives on the relevance of barriers to EC development and operation. *Institutional* and *Economic barriers* emerge as the most relevant, while variation across selected EC characteristics suggests that barrier perception is not uniform across contexts and initiatives. These findings have relevant implications for research and support the adoption of more differentiated policy approaches, while the limited and uneven sample requires caution in generalising subgroup patterns.

From an academic perspective, it advances the literature by providing primary evidence on the relative relevance of barriers affecting ECs and by showing that these perceptions vary according to contextual and operational characteristics, thereby reinforcing the need for more context-sensitive analyses. For policymakers, the predominance of *Institutional* and *Economic barriers* underscores the importance of administrative simplification, regulatory stability, improved access to tailored financial instruments, and the adoption of differentiated policy approaches across territories, spatial contexts, and maturity phases. Furthermore, the implementation of dedicated support structures, such as one-stop shops for ECs, can play a pivotal role in mitigating barriers related to limited awareness and information asymmetries.

This study has some limitations. First, the number of survey respondents represents only a limited share of the ECs currently active in Italy, although empirical coverage is partially broadened by the inclusion of umbrella organisations representing multiple ECs. The relatively small sample size required the use of descriptive statistical approaches, notably Top Two Box scores, which provide a clear synthesis of respondents' assessments but may not capture finer-grained variation in responses. Further limitations concern the analysis of variation in barrier relevance across ECs with distinct characteristics. This analysis is exploratory as it does not test statistical significance, assess causal relationships, or account for potential correlations among EC characteristics (e.g., spatial context and geographic location). Consequently, the observed differences in perceived barrier relevance should be interpreted as associations rather than causal effects. In addition, uneven sample sizes across options of the same characteristic (e.g., ECs in the North vs. ECs in the Centre-South) limit the robustness of comparisons.

Future research could build on these exploratory insights by increasing the sample size and coverage to strengthen the representativeness and generalisability of the findings. Further studies could employ causal modelling approaches in the analysis of variation in barrier relevance across EC characteristics to formally test hypotheses and assess the statistical significance of observed differences. Finally, the survey assessing the perceived relevance of barriers could be extended to other national contexts, enabling cross-country comparisons and improving the understanding of barriers as a basis for designing more effective policies for supporting EC diffusion.

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Author Contributions

Annamaria Bagaini: Conceptualization, Methodology, Validation, Investigation, Resources, Writing - Original draft, Writing – Review & Editing, Supervision, Project administration. Edoardo Croci: Conceptualization, Methodology, Validation, Resources, Writing – Review & Editing, Supervision, Project administration, Funding acquisition. Alberto Mori: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – Original draft, Writing – Review & Editing, Visualization.

Data availability

The data supporting the findings of this study are available from the authors upon reasonable request, due to the presence of confidential information.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this manuscript, the authors used ChatGPT (OpenAI, GPT-5.2) exclusively for English language proofreading and stylistic refinement. After using this tool, the authors carefully reviewed and edited the manuscript as needed and take full responsibility for the content of the published article.

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Appendix A. List of barriers to energy communities

Table A.1 – List of barriers and recurrence in literature

Categories	Classes	Individual barriers	Recurrence	References
Economic barriers	Financial barriers [1], [2], [3], [4], [5]	Lack of access to traditional finance	3	[2], [4], [6]
		Lack of access to finance from members	2	[1], [2]
		Lack of tailored financial options	5	[1], [2], [3], [4], [5]
		Lack of public funds	2	[2], [7]
	Market barriers [1], [2], [7]	Lack of a level playing field	3	[2], [6], [8]
		Presence of market incumbents	1	[9]
Institutional barriers	Policy and regulatory barriers [10], [11], [12], [13]	Absence of a clear and uniform definition of ECs	6	[2], [3], [4], [5], [8], [14]
		Lack of a clear scope of EC activities	6	[1], [11], [12], [13], [14], [29]
		Lack of policy stability and coherence	3	[1], [5], [8]
	Administrative and bureaucratic barriers [11], [12], [13], [15]	Lack of simple and clear administrative procedures	4	[1], [2], [4], [14]
		Slow administrative procedures	5	[2], [5], [7], [15], [31]
Technical and technological barriers	Technical barriers [2], [7], [15], [16], [17], [18]	Lack of space to build RES plants	3	[2], [7], [15]
		Lack of technical skills (skilled personnel)	4	[2], [7], [17], [18]
		Lack of technical expertise	2	[2], [7]
	Lack of efficient infrastructure [2], [19], [20], [21], [30]	Lack of efficient and suitable energy infrastructure	6	[2], [16], [19], [20], [21], [30]
		Lack of IT infrastructure	5	[2], [11], [12], [20], [21]
	Lack of enabling technologies [12], [17], [20], [21], [30]	Low diffusion of smart technologies	5	[7], [17], [19], [20], [30]
		Data management issues	4	[11], [12], [20], [21]

		Cybersecurity and data protection issues	3	[12], [20], [22]
Socio-cultural and behavioural barriers	Lack of knowledge and awareness [2], [17], [18], [23], [24]	Lack of knowledge regarding the EC concept	5	[11], [12], [14], [16], [25]
		Lack of awareness of EC benefits	7	[1], [2], [3], [4], [8], [18], [26]
	Lack of trust [18], [25], [27], [28]	Lack of trust in public and private actors	2	[2], [18]
		Lack of trust in peers within the EC	3	[18], [25], [27]
	Lack of socio-cultural conditions [4], [25], [18], [27], [32]	NIMBY attitudes toward RES and ECs	2	[4], [9]
		Lack of cooperative tradition	2	[1], [7]
		Lack of environmental awareness	4	[7], [18], [27], [32]

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Appendix B. Survey Questionnaire

FIRST SECTION: ENERGY COMMUNITY CHARACTERISTICS

Q1 Please provide the name of your Energy Community / Website of the Energy Community
Q2 Please indicate the year of the EC set-up, if applicable
Q3 Does your EC meet the requirements for a Renewable Energy Community (EU Directive 2018/2001) or Citizen Energy Community (EU Directive 2019/944)?

- Yes, for Renewable Energy Community
- Yes, for Citizen Energy Community
- No
- I don’t know

Q4 Please specify what the current state of your EC is

- Development phase
- Operation and management phase
- Evaluation and expansion phase

Q5 Please indicate the country, the city, and the size of the city where your EC is located

- Country

- City/Town/Village

Q6 Please indicate the type of urban/rural context where your EC is located
- Urban
- Rural

Q7 Please indicate the legal form of your Energy Community
- Limited partnership
- Cooperative
- Public-private partnership
- Non-profit organization
- Public utility company
- Community trust and foundation
- Housing association
- Social enterprise
- Other (please indicate)

Q8 Please indicate the size of your EC, in terms of the number of members
- Less than 50 members
- From 51 to 200 members
- From 201 to 1000 members
- From 1001 to 5000 members
- Above 5000 members

Q9 Please indicate the type of EC members
- Citizens (If yes provide the % of the total members)
- NGOs (If yes provide the % of the total members)
- Municipality (If yes provide the % of the total members)
- Other public authority (Please specify) (If yes, provide the % of the total members)

Q10 Please indicate the role of your EC members
- Consumers (If yes provide the % of the total members)
- Prosumers (If yes provide the % of the total members)
- Producers (If yes provide the % of the total members)
- Aggregator
- Facilitator/Promoter
- Manager
- Provider

Q11 Please indicate the main activities that your EC is performing
- Energy Production
- Energy Sharing
- Energy Supply
- Energy distribution
- Energy Services
- E-mobility
- Other activities

Q12 Please compile the following table with information regarding the energy production technologies utilized by your EC.

Please specify the main energy production technologies utilized by your EC.	Please specify the size of the generation plant or the energy production utilized by your EC (kW).
Wind Solar PV Solar thermal Geothermal Hydropower Biomass Biodegradable fraction of waste No production (Not apply)	<100 kW 100 kW-200kW 200kW-500kW 500 kW-1MW 1MW-3MW 3MW-5MW 5MW<

Q13 Please select the main sources of revenue, if any, of your EC

- Public incentives
- Public subsidies
- Donation
- Energy retail
- EC members' fee (e.g., annual membership)
- Energy services fee
- E-V services
- Other activities (Please specify)

SECOND SECTION: ENERGY COMMUNITY BARRIERS

Economic barriers

Q14 Financial barriers. Use a scale from 0 to 5, where 0 means “no relevance” and 5 means “very high relevance”

	Scale 0 indicates no relevance, 5 indicates very high relevance					
Barriers	0	1	2	3	4	5
Lack of access to traditional finance						
Lack of access to finance from members						
Lack of tailored financial options						
Lack of public funds						

Q15 Market barriers. Use a scale from 0 to 5, where 0 means "no relevance" and 5 means "very high relevance"

	Scale 0 indicates no relevance, 5 indicates very high relevance					
Barriers	0	1	2	3	4	5
Lack of a level playing field (i.e., economies of scale)						
Presence of market incumbents						

Institutional barriers

Q16 Policy and regulatory barriers. Use a scale from 0 to 5, where 0 means "no relevance" and 5 means "very high relevance"

	Scale 0 indicates no relevance, 5 indicates very high relevance					
Barriers	0	1	2	3	4	5
Absence of a clear and uniform definition of ECs						
Lack of a clear scope of EC activities						
Lack of policy stability and coherence						

Q17 Administrative and bureaucratic barriers. Use a scale from 0 to 5, where 0 means "no relevance" and 5 means "very high relevance"

	Scale 0 indicates no relevance, 5 indicates very high relevance					
Barriers	0	1	2	3	4	5
Lack of simple and clear administrative procedures						
Slow administrative procedures						

Technical and Technological barriers

Q18 Technical barriers. Use a scale from 0 to 5, where 0 means "no relevance" and 5 means "very high relevance"

	Scale 0 indicates no relevance, 5 indicates very high relevance					
Barriers	0	1	2	3	4	5
Lack of space to build RES plants						
Lack of technical skills (skilled personnel)						
Lack of technical expertise required to deal with administrative and legal procedures and to apply for public funds, grants, etc.						

Q19 Lack of efficient infrastructure. Use a scale from 0 to 5, where 0 means "no relevance" and 5 means "very high relevance"

	Scale 0 indicates no relevance, 5 indicates very high relevance					
Barriers	0	1	2	3	4	5
Lack of efficient and suitable energy infrastructure						
Lack of IT infrastructure						

Q20 Lack of enabling technologies. Use a scale from 0 to 5, where 0 means "no relevance" and 5 means "very high relevance"

	Scale 0 indicates no relevance, 5 indicates very high relevance					
Barriers	0	1	2	3	4	5
Low diffusion of smart technologies						
Data management issues						
Cybersecurity and data protection issues						

Socio-cultural and behavioural barriers

Q21 Lack of knowledge and awareness of ECs. Use a scale from 0 to 5, where 0 means "no relevance" and 5 means "very high relevance"

	Scale 0 indicates no relevance, 5 indicates very high relevance					
Barriers	0	1	2	3	4	5
Lack of knowledge regarding the EC concept						
Lack of awareness of EC benefits						

Q22 Lack of trust. Use a scale from 0 to 5, where 0 means “no relevance” and 5 means “very high relevance”

	Scale 0 indicates no relevance, 5 indicates very high relevance					
Barriers	0	1	2	3	4	5
Lack of trust in public and private actors						
Lack of trust in peers within the EC						

Q23 Lack of socio-cultural conditions. Use a scale from 0 to 5, where 0 means “no relevance” and 5 means “very high relevance”

	Scale 0 indicates no relevance, 5 indicates very high relevance					
Barriers	0	1	2	3	4	5
NIMBY attitudes toward RES and ECs						
Lack of cooperative tradition in the country or the region where your EC is operating						
Lack of environmental awareness in the country or the region where your EC is operating						

Appendix C. Sample description

This appendix provides descriptive information on the sample. Details are illustrated in Figs. B.1-B.5.

Figure C.1 – Distribution of surveyed ECs by region

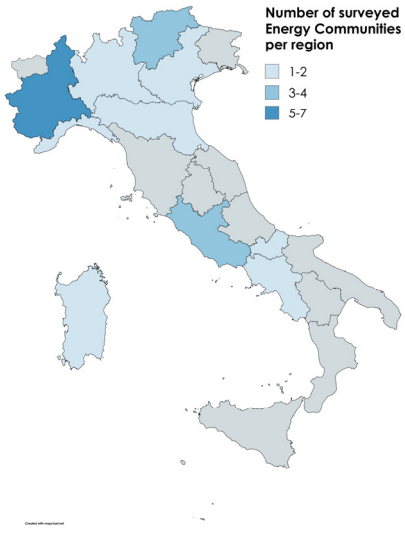

Figure C.2 – Distribution of surveyed ECs by role of members

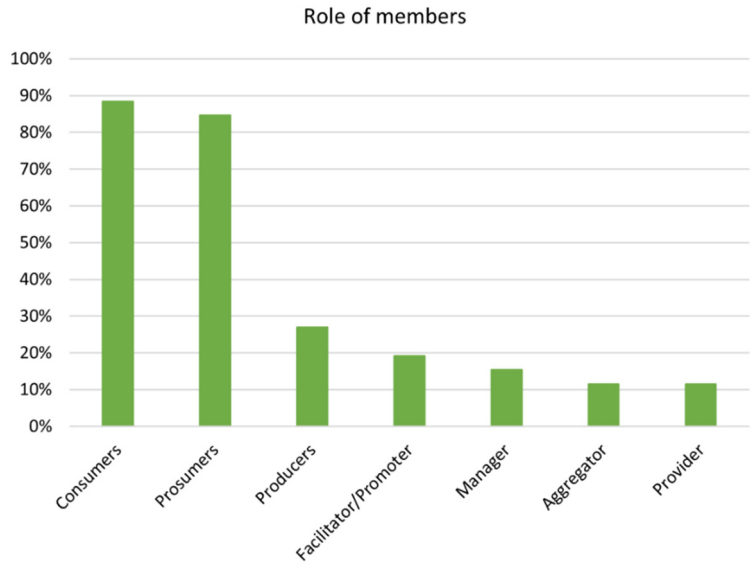

Figure C.3 – Distribution of surveyed ECs by activities undertaken

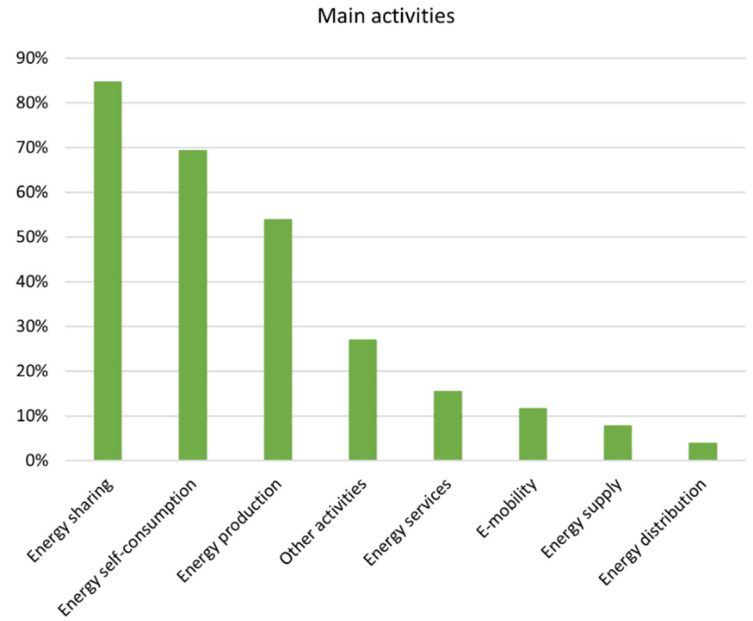

Figure C.4 – Distribution of surveyed ECs by sources of revenue