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Renewable Energy Community: Opportunities and Threats towards Green Transition

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Abstract: The European Union faces a complex economic conjunction where different factors affect and reduce the number of feasible and sustainable projects according to the legislation and the available resources. In this context, one of the available solutions to the current energy crisis could be the implementation of Renewable Energy Communities (RECs) to support the European dual transition targets. The idea of an energy community is still being defined in the literature and from a legislative perspective. The increasing REC dimension and numerosity demand in-depth studies on opportunities and threats in a still unexplored market. To clarify the Italian and European state of the art of these communities, this study in the first section addresses the socioeconomic and policy conditions needed for the foundation and development of energy communities by analyzing the in-force legislation. The analysis of the current regulation has been conducted to verify how RECs affect local communities and their degrees of freedom and action in regions. The second part of the study aimed to define threats and opportunities in creating new professional profiles and local job opportunities in this new thriving market. In this study, we collected interviews and surveys with market operators, both on the service providers' side (ESCo) and the communities' side (promoters), to identify conflicts and advantages associated with establishing communities. The participants were initially selected through publicly available lists, and after verifying the contact correctness, they were contacted by email or phone. The results of the interviews have been processed into a SWOT analysis, showing how national policies currently need to catch up in implementing this efficiency tool and how the restricted number and the variety of the existing communities increase the difficulty in creating cohesive and universal guidelines. Finally, local markets can still not correctly manage this innovative tool's uncertainty despite being interested in it.

Keywords: green transition; 4.0 building transition; RES; SWOT; survey; European legislation

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1. Introduction

Recently, several international institutions and countries faced numerous environmental challenges. The main concern is climate change. In fact, according to the Weather Meteorological Organization (WMO), the past seven years have been the warmest globally since 1927, when the survey started [1]. The world's average temperature has risen by one degree Celsius from its pre-industrial level. If the global temperature continues to increase, global warming will be expected to increase by three degrees Celsius by 2100 [2].

As part of the attempts to mitigate global warming, the Paris Agreement (2015) seals a legally binding international treaty, adopted by 196 parties, on maintaining the temperature increase below the threshold of two degrees Celsius. Ideally, the goal of reducing the overall emissions by increasing the adaptation and resilience of the production activities should be encouraged and financed through market instruments. In this sense, the international market system should strive to direct financial resources toward low-emission technology development.

The intensification of extreme climatic events also strongly demands the introduction of mitigation policies and measures. These include prolonged droughts, typhoons, hurricanes, monsoons, and high temperature changes [3]. If not mitigated, the worsening of environmental conditions could potentially lead to the progressive depletion of resources worldwide, furthering the impoverishment of the marginal areas that already suffer from disparities and inequalities.

Furthermore, global warming and digital transition produced an increase in global energy demand. Together, the worldwide decrease in the availability of fossil fuels and the current European energy supply shortage enforced an energy price increase. These factors exacerbate the so-called energy trilemma: security, sustainability, and affordability [4].

Long-term affordability is further impacted by the effects of inflation on the energy supply. Keeping energy prices at the current level may heighten the phenomenon of energy poverty, defined as the difficulty in buying a minimum basket of energy goods and services or an atypical diversion of resources to afford them [5].

Given the increase in energy prices, the opportunity cost of using renewable energy sources (RES) shrinks. Considering the above, increasing RES investments could minimize global costs, increasing sustainable effects [6–14]. On this path, supporting the establishment of Renewable Energy Communities (RECs) seems a sustainable and resilient approach that could meet the energy trilemma implications. However, this new community type is still being defined both in the literature and from a legislative perspective. The increase in RECs dimension and numerosity requires in-depth studies on their opportunities and threats in a still unexplored market [15–22].

Considering the matter at hand, the EU has facilitated the shift of the internal energy market towards more sustainable energy sources, supporting regions highly susceptible to price variations. In 2014, the European Council formally communicated the aim to reduce greenhouse gas emissions to at least 40% below 1990 levels by 2030 and increase sustainability by raising the energy production from RES (COM2014–2015). After that, in 2015, the EU signed the Paris Agreement formally accepting the goal of curbing the increase in temperature by keeping it below 2 °C.

Finally, as an implementation of this agreement, the EU defined its long-term strategy, increasing the target of greenhouse gas emission reduction to at least 55% below 1990 levels by 2030. Subsequently, the EU adopted a set of reforms known as Clean Energy for all Europeans, reforming the legal framework for the European energy market. A crucial step of this reform is the strengthening of energy communities in the attempt to stimulate private and public investment in the renewable energy (RE) markets [23].

This regulation's reinforcement led to an increase in the RECs' size and numerosity, demanding thorough studies on their opportunities and threats. To clarify the Italian and European state of the art of these communities, this study, in the first section, addresses the socioeconomic and policy conditions necessary for RECs establishment and development. To achieve this goal, firstly, this study analyses the in-force legislation. The analysis of the current regulation was conducted to verify how RECs affect local communities and their degrees of freedom of action of the local communities.

In this study, we collected interviews and surveys with market players on the side of service providers (ESCo) and the side of the RECs (promoters and consumers at once, called prosumers). These surveys aimed to identify possible conflicts and benefits associated with the establishment of new communities along with the establishment of new professional profiles. The results have been processed into a SWOT analysis, showing how national policies currently need to catch up in implementing an efficient tool. Moreover, the low numerosity and the variety of the existing communities increase the difficulty in creating cohesive and standard guidelines. The paper aims to identify the hurdles and difficulties, together with some of the advantages, of creating CERs in Italy.

The literature review highlighted the general lack of best practice studies in this growing market, usually focusing on the more theoretical components of the constitution process.

Finally, it seems that local markets can still not correctly manage all of the uncertainty associated with it despite being interested in this innovative tool.

2. Literature Review

This section aims to understand how the academic debate has evolved on the topic of energy communities over time better to understand this subject's state of the art. We first run a general query in the Web of Science (WoS) search engine, typing the term *energy community* searching in any field (operator ALL=). The engine provided a total of 115,220 results. Next, we narrowed the research by searching the same term in the topic field (operator TS=), obtaining 59,255 results. Limiting the time frame between 2018 and 2022 obtains 27,223 results. The research can be refined using quotation marks, forcing the engine to search for the exact term. Searching the term "*energy community*" instead of *energy community* in the same period obtains only 664 results. The set can be expanded by adding the research term "*community energy*" as an alternative (using the OR operator), providing 1312 results in the same period. The simple addition of the research term *review* reduces the outcome set to 141 results. Additionally, if the second research term is substituted by *taxonomy*, the query obtains only three results.

Since the research involves exact terms (by using quotes), an attempt to expand the research has been made by reverting the research to any field instead of specific topics (operator ALL instead of TS). The engine hence showed a total of 1015 results using only "*energy community*", and 1819 results by adding the term "*community energy*". Even in this case, the research highlighted a need for taxonomic approaches. Additionally, the research for reviews instead of taxonomic studies obtained a total of 214 results. The same research, avoiding the use of quotes, highlights a total of 7243 results for the reviews and 259 for taxonomy. Additionally, the use of a wildcard symbol, *taxonom** yields a total of 1249 results when searching it together with *energy community* or *community energy* terms (note the lack of quotes). The results can be narrowed down to five by simply adding the quotes to the research terms (except *taxonom**).

In the literature, the terms *Energy* and *Communities* are often linked to terms such as *renewable, transition, system, poverty, and empowerment*, and those combinations are easily found by the engine. However, using exact-term research, by the use of quotes, excludes most cases in which these combinations are irrelevant to the studied topic.

To give context, searching the terms *community energy* or *energy community* without the quotes brings a total of 50,340 results, of which firstly it is possible to find Environmental Sciences Ecology papers, with 11,683 results (23.20%), secondly Engineering papers, with 9704 results (19.28%), and thirdly Energy Fuels papers, with 7313 (14.52%). Within the first ten positions, it is then possible to find papers on Science Technology, and Other Topics (13.20%), Chemistry (7.37%), Physics (6.69%), Computer Science (5.88%), Material Science (5.84%), Microbiology (4.29%), Agriculture (3.64%), Biotechnology and Applied Microbiology (3.34%).

On the other hand, the use of quotes, by also adding the term "*energy communities*" for completeness, brings a total of 3610 results. It is possible to firstly find Energy Fuels papers, with 1276 results (35.35%), secondly Engineering papers, with 1119 results (31.00%), and thirdly Environmental Science and Ecology papers, with 661 results (18.31%). Within the first ten positions, it is possible to find: Science Technology and Other Topics (16.98%), Nuclear Science Technology (7.48%), Computer Science (7.26%), Physics (6.87%), Material Science (5.51%), Business Economics (5.13%), and Construction Building Technology (4.32%) (see Figure 1).

By removing the limit of five years, the results increase to 3585, also showing a steady increase in the number of articles through the previous years (see Figure 2). In 2012, the number of published articles exceeded one hundred, and since 2022, the published articles have reached a peak of 526 in 2022, with a relative increase of 400%.

The literature on energy communities is growing but also inflated. As shown before, the terms *energy* and *community* are often used with terms commonly used in articles about the environment. The research engine hence includes in its results several articles generally on environmental topics (e.g., energy transition) but not directly addressing the topic of energy communities. To further clarify this passage, when using a research term such as *energy community*, this is translated in, for example, ALL = (energy community) when searching for any field in the database. In practice, the engine reads the operator as ALL = (energy OR community), then searches for the two terms separately within the selected field, so a standard term such as energy may be associated with *transition*, *poverty*, *nuclear*, *solar*, *pricing*, etc. Between all possible combinations, there is the possibility to find an energy community. However, there is the risk that broad research may yield many unfocused results since both terms *energy* and *community* are pretty common in the English language.

After several tests aimed at expanding the number of results on the topic of energy communities, the final query used in the present article is structured as follows:

TS = (energy community OR community energy) AND TS = (literature review OR taxonomy OR business model OR case study) AND TS = (Italy OR Germany OR Europe OR EU OR UK) AND TS = (renewable energy)

Figure 1. Number of publications per research area, source Web of Science.

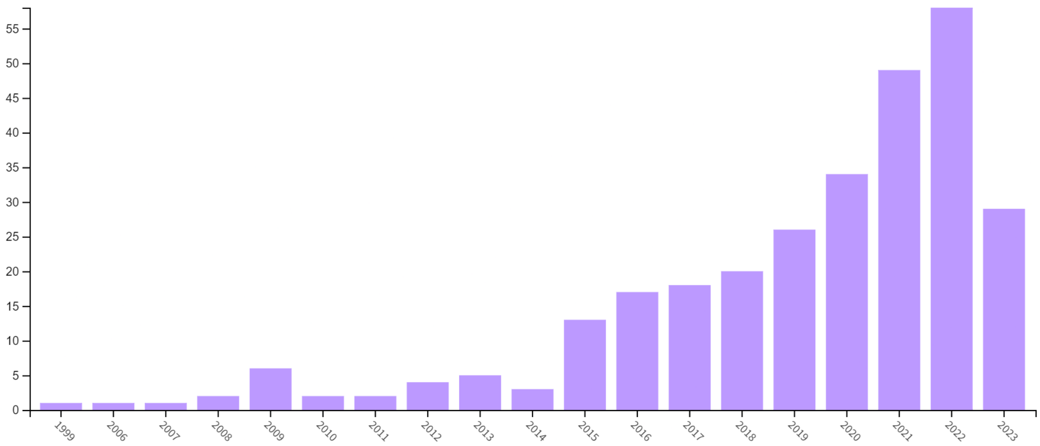

Figure 2. Number of publications per year.

The above query has searched for any article using both the term *energy community* and the equivalent *community energy* used chiefly in the UK, together with the main topics of interest so far inquired, taxonomies and reviews, together with two additional topics *case study* and *business model*, since they may help in identifying the experiences, positives and negatives of energy communities in Italy. The query has focused mainly on Europe: Italy, Germany, and the UK specifically. We decided to restrict the research to these countries for different reasons. Our study focuses on RECs, which are place-based in Italy, so we selected Italian studies. Concerning the selection of studies located in Germany, it is the country with the highest number of implemented energy communities in the Union (4848 in 2021) [24].

On the other hand, despite showing a much smaller set of communities (424 in 2021), the UK has already established an institutionalized approach to the theme, with rules, processes, agents, and a feed-in tariff system to favor the creation of such communities. The system is already sufficiently set up and mature that the feed-in tariff system is planned to be terminated, with the expectation for the communities to sustain themselves through market systems economically [25]. From this perspective, the UK instance is an interesting case study for the medium-term prospects of energy communities.

The terms *EU* and *Europe* are included to find references to studies around Europe since the idea is to try to capture the broader scope of the energy community experience in the Union, despite the focus on specific countries.

Finally, the last tuple (TS = (renewable energy)) has been added only to ensure the focus of the research on RES. Additionally, the research has been refined by limiting the results to papers at most five years and to belong to a limited set of categories, namely environmental studies, energy fuels, energy studies, and business. The query resulted in a total of 132 papers.

Subsequently, the filtering process involved reading both the title and abstract to eliminate all the papers that resulted in being out of focus. By doing so, the remaining papers have been reduced to 81. The next step was to read those 81 papers and categorize them. Of those remaining papers, only 37 resulted explicitly on the topics of interest, meaning case studies, business models, incentives, and decision drivers. Aside from a few papers that resulted in being out of focus after the reading, the majority of those excluded after this last phase focused mainly on the study of RES and storage solutions from a technical point of view or concepts of circular economy [26–28].

Of the remaining 37 articles, 15 focus on case studies; for example, Tricarico et al. [29] focus on two different Italian case studies to identify the preconditions needed for forming energy communities. Similarly, other studies focus on the drivers needed to promote the creation of energy communities and the conditions needed for those to thrive [30–33], as the firm reliance on volunteers [34]. This dependency may hinder the growth perspective of the community in the medium- and long-term and discriminate on the kind of participants in the community, selecting only those with the willingness and enough spare time.

Alternatively, other studies focus on the policymaker side, providing considerations either on the systemic effects of communities on consumption or the requirements needed for the establishment of communities as detected by studying the creation process [35–37]. Communities prove to be a viable solution to reduce the overall consumption on the main grid, reducing consumption peaks. On the other hand, it is required for the policymaker to provide some form of safeguard to the communities, e.g., tax exemptions as in the Netherlands [38], favoring the role of different organizations as aggregators in the attempt to create an energy market for small communities [31], or initiatives to activate people for a bottom-up approach by removing hindering regulations and the expansion of financial support [39]. On the same topic, Braunholtz-Speight et al. [40] calls for policymakers to encourage and help energy communities to create a long-term vision and structure to establish partnerships between local entities and large organizations, supporting the former with the technological aspects. On the same note, creating a network between managers of different communities should be encouraged [41].

Additionally, the policymakers should focus on the crucial role of educational reinforcements and investments in building efficiency, with prolonged institutional support [42].

The problem of a longer-term perspective, coupled with the integration of communities in the broader energy system, also introduces the problem of developing sustainable business models for the energy communities [43].

Another potential area of intervention is highlighted by Ceglia et al. [44] focuses on the possibility for communities to reduce the impact of energy poverty.

Finally, in the selected sample, the remaining studies are economic-focused, emphasizing the risk for energy communities to face financial concerns, for example, the evident reduction in polluting emissions offset by the negative Net Present Value (NPV) of the community [36]. Alternatively, these studies pointed out the relevance of the benefit redistribution factor in making the energy communities appealing to the potential members while considering the Return On Investment (ROI) to depend directly on the quantity of energy supplied on the grid by the community and the price offered for such energy. The increase in ROI, given fixed prices, may depend only on the energy supplied to the grid, which will decrease as the self-consumption increases, hence decreasing the community appeal to prospective investors [32]. On the same topic of ROI, a study in the UK on self-consumption and consumption configurations shows the possibility of increasing the ROI of the project by better matching the local production and local consumption through the implementation of a storage system [45].

Another limit of the energy community configuration is highlighted in the installation of photovoltaics in cities and, specifically, on condominium rooftops due to both the limited surface available and the shading effect of other attached and nearby buildings [46,47]. Finally, some of the studies stressed the possibility that the more significant effect on energy consumption reduction is connected to the improvement of building energy efficiency [48]. This topic is particularly relevant in Europe, where the building stock is aging.

Other papers focused on different methodologies, such as simulations, and restoring specific local case studies, such as the study of the impact of the implementation of storage systems on the grid, which favors the reduction in consumption [49].

Finally, there are a total of six articles focused on literature reviews on RECs. Bielig et al. highlight the general lack of quantitative data and experimental analyses, in addition to the lack of longitudinal and counterfactual designs for studying the impact of energy communities in Europe [50]. Chodkowska-Miszczuk et al. point out the need for investments in buildings' energy efficiency coupled with prolonged institutional support [42], a theme also linked with Nematchoua et al. and the aging of the building stock in Europe [48]. Grignani et al. introduced the possibility of establishing energy communities through energy cooperatives [51]. Then, an inquiry into the non-economic characteristics of the people most involved in the development of energy communities in Germany, highlighting how the type of individual more often involved in this type of project is male, with high education, high income, and high willingness to pay for sustainable goods, who usually live outside of the main cities. The author suggests that future policies should be more inclusive, focusing more on involving women, young city residents, and lower-income citizens [52]. An exciting addition to the debate has been introduced by Golubchikov et al., who introduced the concept of energy vulnerability through the adoption of the term energy periphery [53]. The study emphasizes attention to the risk of uneven development of different geographical areas due to, for example, inferior characteristics of the location. The differences in geographical locations coupled with a relatively free development process aggravate the existing differences between core and periphery and, instead of creating a decentralized landscape and economies, may further push toward a concentration of economic activities.

Through some interviews, Brown et al. exalt the role of prosumers in the energy transition and in shaping the new energy market through developing new business practices and business models [54]. On a similar note, it is pointed out how a high level of community participation, together with high-quality legislation and independent surveillance, is paramount for a successful implementation of RECs [55]. The general uncertainty in CER implementation is mainly linked to the poor legislative framework and the need for experimentation [56]. Mirzania et al. conclude their study by stressing that the legislative uncertainty has been detrimental to the experience of energy communities but also gave a few of those communities the right opportunity to experiment with new business models. By contrast, many of the communities studied in the article focus more on surviving rather than innovating. This problem may also be connected to the reliance on volunteers and the general need for more professionals in the sector. The general involvement of the community increases the level of awareness of the participants; still, it remains to understand whether the level of engagement correlates with energy-use habits [57].

Finally, a few scenario simulations focus on emission reduction, either comparing the standard self-consumption with the energy community case [58,59] or with the integration of electric mobility in the communities' business model [60].

The main outcomes retrieved by the literature review are the generalized lack of data on energy communities and the experience heterogeneity of the latter. This is because the energy community concept is quite recent, and laws, where implemented, still differ across countries. In general, few studies focused on already operative energy communities, highlighting the strengths and weaknesses of this approach to renewable energy. The lack of data and the difficulty of comparing them leads to a general lack of quantitative studies.

Legislative Framework

The EU Renewable Energy Directive 2018/2001 (RED-II) formalized the concept of a Renewable Energy Community (REC), while the Internal Energy Market Directive (IEMD) 2019/944 defined Citizen Energy Communities (CEC). RECs are defined as legal entities that are based on open and voluntary participation. RECs are autonomous and effectively controlled by shareholders or members located near renewable energy projects, which are developed and owned by the community. The shareholders or members must only be natural persons, small or medium enterprises, or local authorities. Additionally, the primary purpose of the community is to provide environmental, economic, or social benefits to the members of the area where it operates, not financial profits. On the other hand, CECs are defined as legal entities based on voluntary and open participation and are effectively controlled by their members. The members legally allowed to exert control are natural persons, local authorities, or small enterprises.

Following what is prescribed by the two directives, it is possible to identify the main differences between the two types of communities. The first difference concerns the geographical scope; CERs are localized since they must be located in the proximity of the renewable energy projects they own or develop, while CECs do not have such limitations. Another critical difference is the type of energy source and activities they can engage in and rely on. CERs can provide a wide range of services, but they must only relate to Renewable Energy Sources (RES). CECs can exploit any energy source, and consequently, they can also use fossil fuels. Finally, the membership is another difference between the two communities. Any actor can participate in CECs, with the limitation that prominent energy-related members cannot exert any control over the community. On the contrary, only natural persons, local authorities, and micro, small, and medium enterprises can participate in CERs.

The legislative agenda required the implementation of the directives in the Italian legislative framework, following the EU regulation 2018/1999, asking the member countries to adopt a national plan for energy and climate. In 2019, only the RED-II was partially translated into Italian legislation through decree-law 162/2019. As a temporary solution, to test the operation of energy communities before the full implementation, the decree allowed only RECs to be established in Italy, and those needed to be underpowered concerning what was established in the RED-II. Subsequently, in 2021, the two directives, RED-II and IEMD, were definitively implemented in Italian legislation through legislative decree 199/2021 and 210/2021, respectively (see Figure 3).

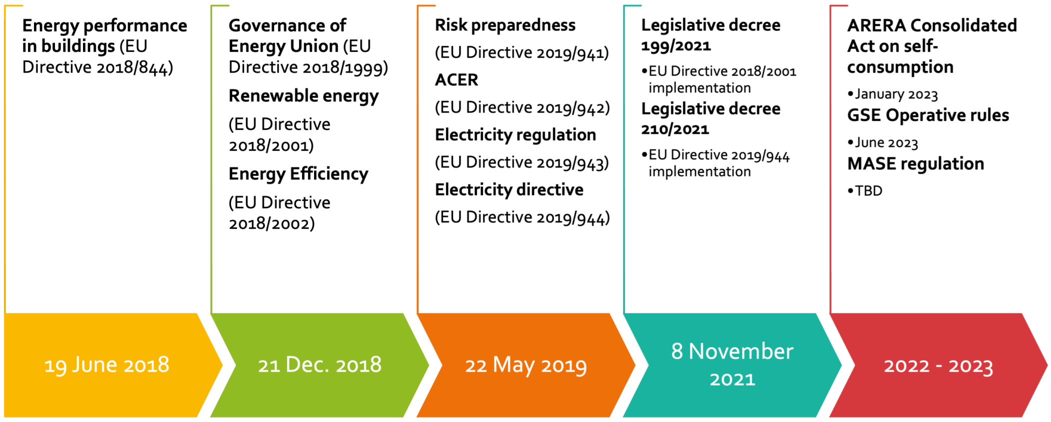

Figure 3. Clean energy package timeline (EU) (new).

The legislative decree 199/2021 and the decree-law 162/2019 differ from the previous legislation. Firstly, they increased the limit of the nominal power of the plant to 1 MW, which was previously set to 200 kW. The second main difference is the possibility for the members to be linked to the same primary substations (high to medium tension) instead of a secondary substation (medium to low). This increased the area that the community could cover.

The legislative decree 210/2021 introduced the CECs in Italian Law in 2021, mirroring the European directive. This decree allowed this community to manage only electricity generated from non-RES. In Italy, this type of community has received little attention from an academic and public perspective.

Decree 199/2021 also introduces the subsidization of the communities through a feed-in tariff. The tariff is paid by the GSE S.p.A. (Gestore dei Servizi Energetici), a publicly owned company responsible for favoring the development of RESs in Italy. The tariff is computed on the energy shared within the community and added to the market price of the potential energy distributed on the national grid.

In general, Italy shows a slight delay in implementing the European directives. The national decrees are formally implemented, but they still lack full effectiveness. The delay in the European directives implementation may add to the difficulties in publicizing the energy communities among the public since the uncertainty may reduce the appeal, both among public institutions and privates, of the community as a reliable tool for energy production. This is mainly due to the delay in issuing official implementation norms by ARERA, the Italian Energy Authority and updating the feed-in tariffs by the MASE, the Italian Ministry for the Energy and the Environment.

3. Materials and Methods

After reviewing the literature and the legislative framework, since the energy community is a relatively new and relevant topic, it is crucial to define how this tool is implemented in the real world. One of the conundrums of the energy community is how its creation process begins and which kind of subjects are involved in this step. Additionally, given the need for technical expertise in the establishment process of energy communities, the demand for specialists to provide counseling and know-how arises. These experts may be supplied by several different firms' profiles, such as legal, technical, managerial, and valuation consulting.

To respond to such an increase in demand, we attempted to contact and interview these new professional operators and operating energy communities. Specifically, we contact energy communities and Energy Service Companies (ESCos). We contacted this type of stakeholder to understand better how the creation process starts and develops. The survey was conducted to contact households, agents, operators, and companies operating in this market to understand better how the creation process begins and evolves.

The survey approach followed the methodology presented in Vannette and Krosnick (2018) [61]. The preliminary definition of the sampling frame has been driven by the limited availability of both communities and ESCos in this sector in the Italian National market. Those available were selected from public lists. The contacts were subsequently verified (e.g., checking if the contact has a website) and contacted via email or phone.

The contact method was structured as a survey to be submitted to the operators, implementing two different questionnaires, one to be submitted to CERs and the other to private companies specialized in this sector. We selected these two different profiles to capture both the shade and a clearer picture of the process by involving both sides of the operation. The two questionnaires with the lists of questions are presented in Table 1.

The list of CERs and firms to be contacted was obtained through research in public databases, such as Legambiente, GSE, AssoESCo, and Accredia. Given the small number of nominatives available, there has been no initial selection.

Table 1. Questions asked to energy community operators and firms with expertise in the CER market.

List of Questions	
CER	**FIRMS**
Constitution process	
Is the energy community already operating?	How does the CER creation process start?
If so, how much time was needed for the full realization?	What are the most common categories of customers?
Which constitutive form was chosen for the CER?	What is the most common contract type in use?
Was the project developed together with a partner?	What kind of consulting services do you offer to prospective customers?
If so, how the partner was chosen?	What role is usually entrusted to you in the creation process?
Technical questions	
How much time was needed to define the project?	Do you offer financial support for the creation?
What is the kind of installed plant?	What are the most relevant factors you consider for medium/long-term financial sustainability?
What kind of financing was adopted?	What are the most promising RESs to be used for the CERs and why?
Was a battery system installed?	How was the engagement process organized?
To whom was the energy community management assigned?	Did the new legislation implementation affect your workflow?
How many members does the community have in the constitution?	What kind of job opportunities may arise from the creation of energy communities?
Has the members' number varied over time?	

The general lack of responses by the contacted subjects pushed for a different approach. Given the context, of the 78 CERs contacted, only 2% answered the survey, while of the 70 ESCos contacted, only 4% answered.

As said, they encountered difficulties contacting and receiving answers from the communities and the ESCos for the survey campaign, which called for a different approach. Instead of structuring a written survey campaign, interviews were deemed more feasible.

The answers from both CERs and firms, together with the literature review results, are summarized in a SWOT analysis presented in the discussion section of the present paper.

SWOT Analysis

SWOT analysis is an acronym for Strengths, Weaknesses, Opportunities, and Threats, and it is a strategic planning instrument often used to assess how an organization places itself in a specific market. Usually, it is represented in a matrix form, in which each quadrant represents one of the four analysis dimensions [62].

Currently, the SWOT analysis is frequently used in different areas, such as education, industry, agriculture, and marketing and management, where it was initially developed [63–75]. The main attraction of such a tool is the easiness of use: in fact, the representation allows the user to rapidly understand what was considered in the analysis and how.

Despite its diffusion, the SWOT analysis is often criticized because there is the concrete possibility for it to be either superficial or stereotypical. The latter is particularly the case if the analysis is not anticipated by an analytical critique by a plurality of collaborators [62].

On the other hand, if the SWOT is methodically sound, it provides a clear representation of the different problem dimensions and an easy-to-follow taxonomy of the same problem. In applying such a methodology, the analyst has a degree of arbitrarity in choosing where to locate each element in the matrix. Finally, the classification of the elements need not be unique, but still, it needs to follow some guidelines in doing so [76]:

1. Strength: Generally, those are positive characteristics, adding value to something related to the organization. Those may be properties and abilities granting some form of advantage concerning the competitors.
2. Weaknesses: Those are the opposite of the previous category. Those characteristics pose the organization with some form of disadvantage to the competitors. For example, in the case of CERs, the weakness may be the same as FERs, meaning the non-dispatchability of the production.
3. Systemic opportunities: those identify favorable situations and conditions at the beginning or during the development of any activity but that, at the same time, are outside the control of the organization itself, e.g., the availability of public financing or the increased environmental sensibility.
4. Systemic threats: This category is the inverse of the previous one, and it comprehends all those situations and conditions potentially either hindering or having the potential to cause the failure of a project. E.g., the end of public financing or hurdles in supplying the materials needed for CER creation.

These four categories may further be grouped into two distinct macro-categories: endogenous and exogenous characteristics [76]. Having clear what elements can be acted upon and modified and which must be taken as given allows for precise planning and avoids wasting resources.

Finally, considering strategic planning, it is possible to structure the SWOT analysis to represent and group the strategies according to the elements previously identified to which they address (Table 2). The strategies can be identified according to the elements of the SWOT they address (e.g., in Table 2, the SO strategy addresses the elements Strength 1 and Opportunity 2). Enumerating the elements allows for a more straightforward representation of the various strategies.

Using this type of representation, it is possible to represent four strategies addressing two dimensions simultaneously. These strategies can be described as [77]:

- SO strategies (Strengths and Opportunities): These are the most desirable strategies since they assume the organization to be in the right conditions to take advantage of the general trends and events through its positive characteristics.
- WO strategies (Weaknesses and Opportunities): These are strategies aimed at compensating the internal negative characteristics by taking advantage of external opportunities.
- ST strategies (Strength and Threats): are those strategies aimed at minimizing the impact of external (hence, out-of-control) events through the positive characteristics of the organization.
- WT strategies (Weaknesses and Threats): are defensive strategies aimed at compensating for internal weaknesses and shielding from adverse external events at once. In extreme cases, these strategies may translate into mergers, third-party acquisitions, or bankruptcy.

Table 2. Example of SWOT matrix representation.

	SWOT Matrix	
	STRENGTHS 1. . . . 2.	WEAKNESSES 1. . . . 2. . . . . . .
OPPORTUNITIES 1. . . . 2.	SO 1. *(S1, O1)* 2. *(S1, O2)* . . .	WO 1. *(W1, O1)* 2. *(W2, O2)* . . .
THREATS 1. . . . 2.	ST 1. *(S1, T2)* 2. *(S2, T1)* . . .	WT 1. *(W1, T1)* 2. *(W2, T2)* . . .

4. Results

In this section, the results of the surveys and interviews, which have been performed with the energy community's operators and energy market stakeholders, will be presented. The authors discuss drivers, needs, and difficulties encountered while creating an energy community process in this section.

As anticipated, the energy market for energy communities in Italy is still in an early stage. This implies that the number of communities still needs to grow, and consequently, the firms with expertise in establishing energy communities are also few.

The interviews aimed to gain insight into the operative level of energy communities in the Italian market to understand better how the different stakeholders act in an underdeveloped market with high uncertainty. The low answer rate highlights a still need to fully develop market composed of not yet fully formed stakeholder positions and an unwillingness to share information.

4.1. CERs

Here, the experiences of two Italian energy communities are reported. The legislation and the procedures for the foundation of such experiences are still unclear. The lack of clear fiscal legislation or, at least, standard practices, together with the still lack of full implementation of the European directives, leave these projects in a state of uncertainty that causes them to face substantial hardships during the creation phase, hence hindering the widespread diffusion of the communities in Italy.

4.1.1. Energy Community 1

The CER project is located in the Sicilian hinterland. The town preserves high historical relevance, with historical findings dating back to the III AD. However, most historic buildings are more recent and were rebuilt after an earthquake. The town is also part of the circuit "I Borghi più belli d'Italia" (the most beautiful Italian hamlets).

Despite the limitations imposed by the Cultural Heritage Department on new installations, the municipality was willing to endeavor to create an energy community.

The project is public-led, developed by both the local municipality and Catania University through the project TREPESL (Energy Transition and New Engagement and Local Development Models). The municipality has always been responsive to environmental topics and the integration of RESs. In fact, before this energy community project began, the municipality had already installed 300 kW of PV across their estates.

This community project was developed without external consultants and, given its limited dimension, with a 20 kW PV plant, the financial exposition of the potential members was residual. The project should be entirely financed through public incentives.

The engagement process was relatively simple, given the dimension of the town, and took place through direct calls to the potential members, message broadcasts, or social media posts explaining the advantages connected to the membership.

The only two notable problems the community clarified regarding the plant installation were the Cultural Heritage Department imposing the panels to be the same color as the building for aesthetic reasons. The numerous people interested in membership could not join since they were connected to a different electric substation.

4.1.2. Comunità Energetica Di Gallese

This energy community is the result of the partnership between "Bio-distretto della via Amerina e delle Forre", the municipality, and an ESCo located in the Viterbo province. The project was implemented due to participation in the ReDREAM European project. The ReDREAM is a three-year project that aims to support flexibility in energy consumption. The involved Town is considered a *demo-site*, where consumption metering devices are to be tested. Within the project, a local ESCo was the promoter of the energy community configuration.

Regarding the initial planning, the Bio-distretto representatives consulted with the selected ESCo to create a preliminary business plan, assuring the coverage of the initial investment together with the future financial sustainability of the project. The ESCo should provide for financial consulting, the bank relationship, and the plant installation. In contrast, the community should provide for the day-to-day and extraordinary management of the plant. The plan expects the initial investment to be financed directly by the Bio-distretto through a mortgage, while the PV plant is to be installed on the roof of a willing community member.

It must be pointed out that this plan was not implemented at the time of the interview since the community still needs to receive approval from GSE, then being excluded from the feed-in tariff. The community exists only in association, but it did not begin its operations since the exclusion from the feed-in tariff does not allow the community to receive public financing.

In developing the project, soft skills as the *facilitator* showed to be of relevance, in addition to the technical skills required for the plant realization. The skills involve clearly understanding the advantages and implications of establishing an energy community project and convincingly communicating them to prospective members. Following the communication phase, the engagement process requires the facilitator to create a motivated and cohesive group of participants to develop the project. At this early stage of the energy community market, this is a sensitive and demanding task since energy communities are rare, and people may be wary.

The energy community was initially composed of only five members, and the recruitment required a considerable investment of time and energy to the promoters. The population engagement was challenging, although the initial monetary investment cost for citizens was zero since the European funding and feed-in tariff would have entirely covered the initial investment.

The engagement technique required direct contact with the residents and public announcements from the municipality. After that, during public sessions, the benefits and advantages of being part of an energy community were explained in more detail.

In general, the lack of participation was due to a high degree of wariness and skepticism from citizens and to the delayed implementation of the new legislation, causing the exclusion of all the individuals connected to a different secondary substation, limiting the number and the location of possible prosumers.

4.2. Firms

The role of firms that are involved in the establishment of new CERs creation is shaped by the legislation. In Italy, the European legislation was, as said, partially implemented by the *Milleproroghe* Decree (d.lgs. 162/2019), which introduced the RED-II legislation in

Italian law. Before the full implementation of the directive, the stakeholders had the chance to operate in this market freely and without significant restrictions.

As a confirmation, none of the companies that the authors interviewed reported any substantial variation in their internal processes and structure after the RED-II implementation, meaning that the know-how accumulated during this experimental period had been helpful. From an operative standpoint, implementing the directive has only expanded the potential reach of energy communities from the area covered by the Medium to Low Voltage (M/L) electric substation to the area covered by the High to Medium Voltage (H/M) substation.

According to the authors' interviews, two main issues have arisen from implementing the directives. The former is linked to the fiscal treatment of the communities, and the latter concerns the feed-in tariffs that the Italian legislation envisages. There still needs to be a clear consensus on the legal treatment of the energy communities. Often, these are set up as associations, meaning that they cannot reload the VAT (Value Added Tax) as a firm and must pay it as final consumers. Furthermore, the prior legislation envisioned paying a feed-in tariff to the communities. Still, there needs to be more guidelines on whether the amounts established by the prior legislation are to be confirmed or modified according to changed market conditions.

Finally, the interviewed companies reported that they foresee further issues related to the possibility that the National Resilience and Recovery Plan (NRRP) has to finance such initiatives. The municipalities involved in CERs' development process yearned for a national agreement providing non-repayable funds. However, the agreement settled on a co-financing plan, forcing the municipalities to increase their leverage.

Within this framework, the interviewed companies usually offer various services to the CER promoters. The companies offer a wide range of services as they want to offer a tailor-made approach to each initiative since the Italian market still needs widespread practice.

The offered services cover the preliminary stage, such as the feasibility assessment of the project and its design, to the implementation phases process (e.g., bureaucratic requirements, statute drafting, and fundraising). Additionally, the firms can help in identifying the boundaries of the area pertaining to each electric substation and, in turn, to an energy community, and in engaging the prospective community members, also by explaining and clarifying what is an energy community and what are the advantages connected to its membership.

The services offered by the company may be summarized as:

- Initiative planning,
- Funding consulting,
- Plant planning, realization, and starting,
- Operation and Management (O&M)
- Asset management
- Information and Communication Technologies (ICT)

Another service that firms offer is direct financing of the project. This service is subordinated to the financial soundness of the business plan and the financial forecast. One of the firms highlights crowdfunding as an additional form of financing, specifying how this tool is still underdeveloped in Italy. Finally, they stressed the possibility of applying for European grants since there is a general need for more privately provided loans and funding for CER projects.

All the interviewed firms noted how photovoltaic technology (PV) has a competitive advantage over the other types of RES when applied to the energy communities. The PV advantage is mainly connected to the management easiness; it is scalable and easy to install, particularly for users who do not have energy production as their core business. Finally, the PV has the potential for hydroelectric integration for overnight production.

Finally, the firms recognized some opportunities connected to the spread of energy communities. The energy communities may stimulate job creation in the form of technicians needed for planning and plant installation, law advisers studying the evolving legislation on the matter, and economic advisers studying the financial sustainability of the projects.

5. Discussion

The discussion is structured as a SWOT analysis, separately highlighting the differences of the energy community concept. The SWOT can be conducted and performed from a private and a public perspective. In Table 3, it is possible to read a quick summary of the various CER characteristics and their grouping in the four categories.

Table 3. SWOT analysis. Summary of interview and survey answers.

SWOT	
STRENGTHS	**WEAKNESSES**
Reduction in energy billing	Non-dispatchable energy production
Local development through investments and high initial cost (relative to the households' willingness to pay	
Emission reduction	Lack of market good practices
Increase in energy consumption efficiency	Need for precise bookkeeping of the energy exchanged with the grid
Link with the NRRP funding	Lack of standardization
	Need for aggregation for effective market selling
OPPORTUNITIES	**THREATS**
Increase in human capital (opportunity for the consumers to acquire new skills and knowledge in a highly technical market)	Possible reduction in funding in the future
Availability of public funding	Investment diversion favoring energy sources alternative to renewables (e.g., nuclear power)
Possible innovation through the proposition of standardization approaches	Uncertainty in the market
FER technology development	Unclear legislation
Increase in fossil fuels cost	Insufficient public funding
Job opportunities for accounting, financial, and law advisors	Legislation changes disrupting the fundraising process
Creation of new professions aimed at the initial point	Continuous engagement of the community members and difficulties in assuring the long-term economic stability of the energy community

From a private point of view, the main strengths of CER implementation are the reduction of the energy bill and the eventual income obtained through the supply of excess energy to the national grid. On the other hand, the risks involved in creating an energy community seem reasonably low, given the feed-in tariff and the availability of public funds to sustain the projects. The availability of public funding mitigating any individual risk together with the collective investment reduces the overall individual risk to virtually zero, as described in Section 4.1.2).

Given the limited individual risk and benefits in the form of reduced energy bills, it is still being determined why the development of these projects is lagging in Italy.

One explanation may be that the perceived potential benefits need to be higher, but it remains to be understood what the cost is that the benefit is not enough to overcome. The technical skills required to establish an energy community may be perceived to capture the high initial cost for such ventures. The fact that the community members have to rely on external consulting firms may aggravate this aspect of the problem since there may be the idea that the future possible benefits will be distributed within the engaged company.

Another critical aspect of any community energy project is bureaucracy, which creates another possible obstacle in launching such projects. As before, an external advisor may take care of the problem, but again, there may be the risk that it will absorb a consistent part of the benefit.

The monetary incentive to act, in the form of the overall benefit from the community, may be perceived as too little to push any individual to justify the research of the professionals needed to develop such projects after the consultancy costs are considered.

From a member's point of view, the conundrum of establishing a new energy community may be represented as a free-riding problem. Since the CER creation process, at least in the initial phases, rests on the volunteers' shoulders, those interested in CERs may be discouraged by the amount of work needed. The problem may persist after the creation of the community if the work is still not equally distributed or the benefits are not shared considering the uneven workload.

Without a fair sharing mechanism favoring those willing individuals initiating the process, there is the risk that this bottom-up approach may not work efficiently.

The relationship between the community members can be represented with the "prisoner dilemma", in which the parties involved's collaboration may create greater value for everyone. However, each individual has the incentive to not cooperate since, in this way, they would obtain a higher personal benefit, for example, in the form of avoided costs.

In the following paragraphs, the pros and cons of the energy community configuration that emerged from our interviews both with the CERs and with the private companies, will be presented to provide a clearer picture of the issue at hand.

5.1. Strengths

One of the main strengths of the CER is the possibility for its members to reap the benefits linked to the community in the form of a decrease in energy billing, a secondary form of income by supplying energy in the primary grid, or, more indirectly, by increasing the local welfare [78]. Additionally, the CER configuration allows for the constitution of energy autarkies, allowing isolated communities to source energy at a lower price than on the main grid [79,80].

Given the lower cost of locally generated energy, 12 €ct/kWh instead of the price market of 30 €ct/kWh, as long power demand exceeds the PV generated energy, it is economically feasible to engage in such generating activities [81]. The price differential economically justifies and drives the decision to participate in energy generation activities.

From a technical point of view, the demand aggregation should allow for smoother spike management on the peaks on the grid. If a community storage system is provided, managing the demand within the community should also be more manageable, with an overall more efficient energy use and distribution. Additionally, any collective investment provides higher economies of scale, possibly investing in a feasible storage system [82].

As highlighted in the interviews, the market offers relatively cheap PV installations that provide a flexible solution for any situation.

The availability of solar energy, particularly in Italy, together with the increase in technical efficiency and its generalized price decrease, opens up the possibility for energy communities to generate affordable energy with flexible technology, potentially adjustable to the several different necessities of the projects [83].

At the same time, PV panels do not emit Greenhouse Gases (GHG) of any kind and, with an expected life of 20–30 years [84], they require little maintenance with the possibility of recycling them at the end of their lifespan [85].

5.2. Weaknesses

Overall, real estate in Europe accounts for a total of 40% of energy consumption and 36% of GHG emissions [86]. While there is scope for small interventions and the creation of numerous small communities, self-sufficiency is most beneficial for great consumers or large aggregations of communities, enjoying larger scale economies and efficiency gains due to the increase in dimension [87].

Standardized measures for project comparison are generally lacking, and the consequential lack of quantitative analyses prevents any study about the optimal sizing of the community and the optimal degree of decentralization of the system [81].

The use of PV panels, while advantageous for the user thanks to relatively low installation cost and low maintenance required, displays the problem of storing the generated energy and disposing of the materials at the end of the life-cycle. With an increase in overall PV installations in Italy, the problem becomes relevant. In particular for the rare materials needed in PV production [84].

The problem of waste disposal and recycling couples with the problem of energy storage systems; on the one hand, the RES has the problem of variability and instability in production due to weather conditions. On the other hand, specifically for PV, energy production is feasible only during the daytime. Therefore, the energy demand reaches its maximum during those hours, or part of that energy will be wasted. The variability in production and the disconnection between peak generation and demand call for the use of batteries. The batteries pose a double problem, both the purchase cost and their disposal at the end of their life [88].

5.3. Opportunities

As mentioned above, the main opportunities for energy communities are related to the high public interest in environmental and energy transition topics, the cost of PV panels is decreasing, and there is governmental support towards those projects.

Further, there is the possibility for integrating the energy communities through blockchain technology, allowing the communities to trade energy peer-to-peer (P2P) without needing a dedicated marketplace [81,89].

Energy communities can also participate in the electricity market, allowing them to further possible income [90].

The energy system may benefit from providing ancillary services by small and decentralized entities, possibly capable of rapid interventions through storage systems [91] or through the intervention of coordinated prosumers [92].

Any group of individuals can strengthen the bonds between them with the opportunity to deepen their technical knowledge of the functioning of the electrical market and power generation. In this sense, there are several opportunities to increase both the individual human capital and the overall social capital [93].

Additionally, as reported above, the development of energy community projects may help create new business models and good practices [43,93].

5.4. Threats

In Europe, the connection to the main grid ratio is already around 100% in a highly centralized system. Hence, the integration of energy communities in the system requires a reconsideration of the system organization [81].

It should be noted that there is a risk of a discrepancy between local ownership and local benefits, i.e., a risk that the benefits will be absorbed elsewhere, as in the case of an unfavorable agreement with the consulting companies needed when there are technical skills shortages [94].

There is the possibility that the project's promoters must face a trade-off and have to decide whether or not they would prefer a decrease in CO2 or an increase in costs and competing land use [95].

A further consideration that needs to be considered is that all the consumers usually share the system costs. If the establishment of energy communities increases substantially in number, there is a risk that a smaller amount of users will bear those costs [96]. There is a clear microeconomic benefit, meaning an increase in individual utility, but a less clear macroscopic effect.

There is the risk of market fragmentation, with many small stakeholders operating in the market, retaining small market power and having little knowledge of the electric system, possibly causing disruption [97] also related to the *energy trilemma* [4].

Finally, the public financial support for such projects will end at some point. Then, there is the risk that the communities will arrive unprepared for such a moment, jeopardizing the results and achievements obtained up to that point.

6. Conclusions

The literature review and the interviews have highlighted some of the critical dimensions of the energy community phenomenon and the energy transition problem.

The paper aimed to describe the overall situation of energy communities in Italy. The current situation has been presented through an initial literature review, presenting how researchers approach the topic. The review has highlighted an increasing bulk of literature on the topic, particularly in recent years, but still needs more consensus. Notably, the subject of energy communities is addressed in the literature on different topics, possibly linked to the cross-disciplinary nature of the CERs, requiring a wide array of skills to be correctly and fruitfully established.

The literature review has also integrated a section on the legislative framework in force in the European Union and how it is implemented in Italy, showing the country's delay in effectively implementing the European directives.

After that, the paper focused on the feedback received from market operators, both energy communities and firms. The surveys and interviews gathered the agents' knowledge and highlighted the positive and negative aspects of the Italian experience so far. The agents highlighted the lack of clarity in the legislation, the delays, and overall uncertainty while also specifying the potential of energy communities to positively affect the areas where they are located.

Finally, a general discussion on the positive and negative aspects of the energy communities, summarizing the results of surveys, interviews, and literature review, is presented and mediated through a SWOT analysis.

There needs to be more bottom-up initiatives, possibly due to a lack of information, the mismatch between the demand and supply of energy consulting services, and a general lack of trust in the project and the members of the future energy community. Hence, to foster people's engagement, specific techniques are needed to increase or consolidate the trust among potential members and, by doing so, their willingness to cooperate.

As highlighted by the interviews, any initiative relies on already-existing trust bonds, e.g., in small towns where the mayor and the residents know each other or have preexisting business relationships.

The lack of quantitative indicators, KPIs, and, in general, any comparable measure impedes, on the one hand, any deep study on community sizing and system optimization and, on the other hand, the establishment of business models and best practices shared.

In conclusion, given the lack of coordination between individuals, a bottom-up approach, at least in this initial implementation phase, will prove likely unsuccessful. The intervention of big firms, the public sector, or partnerships between the public and private sector may provide coordination and overcome the organization problem, favoring the creation of communities. The increase in the number of communities may provide for the business customs and the data needed for analyses. The possible implications for the subjects involved in the energy community creation process are several and diversified according to their role. For example, the public has the issue of correctly and effectively implementing European norms while managing funds. All of this should be obtained by favoring a bottom-up approach to strengthen social cohesion within the communities. Since the social impact may be difficult to measure, the policy effectiveness might be measured through a decrease in emission levels and energy costs for community members. At the same time, private actors will see cost decreases thanks to financing and lower energy billing.

As a further research development, the focus on case studies, particularly for the Italian case, is suggested. Following the creation phases of an energy community should provide much-needed insight into the hindrances and advantages of the system. Additionally, a methodology for standardized data gathering might be studied in the future, favoring quantitative analysis.

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