

Review

The Emerging Trends of Renewable Energy Communities' Development in Italy

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Abstract: Increasing concerns over climate change and energy poverty have triggered the transition toward a decentralized energy system through the widespread adoption of renewable energy technologies. Although this transition was led, over past decades, mainly by major investors and large industrial players, citizens and local authorities are increasingly playing an active role in delivering clean energy investments. In particular, the current European Renewable Energy Directive introduced Renewable Energy Communities (RECs), which allow citizens to collectively organize their participation in the energy market, leading to a more distributed renewable energy system and new forms of sustainable, collaborative, and democratic economies. RECs currently under implementation show differences among European countries due to the different national contexts. A literature review exploring the peculiar Italian regulatory framework on RECs and its recent evolution has been carried out to identify available national and regional financial support mechanisms, barriers, and emerging trends in the diffusion of RECs across the country. The paper reviews and describes three main approaches that emerged in the development of RECs in Italy, discussing their strengths, and limitations. In addition, it provides a brief comparison of the regulatory framework in different European countries, highlighting the distinctive features of the Italian experience. Although the development of RECs in Italy involved a combination of both public and private initiatives, the leading role of local authorities as promoters and aggregators of RECs is evident. This role helps preserve the social impact of RECs but might slow down their implementation due to bureaucratic issues often linked to public procedures and procurement processes, as well as the lack of sufficient expertise within local authorities.

Keywords: energy community; Renewable Energy Community; RED II; energy transition; Italian regulatory framework; developing model



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1. Introduction

The energy sector is currently at a turning point. It has always played a key and vital role in the development and progress of modern societies, providing the power that drives our economies and our daily lives; however, the way we produce and use energy has significant impacts on global warming and, thus, on climate change. The reliance on fossil fuels has contributed to global warming. As a result, the call for a shift toward more sustainable energy sources is increasing and many countries are taking ambitious actions to reduce their greenhouse gas emissions [1–3]. Moreover, the ecological transition, a common goal internationally recognized in the United Nations (UN) 2030 Agenda [4] and the European Union's (EU) 2030 Climate Target [5], requires an acceleration of the shift from an economy based on the use of fossil fuels to clean, renewable, and widespread forms of energy production. The urgency is not only technological but also geopolitical; the confluence of crises in recent years has not only focused attention on the reduction of energy use, but also on the need for a reformation of the energy markets that allows security, stability, and affordability.

In this context, Renewable Energy Communities (RECs) are gaining momentum, standing as leading configurations of the new decentralized energy production and consumption paradigm; RECs are focused on the simultaneous fulfillment of environmental, economic, and social benefits [6–12].

In 2019, the Clean Energy for All Europeans Legislative Package (CEP) [13] recognized the role that REC ownership can play in helping the EU meet its climate and energy objectives [8,14]; it also offered an enabling legislative framework for citizen and renewable energy communities. Inside this package, for the first time at the European level two directives provided a specific recognition of the energy community concept [6,8]. The Directive 2008/2001 (the recast of the European Renewable Energy Directive, known as RED II) introduced the definition of Renewable Energy Community (REC) [15], whereas the Directive 944/2019 (Internal Electricity Market Directive, known as IEMD), which is dedicated to electricity market design, defined the Citizen Energy Community (CEC) model [8,16].

RECs were defined in the RED II as legal entities, grounded on the voluntary participation of their members or shareholders and entitled to produce, consume, store, and sell renewable energy to provide environmental, economic, and social benefits, rather than financial profits, to the community members. RECs can, therefore, contribute to increasing local acceptance of renewable energy projects and accelerate the process of decarbonizing the energy system [9,10,17–20].

Although RED II provided a framework for the implementation of RECs in the EU, the transposition depends on the individual EU Member State. By 30 June 2021, each EU Member State was expected to transpose RED II to develop an enabling framework for an extensive uptake of RECs and define their rights and duties [7,17,21–23]. The progress on RED II implementation and transposition varies considerably among the Member States since RED II contains legal, governance, spatial, and technical concepts that should be elaborated to be integrated at the national level. Different research projects, such as NRG2peers [24] and COME RES [25], as well as articles and reports (e.g., [8,17,20–23,26–32], etc.), examine the transposition of RED II in different Member States by highlighting similarities, differences, weaknesses, barriers, and opportunities via analysis and comparison of regulations in different European countries. However, a detailed review of the implementation process and its implications and consequences within the larger and highly populated EU Member States is still missing.

In Italy, one of the mostly populated EU Member States, the process of implementation is still ongoing; the present paper analyzes and reports the different configurations and emerging trends of REC development, focusing on the peculiarities of the Italian context. By examining the available literature about the mapping activities of REC experiences in Italy, the paper aims to outline the Italian development pathway of the REC sector. It identifies three developing models which share sets of common characteristics, such as stakeholders, purposes, sharing benefits models, available fundings, and subsidies for their development, as well as technical and legal barriers that are emerging in the process of implementation of RECs across the country. Challenges to the territorial implementation of the three main REC models have been analyzed and discussed in order to outline the possible solutions, tools, and models that can be exploited for REC development and management. This may help improve the ongoing process and may provide guidance for other EU and non-EU States that still need to set up RECs regulation and models.

In summary, the paper intends to provide a novel and comprehensive analysis of the distinctive features of the Italian regulatory framework on RECs through a brief comparison with other Member States. At the same time, the paper outlines potential pathways for the development of RECs throughout the country, making it a valuable resource for policymakers, researchers, and anyone interested in RECs.

Section 1.1 reports the Italian regulatory framework, updated in January 2023, while Sections 2 and 3 are dedicated to the description and review of the emerging trends, barriers, and pathways to REC development in Italy. Section 4 offers insights into the

regulatory frameworks and support schemes implemented in other EU Member States for REC development, aiming to verify the completeness of the Italian regulation and analyze its enabling potential for the diffusion of RECs. Lastly, in Sections 5 and 6, general discussions and conclusions are proposed.

1.1. Italian Regulatory Framework and Recent Developments (Update to January 2023)

In Italy, between the end of 2019 and the beginning of 2020, a process of partial and early transposition of RED II was started to experiment *pro tempore* RECs configurations and experience their effects, impacts, and potential critical issues with the decree-law no.162/2019 [33], known as “Milleproroghe” (converted into law on 28 February 2020 n.8 [34]) [8,35]. This transitional framework allowed the activation of collective self-consumption initiatives (introduced in RED II as Jointly Acting Renewables Self-Consumers [15] and defined in the art. 42bis of decree-law no. 162/2019 [33]) and REC experiences. It also introduced geographical and technical constraints and specific characteristics, such as: the maximum eligible nominal power (200 kWp) of each Renewable Energy Source (RES) system for obtaining the feed-in premium tariff on the shared energy; the connection of RES plants and members to the same low/medium voltage (LV/MV) substation; and the possibility for a REC to hold a RES facility only if it entered into operation after March 2020 [7,8,14,29,36].

In 2020, the Italian Regulatory Authority for Energy (Arera), with the Resolution 318/2020 [37], and the Ministry of Economic Development, with the Ministerial Decree DM 16 September 2020 [38], respectively defined the regulatory model and tariff components to be applied to members of RECs and participants of collective self-consumption schemes, and the support mechanism, in the form of a feed-in premium tariff, available for the two configuration schemes [35]. Arera, through the Resolution 318/2020, decided to resort to a virtual regulatory model for the management of RECs and the calculation of energy produced, consumed and shared, offering RECs and collective self-consumption schemes the refund of certain grid components (about 8 €/MWh with respect to the energy produced by the RES plant and consumed in the same time frame by REC members, compared to about 10 €/MWh for collective self-consumption schemes). The Ministerial Decree 16 September 2020 then identified the incentive on shared energy (such as a feed-in premium tariff) equal to 100 €/MWh for participants in collective self-consumption schemes and 110 €/MWh for RECs, both available for 20 years. It is under this transitional regulation that the first Italian REC was established in the municipality of Magliano Alpi (Piedmont region) in December 2020 [39].

The course of 2021 was characterized by the activation of other RECs, allowing the identification of critical elements and limitations of the transitional regulation framework, and by the issuance of the decree which enabled the full transposition of RED II in Italy: the Legislative Decree no. 199 of 8 November 2021 [34]. This Legislative Decree was defined to enable the development of large-scale energy communities since it included some innovations regarding the size of the RES plants admitted to the incentive mechanisms (admitted system’s nominal power up to 1 MWp) and the physical extension of the community, recognizing as potential members of the same REC all the users connected to the same medium/high voltage (MV/HV) substation (instead of the LV/MV one) [21,29].

Article 14 of Decree 199/2021 defined the specific criteria for coordination between the measures introduced by the National Recovery and Resilience Plan (NRRP) and sectoral incentive instruments [35]. Component 2 (C2—renewable energy, hydrogen, grid, and sustainable mobility) of NRRP’s Mission 2 (M2—green revolution and ecological transition) aims to contribute to the achievement of strategic decarbonization goals through five tasks and lines of investments, including one related to the promotion of RES for energy communities and energy self-consumption configurations [40–42]. Under the M2C2 mission of NRRP, a 2.2 billion EUR fund has been set up to provide financial resources for the installation of 2 GW of RES facilities in REC and self-consumption schemes located in small

towns with fewer than 5000 inhabitants, which represents congenial support to finance public–private REC initiatives [21].

On 15 December 2021, the Legislative Decree no. 199 came into force and, consequently, the deadlines by which Arera and the Ministry of Environment and Energy Security were required to update, respectively, the regulation and the support mechanism to be applied to RECs and collective self-consumption schemes were confirmed [35,36,43]. These regulatory documents were expected by mid-2022; however, Arera published the regulatory document, called Resolution 727/2022/R/eel “Integrated Regulation for Diffuse Self-Consumption” (TIAD with the Italian acronym) [44], at the end of December 2022, while the decree that will define the financial support mechanisms is still under discussion and preparation by the Ministry of Environment and Energy Security (MASE with the Italian acronym). In fact, at the beginning of December 2022, the Ministry published a public consultation [45], obtaining opinions from public and private stakeholders about the expected decree; this consultation covered the following subjects: the value of the feed-in premium tariff and its applicability, the duration of incentives, and the ministry’s willingness to limit the total power (5 GW) of RES systems installable in the period 2023–2027 under these configurations. The expected decree will also specify the compatibility of national (NRRP) and regional funds with the incentive mechanism of shared energy (feed-in premium tariff). On the other hand, the authority’s regulatory document (TIAD) established the criteria that Distribution System Operators (DSO) must comply with in order to identify the areas underlying the MV/HV substation to simplify operational procedures for the establishment and management of RECs configurations. The document also defined how the Gestore dei Servizi Energetici—GSE (a state-owned company which manages renewable energy incentives) quantifies shared and self-consumed energy under REC configurations.

The delay in publishing this regulation and the financial support mechanisms for RECs through 2022 have also delayed the publication of the NRRP calls for supporting and stimulating the development of RECs in Italy. As a result, the deployment of large-scale RECs in Italy has been hindered. During these years, some experiences have emerged and continue to develop that follow the regulation that incentivizes the energy produced and shared by plants with a maximum nominal power of 200 kWp, in which all members belong to the same LV/MV substation. In 2023, the regulation is expected to be completed, presumably leading to the acceleration of the development of RECs and the promotion of RES in Italy.

2. The Emerging Trends in Italy

2.1. National and Regional Support Schemes for RECs Development

The activation of the REC model in Italy suffered a setback due to the postponement of the publication of the Authority’s regulation (TIAD) and the decree on incentive mechanisms. This has led operators to wait for the final regulation before undertaking concrete initiatives and investments regarding the diffusion of these models.

Despite this, there is evidence of considerable ferment regarding RECs development in Italy. Support tools, such as national and regional calls, private and open-access REC-modeling platforms, and seminars and conferences have been made available to develop and disseminate information and best practices about RECs. Moreover, it is worth mentioning that, in Italy, the energy sector legislation is shared among the national authority and regional authorities [22]. In such circumstances, regional authorities, as public entities in contact with the territory and its citizens, have played an important role in promoting REC experiences. Most of the Italian regions have issued ad hoc actions with the aim of promoting and supporting REC configurations; the first examples of regional laws on energy communities came from the Piedmont and Puglia regions. In 2018, the Piedmont region implemented the law no. 12 of 3 August 2018, known as “Promozione dell’istituzione delle comunità energetiche” [46]; this law recognized the social and environmentally sustainable value proposition embedded in energy communities, being the first legislative initiative explicitly dedicated to the Italian REC sector [47,48]. Puglia region, with law no. 45 of

9 August 2019 [49], was the second region to enact a specific measure for the promotion of RECs in Italy, providing ad hoc incentives to financially support their development.

Apart from these early and pioneering examples, most Italian regions, in the following years, have enacted regional measures concerning renewable energy self-consumers and RECs promotion. At different times, Italian regions have also determined how and with what intensity they intend to support the diffusion of these configurations. Operational financial supports to sustain their establishment and technical–economic feasibility design are among the most common supporting mechanisms adopted. In September 2022, the Energy and Strategy group of the Politecnico di Milano mapped 14 regional measures promoting the establishment of RECs [50]; there are now 16. Most regions only financially support the establishment of RECs; however, a few have allocated funds for the purchase and installation of RES systems. In addition, most of the regional calls target local authorities and public administrations as the major aggregators of the REC initiative (e.g., Lombardy Region [51], Sardinia [52], Campania [53], Sicily [54], etc.), while others target a wider audience, such as small- and medium-sized enterprises (SMEs), non-profit organizations, etc. (e.g., Molise [55]).

Other initiatives at the supra-regional level have been published in recent months by foundations working on Italian territory. Some examples are the calls of “Fondazione Cariplo” and “Fondazione con il SUD”, which are addressed mainly to municipalities and non-profit organizations [56,57]. Other available funds are those of the National Plan for Complementary Investments (PNC), which is aimed at integrating, with national resources, the interventions provided by the NRRP; thanks to this organization, the NextAppennino program allocated 68 million euros to the seismic areas of central Italy (Abruzzo, Lazio, Marche and Umbria), affected by the earthquakes between 2009 and 2016, to create energy communities promoted by territorial public administrations [58]. Finally, as already mentioned, the NRRP allocated 2.2 billion EUR for the promotion of RECs in municipalities with fewer than 5000 inhabitants through the M2C2 measure.

2.2. Development Trends of Italian Energy Communities

Recently, a mapping activity of the REC experiences developed in Italy began. In February 2022, the “Orange Book 2022”, written by Fondazione Utilitatis and Ricerca sul Sistema Energetico—RSE (Energy System Research) [35], mapped about 20 REC experiences (actually established) on the Italian territory with RES plants, reporting only photovoltaic (PV) plants with nominal power from 20 to 60 kWp. The deployment of solar energy technologies has gained more attention, being the most technically and economically feasible solution for the implementation of RECs in the national and local context. The feed-in premium tariff foreseen by the Italian regulation for RECs (i.e., 110 €/MWh for energy shared by REC members) does not allow for a wide choice of RES technologies that are economically affordable and, at the same time, does not enable the establishment of a viable business model.

In May 2022, Legambiente, an Italian environmentalist association, continued the mapping initiative of collective self-consumption experiences in Italy. In total, 35 established and operating RECs and collective self-consumption configurations were identified; in all, 23 of these configurations are RECs, with a size of RES plants that typically ranges between about 15 kW and 103 kW [59–61]. All the operating REC experiences, apart from one, made use of PV technology as a power generation system, while in the remaining REC mapped project, solar thermal and geothermal systems were also surveyed. In addition, several other studies and reports, such as the one reported by De Vidovich et al. in 2021 (Community Energy Map [36]), the Energy Community Repository initiative of the European Commission [62,63], or European research projects, such as COME RES [25], NRG2peers [24], and REScoop.EU [64], and many others, also report and describe REC experiences in Italy, thereby contributing to the documentation and spread of the best practices of Italian energy communities.

Overall, the development of RECs in Italy is driven by a combination of public and private initiatives, with the goal of increasing the exploitation of renewable energy and, at the same time, bringing social, environmental, and economic benefits to community members. The leading role of public administrations (PAs) in the spread and dissemination of RECs is undoubted. The national and regional calls mainly entrust PAs with the role of major aggregators and promoters of RECs. As already highlighted by Candelise and Ruggieri in 2020 [48], the role of local authorities as facilitators of several projects also continues to emerge; local authorities facilitate these projects by providing the assets to develop the initiative, e.g., making the public building rooftops available for PV installation, by creating the local regulatory and financing framework conditions to allow them [48], or even encouraging citizen participation in energy transitions [65].

Different models of RECs must respond to the different needs and benefits expected by their own members and to the site-specificity of the area. Starting from the first identification of the Italian REC models carried out by two Italian studies in 2021 [36,66] and a review of further papers and reports [27,29,35,39,48,59,62,63,67], in presenting case studies of Italian RECs, Table 1 revisits and summarizes the main characteristics of three developing models by identifying different stakeholders and proponents, goals and value propositions, and funding and subsidies available for the development of RECs; it also clarifies benefit distribution schemes among members. Compared to the existing literature, a new “Energy/Technical operator driven model” is proposed, which arises not only from a new business opportunity for energy operators, but also from some barriers and limitations highlighted and encountered in the first two models. The following sections will describe the three models in detail by discussing their peculiarities.

Table 1. Qualitative identification and categorization of Italian Renewable energy community development models.

	Bottom-Up/ Citizen-Driven	Top-Down/ PA-Driven	Energy/Technical Operator Driven
Main stakeholder/ Proponent	Citizens, local private proponents, and SMEs	Public/local authority, PAs, and non-profit organizations	Technical player/energy operator
Purpose	Lowering energy bills, consumers empowerment, sharing energy/economic benefits, and fostering social cohesion and local economic development	Energy consumption reduction, tackling energy poverty, fostering social cohesion, value generation in the territory, and local economic development	Business opportunities, energy efficiency measure promotion and commissioning, local economic development, and energy consumption reduction
Available fundings and subsidies	Members’ investment, feed-in premium tariffs, bank loans, and tax deductions	Public (national and regional) funding (in the cumulable percentage) and feed-in premium tariffs	Developer/proponent and members’ investments, and feed-in premium tariffs
Benefits-sharing model	Equitable redistribution or according to the investment participation/amount of energy shared	Equitable redistribution, establishment of a social funds for disadvantaged members, community services, or energy efficiency measures	Mainly divided between energy/technical operator and members (depending on the level of investment participation)

2.2.1. Bottom-Up Model

The bottom-up model, whose stakeholders and proponents can be citizens or small- and medium-sized enterprises (SMEs), can be driven by different purposes, such as the possibility of lowering energy bills, contributing to the energy transition, fostering a sense of social cohesion, developing local economies and consumer empowerment, etc. In this model, the investment is fully supported by citizens and SMEs who can take advantage of tax deductions and bank loans to support them and the premium tariff available for 20 years, as well as the so-called Superbonus 110% incentive; the latter funding support is available according to the limits defined by the Italian Revenue Agency and in case of complex building renovation [68,69].

The citizens-driven model is theoretically the one with the least complexity in terms of organization and governance of the aggregation: it requires few people to begin the project and a potentially limited number of actors can be involved. Moreover, the absence of intermediaries allows equitable sharing of the economic benefits among the community members according to a polycentric governance model [70]; economic benefits are allocated according to the energy actually shared by each member of the aggregation or somewhat proportionally to the investment incurred for the installation of energy production facilities. Despite this, the model is currently the least widespread configuration because it requires citizens and/or SMEs to be willing to support the entire investment, aware of its opportunities and limitations, and able to evaluate them appropriately.

Citizens and SMEs then have to deal with the technical, organizational, and administrative aspects of the project, though they may be supported by experts. Table 2 reports an example of a REC, developed in the Lazio Region, in the center of Italy; this community was established on private initiative according to the bottom-up model [59].

Table 2. Italian REC developed with a bottom-up model in Lazio Region.

Name	Verso il Futuro—Comunità Energetica del Lazio Meridionale
Main proponent	Start-up in the agricultural sector
Members	Private members (private citizens and a start-up)
Purpose	Lowering energy bills of the members
RES system	20 kWp, photovoltaic system
Financial support	Private investment, feed-in premium tariff
Specific features	Established as a voluntary association

2.2.2. Top-Down Model

As previously mentioned, local authorities and PAs are the main beneficiaries of economic support from national, regional, and territory foundations and have been identified as the major catalysts and aggregators in developing and promoting RECs in Italy. The government provided municipalities and local authorities, as connoisseurs of their own territorial specificities, with economic support aimed at triggering new REC projects on their territory. Most REC experiences in Italy have originated according to a top-down or PA-driven model that, as can be seen from Table 1, has a main objective of encouraging energy use reduction for the public and REC members, tackling energy poverty, encouraging social cohesion, and generating value in the territory. More than 60% of REC experiences surveyed by Legambiente in May 2022 [59] have a municipality or a local organization as the project promoter and are based on the direct partnership between citizens and the local public authority or a non-profit organization. RECs are key elements for local authorities, not only because they lead to increased production, use, and share of energy from RES, but also because they allow opportunities for citizens to aggregate and confer with local authorities about the design, purposes, and operation of the future REC.

From an economic point of view, the PAs can join RECs by offering their own available surfaces and areas for the installation of RES plants that access public fundings, as well as receiving the feed-in premium tariff distributed by the Gestore dei Servizi Energetici—GSE based on the possibility of combining incentives with national or regional fundings (as mentioned before, this potential combination is still under discussion and will be specified in the decree of the Ministry of Energy (MASE) expected later this year). The sharing of economic benefits inside the REC is typically based on equity among members; e.g., a social fund can be created targeting the more disadvantaged members or to finance community services or energy efficiency measures; alternatively, the benefits can be redistributed based on the amount of energy shared by each member.

However, this energy community development model is often characterized by limited technical and administrative expertise among promoters and members, especially in small municipalities; this characteristic makes it scarcely scalable as a model in the market in the long run [50]. Moreover, bureaucracy issues are often linked to public procedures

and procurement processes, hindering the fast and practical implementation of works necessary to support the communities and, in the end, the operational deployment of RECs. Therefore, the PAs, despite being identified as the major community aggregators on the territory, often lack the specialized capabilities to efficiently guide actions on the territory and support the development of energy communities.

The number of Italian municipalities in 2021 was 7901, of which 5529 (about 70% of the total) have a population lower than 5000 people [71]. Moreover, the NRRP funds for the promotion of energy communities are allocated to these municipalities, which suffer the most from the lack of technical expertise helpful in the conception and design of RECs. In addition, territorial fragmentation in Italy is very high and this may limit the homogeneous application of an energy policy not only throughout the country, but also across regional territories.

Taking the Lombardy Region as an example, there are a total of 1506 municipalities, 69% of which are small municipalities with fewer than 5000 inhabitants—a further 21% have fewer than 1000 inhabitants [72]—which implies having not only an inadequate technical, but also administrative structure to support any kind of project. The technical staff in these municipalities are generally shared with other neighboring municipalities; thus, technical presence is not even assured for all days. Moreover, technical expertise is often not only limited in small municipalities, but also in medium and large ones. In Lombardy, in 2021, only 23 energy managers were appointed among all public administrations, including regional and provincial authorities. However, the professional figure of the energy manager in Italy should be mandatory in public administrations where the primary energy use of the owned building stock exceeds 1000 toe/year [73–75]. If small municipalities suffer the most for technical and administrative expertise shortcomings, the large municipalities might have difficulties in the effective engagement of the population because of their territorial extension.

In this sense, Lombardy Region has tried to ensure technical support in the field of RECs by establishing, in 2022, the so-called Lombardy Renewable Energy Community; the regional authorities also assigned to it the task of supporting public and private entities, implementing a monitoring system aimed at disseminating the best practices, and gathering elements for the setting up of specific policies to promote RECs [76]. Most public funding calls provide financial support for the design and establishment phase of the REC; however, only very few have provided a technical core group or one-stop shops to support municipalities in the whole process of REC establishment.

Table 3 reports a summary of a REC developed under the top-down approach in the Friuli–Venezia Giulia Region, in the northeast area of Italy [59].

Table 3. Italian REC developed with a top-down model in the Friuli–Venezia Giulia Region.

Name	Comunità Collinare del Friuli—San Daniele 1
Main proponent	Municipality of San Daniele del Friuli
Members	Private and public members
Purpose	Lowering energy bills of the members, promoting RECs through targeted activities energy saving, and encouraging sustainable best practices
RES system	54 kWp, photovoltaic system
Financial support	Regional and municipal funds, symbolic membership fee, and feed-in premium tariff
Specific features	Established as a voluntary association; technical support of the Energy Center (Politecnico di Torino) within the RECOCER project [77]; first REC of a large area project involving other neighboring municipalities

A configuration that can be included in the top-down model of REC development is one in which the municipality is the aggregator and promoter of the REC project, but is supported by its in-house energy company or an energy cooperative which, unlike common energy operators, has a distinctly territorial vocation.

The energy community “Biddanoa E’ Forru” [59], established in the municipality of Villanovaforru in the Sardinia Region with the technical support of an energy cooperative, can be an example of such a public–private cooperation model.

2.2.3. Energy Operator Model

The often-lacking technical expertise within local authorities, especially when they are very small, can represent a limitation to the spread of REC initiatives. The last development model of the RECs is generated from this situation. The energy operator model is started by energy or technical operators who, if energy production and trading is their primary activity [78], cannot be members of the community but can be responsible for the energy and economic management of the REC.

The members of the REC can be public or local entities, private citizens, and SMEs. The energy player could also partner with the local municipality as a connoisseur of its territory and citizens, while simultaneously benefitting from the possible business opportunities of implementing energy efficiency measures along with REC management activities. Often, if the community members include a local authority, the energy operator and the municipality sign a public–private partnership agreement aimed at carrying out multiple energy measures.

In general, the investment can be endorsed by the energy operator or participated in by other public or private members. In both cases, the technical expertise is provided by the energy operator, whose presence can facilitate the scalability of the initiative. Incentives can be distributed between the energy operator and the members based on the investment sustained and the intended business model.

Table 4 reports information about a REC developed under the energy operator-driven approach in the Emilia–Romagna Region, in the north-central area of Italy [59].

Table 4. Italian REC developed according to energy operator-driven model in Emilia–Romagna Region.

Name	Energia Verde Connessa
Main proponent	Energy Service Company (ESCo)
Members	Three enterprises
Purpose	Lowering energy bills of the members
RES system	70 kWp, photovoltaic system
Financial support	Private investments of the ESCo
Specific features	The investment and realization of the PV systems was carried out by the ESCo; the energy company will sell the energy to the three enterprises for about ten years and, at the end of this period, the enterprises will become owners of the PV systems

3. Barriers to the Development of RECs in Italy

In addition to the inherent characteristics of each REC development model, some difficulties and barriers appear to be common to the three approaches used in Italy. The first difficulty is the conspicuous delay in the publication of the decree necessary for the proper definition of the REC business model; this decree will define the feed-in premium tariff (applicable at the moment for the electric carrier only), who can access it, the limits to its application, and its combinability with other regional or national funding support. This has forced energy operators, citizens, PAs, and other potential REC project proponents to wait before taking concrete steps and investments regarding RECs inception [50].

Another of the critical issues mostly experienced in the process of establishment of a REC relates to the definition of its legal form. The reference regulation does not impose a specific legal form, which allows a REC to take any form of legal entity (e.g., energy cooperative, limited partnership, community trust and foundation, voluntary association, housing association, non-profit organization, or public-private partnership [29,47,63]); however, the regulation prescribes objectives and essential characteristics that direct the choice and circumscribe it. The energy community must be a legal entity based on a statute by which all aspects of the community’s operation, administrative bodies, and parameters

and criteria for the distribution of benefits are defined. Thus, its establishment not only requires technical skills, but also legal and management skills, as well as related professional figures, such as notaries and lawyers. Thus, top-down and bottom-up approaches may face limitations; though it is true that the REC can be established in the form of a voluntary association, with a simple contract to register and the advantage of limited management costs and organizational requirements, at the legal level it may be a weak form, especially when considering responsibilities and investor protection obligations.

Furthermore, among the analyzed barriers to the development of the RECs, the effort required to collect information about members belonging to the same MV/HV substation has emerged as a key challenge, with the risk of involving in the design process users who will not then be able to join the configuration, being outside the proximity perimeter. The procedure required that a formal request be made to the distribution system operator (DSO) for each involved point of delivery (POD) after collecting the necessary documentation from individual users (appropriate permission). Arera's latest regulatory document has better outlined the criteria on the basis of which each DSO identifies the areas underlying each MV/HV substation. Maps providing this information have been consequently released by DSOs in early-2023.

Other debated issues are related to: (i) the availability of smart meters useful for monitoring and calculating shared energy on an hourly basis; (ii) the possibility of withdrawal by members of the REC, which would be properly regulated in order to not risk compromising the stability of the energy community and, consequently, the economic return on investment, while still ensuring the freedom of withdrawal to each shareholder; (iii) the possibility of deducting the amount of shared energy from the bill, which introduces operational complications; and (iv) the financial efforts to be considered for the structural and energy renovation of the roof surfaces on which RES systems will be installed, which are not covered by national or state funds. Table 5 summarizes the current barriers to the spread of the energy communities on Italian territory. They can be classified into four main categories: the technical, organizational and legal, policy, and socio-economic barriers.

Table 5. Main barriers to REC development in Italy related to three REC models.

REC Development Model	Technical Barriers	Organizational/ Legal Barriers	Policy Barriers	Socio-Economic Barriers
Bottom-up/ Citizen-driven	Limited resources and technical expertise (during the design and/or operational phases of a REC project); Installation of smart metering system not completed; Structural and energy conditions of buildings selected for RES system installation	Limited legal and management expertise Management complexity of REC; Withdrawal of members and regulation of the REC	Incomplete regulatory framework and incentive mechanism under definition; Support mechanism applicable for the electric carrier only	Members' limited financial capacity/willingness to invest; Members limited awareness and knowledge of the topic/skepticism about energy communities; Deduction of incentives from members' bills not foreseen
Top-down/ PA-driven	Limited resources and technical expertise (during the design and/or operational phases of a REC project); Installation of smart metering system not completed; Structural and energy conditions of buildings selected for RES system installation	Limited legal and management expertise Effective engagement of citizens (the case of large municipalities); Management complexity of the REC; Withdrawal of members and regulation of the REC	Incomplete regulatory framework and incentive mechanism under definition; Support mechanism applicable for the electric carrier only	Members limited awareness and knowledge of the topic/skepticism about energy communities; Deduction of incentives from members' bills not foreseen

Table 5. Cont.

REC Development Model	Technical Barriers	Organizational/ Legal Barriers	Policy Barriers	Socio-Economic Barriers
Energy/ Technical Operator- driven	Installation of smart metering system not completed; Structural and energy conditions of buildings selected for RES system installation	Limited participation of non-investor members; Effective engagement of citizens; Limited control power for specific types of members (e.g., large companies) Withdrawal of members and regulation of the REC	Incomplete regulatory framework and incentive mechanism under definition; Support mechanism applicable for the electric carrier only	Limited diversity of interest; Different priorities of members/limited consumer empowerment

Despite the criticalities listed above, the drivers shaping the advent of RECs include the potential for greening and democratizing the energy system, the fairness and social responsibility potential of these collaborative initiatives and, more generally, the interdependency of economic benefits and wider social and moral goals that are tied to community engagement. The regulatory framework is almost complete and many of the critical issues highlighted are expected to be addressed.

4. Brief Comparison with Other EU Member States REC Regulations

The transposition of RED II is being implemented in most of the MS. However, the provision in the CEP left much room for interpretation and each MS thereby had the freedom to choose how the major elements of the transposition process should be treated [26,28]. Therefore, REC frameworks differ to a wide extent depending on geographic, cultural, economic, and political factors across the EU [23] and, in many cases, transposition gaps have been detected requiring the development of further legislation to specify indeterminate legal concepts, such as those related to effective control or proximity [22]. For example, some countries (e.g., France, Greece, etc.) interpret the proximity requirement, one of the most relevant matters of discrepancy, in terms of geographical distance from the renewable energy project, while others, such as Italy, evaluate the latter requirement in terms of the electrical distance grid, i.e., connection to the MV grid under the same MV/HV transformer [26,28,79]. The Energy Communities Repository, an initiative on behalf of the European Commission to assist local players (including citizens, local authorities, and businesses) with setting up and advancing clean energy projects driven by energy communities in urban areas across Europe, will collect and analyze information on the existing legal, regulatory, and policy frameworks on energy communities in all 27 EU Member States; the repository will also monitor their national development [80]. A summary report regarding legal frameworks will be published in early 2023; an interactive database of existing policies of EU countries will also be published in summer 2023 [80].

By mid-2022, at least 17 EU MS had prepared draft or final regulatory frameworks for RECs [79]. Overall, the differences between the RECs policy frameworks of the EU Member States concern the energy resource exploited and the general framing of energy communities (e.g., REC definition, enabled activities, boundaries, purposes, etc.), governance mechanisms (e.g., legal form of the REC, benefit distribution, members' role and activity, etc.), and support mechanisms (such as incentives and subsidies).

To provide some examples, Greece and Croatia do not provide, as Italy does with the legislative decrees no. 199/2021 [34] and no. 210/2021 [81], a differentiation between RECs and Citizen Energy Communities (CECs). Greece only distinguishes non-profit from for-profit energy communities, while Croatia merges both CEC and REC configurations into the concept of an "energy community". Austria defines RECs and CECs separately even if they present common features, while the current legislation in the Netherlands does not define "energy communities" even if it allows recognized associations of citizens

(e.g., cooperatives) to install and own local grids and participate in the electricity market with a limited number of rights [22,28–30,79]. For detailed information, REScoop.EU published a transposition tracker in January 2023 that assesses the progress of the transposition of the REC and CEC definitions in EU Member States [82].

Regarding the energy resource exploited, Portugal and France, as well as Italy, allow the production of heat and electricity from any type of RES-based system, in line with the REC definition devised by the EU, while Germany restricted energy production for communities to wind power plants, with this scope coming from laws previously enacted regarding the concept of REC [26]. Considering the purpose and the potential activities of a REC, in France, Austria, Portugal, Italy, etc., these initiatives can provide social, economic, and environmental benefits for members or the local area where they operate, rather than financial profits associated with producing, consuming, selling and/or storing energy [26,27]. The broad Greek framework for energy communities goes even further, including tackling energy poverty, promoting energy sustainability, and promoting innovation in the energy sector (e.g., through the inclusion of high-efficiency power plants or combined heat and power (CHP) plants that use natural gas, etc.) [26,28].

The specification on geographical boundaries (the proximity requirement) of the REC is fully remitted to the Member States. In Italy, the proximity limit (that relates to the MV/HV electrical substation) between the RES production plant and the REC member's POD is limited to access to the feed-in premium tariff; otherwise, the REC can be even larger. Austrian regulation foresees two different limitations of RECs (LV and MV) relating to the defined energy system architecture. In Greece, the proximity requirement is related to the topology of the country; the production site and the energy point of delivery must be located within the region where the energy community has its headquarters, except for the Attica region, where neighboring regions are eligible for the production site [26,28]. Other countries, such as Portugal and Belgium, where there is no specific definition of the potential expansion of an energy community, take decisions on a case-by-case basis [17,28,79].

Different kinds of support mechanisms are foreseen in MS regulations. Deliverable 7.1 of COME RES H2020 project [22] describes support schemes dedicated to facilitating RECs development. As an example, in Portugal initial investments for RECs establishment can be supported through the Recovery and Resilience Fund, while the Spanish government has established a comprehensive REC financing support scheme, under the Recovery, Transformation and Resilience Plan. In Belgium (Flanders) and Norway, no dedicated measures/tools have been identified to facilitate RECs' access to finance [22]. Considering operational support schemes instead, in the Netherlands, a subsidy, in the form of a feed-in premium for RECs is provided, known as the "Cooperative Energy Generation" subsidy [22]; in Ireland, RECs underpinned by the Renewable Energy Supporting Scheme can participate in the electricity market and the designated feed-in premium will be exercised based on the market outcomes [27,83]. Moreover, in some countries (e.g., Italy, Germany, and Spain), complementary support schemes, such as dedicated funds, advisory services, and regulatory sandboxes, are provided.

Table 6 shows the overall assessment of the transposition of RED II in the national framework of each Member State and the level of implementation of dedicated support schemes and mechanisms for RECs in the different national territories. The information in the table has been elaborated, starting from the data and information contained in the transposition tracker developed and published by REScoop.EU [82].

Regarding the corporate and legal form of a REC as experienced in Italy, in the other countries it can vary based on the specific purpose, members, investors, governance aspects, etc.; no specific legal form has been prescribed. However, there is a tendency by Member States to define cooperatives as a preferred entity for establishing RECs since they provide the best institutional framework for locally owned and participatory approaches to renewable energy projects [6,19,23,28,32,48,84,85]. Energy cooperatives were already popular before RED II implementation, above all in countries such as Germany, the Netherlands and Denmark, which have been pioneers in RES and energy communities

implementation [6,29]. However, cooperative approaches also present challenges related to their members and shareholders. Lowitzsch and Hanke and Hoicka et al. [23,86] report that when municipalities are partners of cooperatives, they can represent an obstacle due to the necessity of representation of their officials on the management and supervisory bodies of the cooperative. The involvement of public authorities in energy community projects is debated. The work of Busch et al. [87] points out that local authorities as REC members can result, on the one hand, in the potential success of energy community projects; however, there also as a limiting factor due to conflicting views of the goals of communities.

Table 6. Overall assessment of national REC framework of Member States (data updated in January 2023) and level of implementation of dedicated REC national support schemes (data elaborated from [82]).

	AT	BE	BG	HR	CY	CZ	DK	EE	FI	FR	DE	EL	HU	IE	IT	LV	LT	LU	MT	NL	PL	PT	RO	SK	SI	ES	SE		
Overall assessment of the national REC framework	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Dedicated REC support scheme	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●*	●	●	●*	●	●	●	●	●	●	●	●	●	●

Legend: ● Good transposition level of RED II/Good practice; ● Deficiencies in national regulatory framework/average transposition level; ● Major deficiencies in national framework; ●* Action announced but not yet defined/available.

5. Discussion

RECs can integrate distributed energy resources by playing a decisive role to support the transition process towards sustainable development and renewable energy sources [88], as well as increasing the potential for greening and democratizing the energy system [89].

An element of discussion that emerges from the analysis of the current Italian regulatory framework on RECs and its brief comparison with the regulation of other Member States is that, although RED II defines a common framework between the various Member States, its transposition within national regulation, which depends on territorial needs and regional priorities, creates discrepancies between states and different levels of implementation which, in turn, create and foster different opportunities for the diffusion of RECs on European territory.

The Italian interpretation of European regulation on RECs, though outlined in a delayed and discontinuous way, brings interesting new opportunities for consumers, businesses, and institutions. The Italian support mechanisms and funding available for the implementation of energy communities could, in fact, help make the Italian energy market stronger and more competitive.

This scenario has led to the spread of three main models of RECs development in Italy: one driven by private citizens or SMEs (bottom-up model); one driven by the local authorities or non-profit organizations (top-down model); and one driven by energy operators (energy/technical operator driven model). In the case of the top-down model, the presence of a municipality, whether small or large, in a REC can both support and hinder its development. A small municipality, though it may experience direct contact with citizens and foster a strong sense of social cohesion, often lacks technical, legal, and administrative expertise useful in the design and management of a REC. On the contrary, a large municipality, despite having the professional expertise needed to undertake a REC project, cannot rely on direct contact with the citizenry.

Entrusting specific tasks to an in-house company, which acts as a technical interface, can obviate many of these problems. Finally, the organizational form of a REC involving a local authority as a member should be studied on a case-by-case basis, since legal entities other than association require additional efforts to those that already burden the fragile municipal administrative structures. Under the bottom-up or citizen-driven model, the investment and choice of legal, organizational, and technical aspects are entrusted to citizens and/or SMEs, which have to be willing to bear not negligible financial and management efforts. Energy operator-driven initiatives encompass the development and deployment

of renewable energy projects by energy companies and businesses, which often fully or partially support the financial investment and carry out the installations of RES systems or other energy services, shaping their business models and opportunities based on the services provided and the involvement of other parties or citizens.

Energy communities appear to be multi-dimensional as they encompass a range of activities and aspects beyond simply generating and consuming energy; they can provide social, economic, and environmental benefits at a local level and might serve as catalysts for the development and deployment of renewable energy technologies, new job opportunities, local economies, and approaches that can regenerate the energy system at the global level, as well as the building stock. Therefore, a crucial aspect for the success of REC initiatives is securing stable organizational and financial viability for projects, which must attract both public and private investors, while also encouraging partnerships among diverse members and fostering community participation, efficient governance, and spatial planning. Moreover, for the fruitful deployment of energy communities, it is essential to enhance the technical expertise; this process occurs primarily within local authorities as it can limit not only their development but also the activities that can be carried out, potentially resulting in standardized and non-diverse community models.

By supporting favorable financial and technical conditions, RECs might offer ancillary and flexibility services, promote integrated home automation and energy efficiency interventions, offer electric vehicle charging services to their members, act as the driver for the regeneration of urban areas, etc.

Finally, the deployment and definition of policies and coordinating actions by agencies, authorities, organizations, or one-stop shops in the territory can facilitate the implementation of RECs in the form best suited to the needs of members and to the territorial characteristics. RECs are about collaboration and relationships; only after proper informing of the members, citizens, and local authorities will it be possible to develop a solid and productive REC, both socially and economically.

6. Conclusions

The paper aimed at presenting the Italian regulatory framework on RECs, discussing RECs with respect to other member states, and reviewing the national and regional support schemes put in place for the development of these aggregations across the country. Furthermore, through an analysis of REC experiences developed or under development in Italy, the paper attempted to identify emerging trends and development patterns of these aggregations by considering a range of various aspects, such as governance, organization, and socio-economic factors. A key finding of the review activity of the Italian RECs developing models is the presentation of the main characteristics of three models and the discussion of the strengths and limitations of each model. Although the development of RECs in Italy is driven by a combination of public and private initiatives, most of the RECs established in Italy fall under the top-down development approach, being led by a local authority (e.g., municipality, public administration, etc.) or a non-profit organization; this finding highlights their role as project promoters and facilitators.

The work also analyzed and compared some aspects of the regulatory frameworks of the other EU Member States, highlighting that, although Italy acted with some delay in the implementation of RECs, it has set up one of the most comprehensive and enabling financial support schemes in the EU.

Eventually, tools and indicators designed to capture and assess the wide range of impacts that an energy community can generate, including the social ones, must be deployed. Authorities must accurately and comprehensively monitor, evaluate, and report the technical, economic, and social performance of RECs to them help make informed decisions, reduce costs, and enhance their social impact on the community. In addition, monitoring REC experiences will help in identifying challenges and opportunities for improvement, as well as provide feedback to inform the development of future energy systems.

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