# Implementing collective energy schemes: suggestions for the Italian national legal framework on energy communities

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## ABSTRACT

New arrangements for the aggregation of distributed generation and demand are required to increase the flexibility and resilience of the electricity grid and to deliver it energy market frameworks are being reformed to enable broad civic participation. This work analyses such reform with a focus on the European Clean Energy Package and the Italian legislation. This paper examines the theme of energy communities and uses the GECO project, as a case study. The research performed is qualitative, applied, descriptive and exploratory. The findings point to the importance of regulating both the concepts of energy communities in a single national law. They also reveal the fundamental role of information and specialized technical bodies in the success of a community energy endeavour. Suggestions for the Italian national law on energy communities are presented, such as the possibility of integrating existing generation systems, greater consideration given to storage and mandatory customized feedback to users on energy savings to promote behavioural changes and building retrofits.

## KEYWORDS

Energy Transition; Energy Communities; Collective Energy Schemes; Legal Framework of the Electricity Sector; Italy.

## INTRODUCTION

The energy sector (generation and consumption of electricity, heat and cooling) is responsible for 49% of greenhouse gases GHGs globally [1]. The International Energy Agency points out

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that "*more than 70% of global energy investments will be directed by the government and as such, the fate of energy in the world lies in the decisions and policies taken by governments*" [1].

Along with scientists [2], citizens' movements such as Extinction Rebellion in the UK as well as school children around the world gathered on the "Fridays for Future" led by Greta Thunberg, calling for concrete action to be taken by the political ruling class [3,4]. As a result, more and more countries are planning measures to push forward energy transition and set targets for carbon neutrality in the electricity sector or even in their national economy, especially in Europe [5,6].

Nevertheless, profound decarbonisation in a fair and inclusive energy transition, aligned with the sustainable development goals of Agenda 2030, is only possible with significant changes in our behaviour as individuals and society [7-9]. This is why the concepts of energy democracy [10] and climate justice [11, 12] are fundamental to put into practice and making this trend grow [5, 7, 10, 13-15].

In European countries, the acceptance of renewable projects deployed on land in large scale facilities is in many cases hard to achieve [16]. Local energy community ownership is part of the growing trend to make a green revolution feasible in the energy sector to tackle the climate crisis, economic inequality and social-environmental injustice in a changing environment [9, 13, 17-25].

The present work analyses the Renewable Energy Directive (Directive UE 2018/2001) [26] and the Internal Market for Electricity Directive (Directive UE 2019/944) [27] of the European Clean Energy Package (CEP) and Italian legislation, regarding the theme of collective self-consumption (CSC) and energy communities (ECs). In particular, we examine the Milleproroghe Decree (Italian Law n. 8/2020) [28], from a technical and legal perspective to investigate the institutions foreseen and the impacts expected of the ongoing process of reform of the electricity markets. The work also investigated GECO (Green Energy COmmunity project) as a case study. Based on the data collected and the analysis carried out, legal alternatives are suggested and recommendations made to improve the Italian national law regarding CSC and ECs, to enable such initiatives to multiply and take-off.

It is important to highlight that during the literature review no scientific study was found that addressed the Italian Milleproroghe Decree or the GECO: Green Energy COmmunity project and only 32 results simultaneously met the search criteria associated with the terms "energy community", "distributed generation", "energy transition" and "Italy", clearly showing the originality of this study and its contribution to academia.

Thus, the final objective is to present legal recommendations for the definitive Italian framework on CSC and ECs, such as:

a) ensuring access to relevant information and data, which are indispensable for the planning and constitution of collective energy schemes;
b) the possibility of integrating existing generation systems in the schemes;
c) greater consideration to provision of flexibility and ancillary services, incentivising storage deployment;
d) promote awareness by inclusion of mandatory customized feedback to users on energy savings and carbon intensity reduction;

e) enabling users to respond to price signals, promoting behavioural changes, building retrofits and helping to increase the resilience of the electricity grid in the near future.

## LITERATURE REVIEW

In an electricity grid largely or completely based on renewables, and fluctuating renewables in particular, the concept of flexibility is central. System flexibility refers to the ability to adapt to fluctuations and bidirectional fluxes. This can be for example due to variable demand and fluctuating supply (from seconds to seasons and from 100% to 0% power output), or to system inertia (black start, reactive power) and malfunctions. All power systems need to have a certain amount of flexibility and inertia to remain stable, however, in a system with high proportions of wind and/or photovoltaic (PV) power, much of the supply will fluctuate over seconds, increasing the need for further flexibility and real time pricing [1, 9, 13].

Thus, in the future electricity grid, new forms of flexibility are key to an affordable renewables-led power system [7, 29]. Without distributed generation, energy storage, smart-charging electric vehicles, demand response management, interconnectors, collective energy schemes and more, the energy transition risks will proceed on a suboptimal pathway, which is more costly or carbon intense. This will lead to a power system reliant on fossil backup and/or oversized renewables capacity, technical features that will come at a higher cost of economic and environment resources [7, 30-34].

Humanity has a unique opportunity to shift future urbanization to a more environmentally sustainable and socially just path. The weight of cities on energy demand and greenhouse gas emissions (GHGs) requires a new approach to focus on a local low-carbon, resource-efficient and inclusive urban society around the globe [1, 2, 6, 8, 14, 34-39].

The end of the fossil fuel era, as well as the end of the electric distribution monopoly and the cost-zero fuel generation fleet, arising from disruptive innovations stemming from decarbonization, digitization, decentralization and democratization requires the rearrangement of the energy markets around product flexibility, the carbon content of electricity and real time prices [5-7, 10-12, 15, 17, 36, 39].

Between 2018 and 2019, as shown in Table 1, the European Union (EU) approved a comprehensive legislative package entitled ‘Clean Energy for all Europeans’ (CEP) [6]. The EU Directives established by CEP attempt to put in place appropriate legal frameworks to enable energy transition and attribute a special role to citizens and community activities [34]. CEP will be transposed to the legal framework of the EU member states by national laws about the themes and the last deadline for internalization is in June 2021.

Table 1. Directives of the Clean Energy Package – Clean Energy for All Europeans

| Directive | European Commission (Proposal) | European Parliament (Adoption) | European Council (Adoption) | Official Journal Publication | Entry into force at EU’s Member States |
|---|---|---|---|---|---|
| Energy Performance in Buildings | Nov 30 2016 | Apr 17 2018 | May 14 2018 | June 19 2018 | Transposition until March, 10 2020 |
| Renewable Energy | Nov 30 2016 | Nov 13 2018 | Apr 12 2018 | Dec 21 2018 | Transposition until June, 30 2021 |
| Energy Efficiency | Nov 30 2016 | Nov 13 2018 | Apr 12 2018 | Dec 21 2018 | Transposition until |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | June, 25 2020 and October, 25 2020 (special aspects) |
| Governance | Nov 30 2016 | Nov 13 2018 | Apr 12 2018 | Dec 21 2018 | Directly applicable from December, 24 2018 and January, 1 2021 (special aspects) |
| Electricity Regulation | Nov 30 2016 | Mar 26 2019 | May 22 2019 | June 14 2019 | Directly applicable from January, 1 2020 |
| Electricity Directive | Nov 30 2016 | Mar 26 2019 | May 22 2019 | June 14 2019 | Transposition until December, 31 2020 |
| Risk Preparedness | Nov 30 2016 | Mar 26 2019 | May 22 2019 | June 14 2019 | Directly applicable from July, 4 2019 |
| ACER | Nov 30 2016 | Mar 26 2019 | May 22 2019 | June 14 2019 | Directly applicable from July, 4 2019 |

Community approaches have not been yet fully explored as instruments of transformation in the energy transition despite the consensus about the need for change in human behaviors, economic dynamics and the technological challenges to create a more sustainable paradigm in the energy sector in line with the climate targets. This is especially the case in countries such as Italy where the collective schemes "one to many" and "many to many" are being allowed for the first time in 2020 by national law, in an experimental phase [15, 18, 31]. However, CSC and ECs are expected to play an important role in ensuring an effective and affordable low-carbon energy transition, especially if citizens become a main driver for the expansion of new installed capacity in the sector, as CEP [11, 31, 32, 34] and other studies advocate [15, 19-21, 35].

Italy has already assumed a reduction target of 33% in GHGs emissions by 2030 in comparison to the baseline of 2005 (Regulation UE 2018/842) and the European Union are now moving to increase the targets of GHGs reduction in the climate policy field thought the EU Green Deal and COVID-19 Recovery plan, trying to achieve a 50% reduction by 2030 and become the first net-zero emissions continent by 2050 [22].

Seizing emerging opportunities, citizens across the world are taking back the power in the energy sector either by direct action or by movements to influence sector policy decisions [13, 31, 33, 36, 23, 24]. The concepts of energy democracy [36] and climate justice [37, 38] are fundamental to making this trend grow and became feasible. Although the new paradigm of the energy sector is already in the pipeline, it will be necessary to rapidly disseminate and deepen its reach in the next decade [25, 40].

The once-natural monopoly has been disintegrating and in face of the innovations of the Industrial Revolution 4.0 and the energy sector has to become more user-centred, resilient and fair to face the magnitude of the challenges posed by technological innovation and low carbon shift [12, 41].

Local energy community ownership emerges as part of this growing trend to make feasible a green revolution in the energy sector, tackling the climate crisis, economic inequality and social-environmental injustice in a fast changing world [9, 30, 33, 35, 15, 19, 20, 42-45].

**The Definitions of Energy Communities in the European Clean Energy Package**

Energy communities target economic sustainability with a wider social mission, reinvesting profits generated to achieve benefits for its members and environment [13, 20, 23]. They are

initiatives focused primarily on providing affordable energy of a specific kind, such as renewable energy (RE), for their members or shareholders, rather than prioritising profit-making like a traditional energy company. Such initiatives can also enable certain groups of organized consumers to participate in the wholesale energy market who otherwise might not have been able to do so [36, 43, 20, 46]. The new regulation will also enable ECs to act like aggregators, bringing new players to the energy field. This collective energy scheme makes it possible to coordinate several units (prosumers or not) to control generation output and load demand, exploring flexibility, bonding small users to allow their participation in the wholesale energy market [31, 32, 33, 35, 15, 19, 20, 21]. Energy communities can be an efficient way of managing energy at community level by consuming the electricity they generate either directly for power or for (district) heating and cooling, with or without a connection to distribution systems [34, 41, 46]. To ensure that such initiatives can freely develop, a new market design is required, and it is under construction, as we have seen in Table 1. Two different concepts of ECs are proposed in the CEP.

The Recast of the Electricity Directive - 2016/0380, approved in 06.14.2019 [27], defined in art. 2, n. 11, Citizen Energy Community (CEC) as a legal entity:

> 'Citizen energy community': (a) is based on voluntary and open participation and is effectively controlled by members or shareholders that are natural persons, local authorities, including municipalities, or small enterprises; (b) has for its primary purpose to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates rather than to generate financial profits; and (c) may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders.

The Recast of the Renewable Energy Directive, promulgated in 12.21.2018 [26], in turn, defined in art. 2, n. 16, Renewable Energy Community (REC) as a legal entity that:

> 'Renewable energy community' means a legal entity: (a) which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity; (b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities; (c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits.

With this purpose, the recitals of the Electricity Directive also affirm that "*The definition of citizen energy communities does not prevent the existence of other citizen initiatives such as those stemming from private law agreements.*" If applied to local energy systems, therefore, it is clear that if Member States choose, they can allow other types of commercial and non-commercial market actors (i.e. non-ECs) to establish, own and manage local energy systems. Indeed, industrial and commercial enterprises are already allowed under Article 38 to set up closed distribution systems [47, 48].

The GECO project, with the period of execution between 2019 – 2022, is inserted into the transition phase of the electricity market, in which new business models, such as ECs, must emerge and develop to enable greater consumer engagement in the energy markets allowing an increase in distributed renewable generation [49].

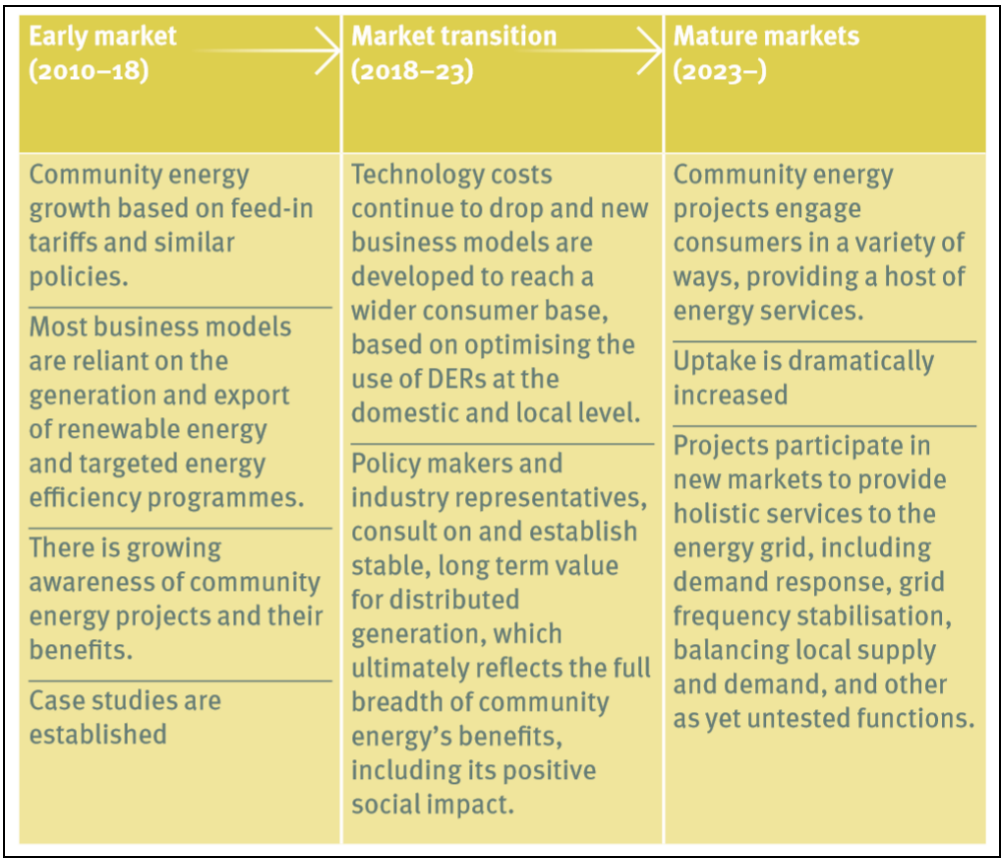

Figure 1. The changing energy community market, from [49].

Energy community initiatives are demonstrating their potential to facilitate the up-take of new technologies and consumption patterns, including smart distribution grids and high-quality demand response, in an integrated manner [12, 43]. In fact, when the community is micro-grid based or organized like a cluster, it could be part of the solution and help to solve the issue of balance in the grid at the distribution level, adjusting generation and demand in real time [32, 17, 21, 41, 46].

However, it is important to point out that some authors [30, 33, 50] consider ECs to be economically unfeasible from a strict investment cost view. They advocate that the best way to ensure the viability is to take into account multiple-values such as energy savings and building retrofits, grid balancing, demand peak shaving, ancillary services and avoided costs of grid-reinforcement.

Traditional energy actors, such as Transmission System Operator (TSO) and Distribution System Operator (DSO), should collaborate to share responsibility with local ECs, to become mutually responsive, anticipating future developments. It would guarantee socially and technologically acceptable towards transformations to a smart, inclusive and sustainable energy system. The collaboration among them might not only provide competitive energy prices and investment returns for partners and shareholders, but also help to fight climate breakdown and providing added-value to the local economy [32, 21, 42, 46, 51].

Neighbourhoods and districts are the ideal units to work with energy production and consumption to push forward the energy transition to a sustainable and low carbon grid. Placing CSC, ECs and prosumers at the centre of the new energy market is necessary to ensure a sustainable and fair pathway in the low-carbon transition in order to limit global warming to well below 2°C [41, 46, 51, 52, 53].

For these reasons, local configurations of ECs are gaining maturity, especially in Europe in the energy sector mainstream [31, 34, 42]. Koirala et al. [42], for example, refer to more than 2800 local energy cooperatives in EU, 1000 of which are in Germany and 400 in the Netherlands.

On the horizon, technical innovations are foreseen, increased awareness of different actors, as well as adjustments in the external environment, including regulation, legislation and culture. Enabling suitable conditions for collaboration between institutional, social and energy system actors as well as the technical, regulatory, policy and market environment is indispensable for success. These factors together will determine the appearance and progress of local ECs towards innovation in the energy system, accomplishing the energy transition [7, 30, 32, 33, 36, 15, 19, 21, 42, 43, 46, 54].

**The Collective Self-Consumption schemes**

The theme of Collective Self-Consumption (CSC) can be configured as an intermediate step for the creation of the ECs [47, 48]. CSC occurs when a system supplies electricity to more than one consumer ("one to many") in the same building or condominium, the classic example is when a multi-unit building with a system in the common area supplies power to the condominium itself and also to its autonomous units.

CSC is included in EU Directive 218/2001 (Recast of the Renewable Energy Directive) [26], in article 21, under the name of Renewables self-consumers, the aspect discussed here in item 4:

> 'Renewables self-consumers' 4. Member States shall ensure that renewables self-consumers located in the same building, including multi-apartment blocks, are entitled to engage jointly in activities referred to in paragraph 2 and that they are permitted to arrange sharing of renewable energy that is produced on their site or sites between themselves, without prejudice to the network charges and other relevant charges, fees, levies and taxes applicable to each renewables self-consumer. Member States may differentiate between individual renewables self-consumers and jointly acting renewables self-consumers. Any such differentiation shall be proportionate and duly justified.

The CSC scheme was allowed in Italy in 2020, together with the EC scheme as will be detailed below. For some authors [55] a preliminary step towards the regulation of ECs can be envisaged. Joint renewable self-consumption or collective self-consumption can form islands or components to be further integrated into a more complex community scheme, like a EC.

**The Italian National Regulation on Energy Community: article 42-bis of the Milleproroghe Decree**

Although Italy has not yet promulgated the national law for the transposition of the Renewable Energy Directive [26] or the Directive on the Internal Electricity Market [27], it is starting an experimentation phase. To date, the Italian regulation on CSC and ECs consists of article 42-bis, inserted in the Milleproroghe Decree (converted into Law n. 8/2020 in February 29, 2020) [28]. The current regulation is designed to collect data and useful elements for the final implementation of the Directives, as well as to enable the unblocking of investment in renewables, to accomplish the objectives established in the Integrated National Energy and Climate Plan (PNIEC).

In accordance with the provisions of the Milleproroghe Decree [28], in both collective energy schemes the participants must produce energy for their own consumption with new renewable facilities with a total power not exceeding 200 kWp. To share the energy produced, users must use existing distribution networks and use forms of virtual self-consumption [28].

The CSC scheme is set up by a plurality of consumers located in the same building in which there is one or more plants powered exclusively by renewable sources. The plants can be owned by the condominium, one of the private units or even by a third parties (such as Energy Service Companies - ESCOs) and take advantage of specific benefits, such as tax deductions. The typical example is a condominium which has a PV system on the roof that supplies electricity to the condominium and to the housing/business units in the building who join the scheme.

The REC scheme, on the other hand, must be set up by users connected to the low voltage electricity network, using the same medium / low voltage transformer feeder. Participants retain their rights as end customers, including choosing their supplier and can leave the community when they wish. Participation must be open to all users using the same electrical feeder, in an attempt to include lower-income or vulnerable families.

In both cases, the energy shared within the scheme members is equal to the minimum, in each hourly period, between the electricity produced and injected into the network by the generation facility and the electricity withdrawn by all the associated members. Energy is considered shared for instant self-consumption also through storage systems [28, 56].

The experimental phase implemented by the Milleproroghe Decree [28] will remain in effect until two months after the definitive reception of the European Directive on ECs in the Italian legal framework. This is expected to be carried out by a national law foreseen to be enacted on June 2021.

The Authority for Electricity, Gas and Water Systems (ARERA) clarifies in [56] that in order to promote the use of storage systems and the balance between production and consumption, an incentive tariff has been established, to remunerate the self-consumed energy instantly. To access the incentives, the system must be new (installed after 1st March 2020). The incentive rate will be cumulative with tax deductions, where available, and will be established in different values, according to the type below:

**a)** Energy direct and instantly self-consumed by the user (CSC and REC)
**b)** Energy shared and self-consumed in the same building (CSC)

**c)** Energy shared and self-consumed through a medium/low voltage electrical feeder (REC)
**d)** Energy not consumed or shared by members and injected into the grid (CSC and REC).

While CSC in buildings can be managed by the condominium, appointed participants or third parties, ECs must adopt a legal format as an entity capable of acting in their own name with rights and obligations.

Nevertheless, in both cases, participation must be open, based on objective, transparent and non-discriminatory criteria [28, 56]. This means that if the condominium installs a generation plant in the building, all the households concerned must be able to adhere to CSC scheme. Similarly, in an EC is created, all the interested users connected to the same low voltage feeder, have the right to join the community entity (cooperative/association/etc.). Compliance with condominium obligations or a reasonable entrance fee are two examples of objective criteria for access to the collective energy schemes.

It is also possible to create distinct categories of members, according to whether they are only user members (those who do not participate in the investment for the installation of the generation or storage system) and user-investor members (those who financially support the installation of the generation or storage system). In both cases, the users can maintain their electricity supplier and can exit the CSC or REC scheme at any time. However, in the event of early termination, the sharing of the investments incurred must be fair and proportionate. [28, 56].

**Piemonte and Puglia: Regional Experiences in Italy Related to Energy Communities**

The European Directives on ECs, as shown in Table 1, were published in the Official Journal on December 21, 2018 (REC) [26] and June 14, 2019 (CEC) [27] and have to be transposed into the Italian legal framework by a national law by June 2021 and December 2020, respectively.

Despite the short time since its promulgation at European level and even before Italian law removes the prohibition on collective energy schemes "one to many" in 2020, two Italian regions, Piemonte and Puglia, have already legislated on the theme of ECs. The Piemonte Region enacted the Regional Law n. 12/2018, named "*Promozione dell'istituzione delle comunità energetiche*" [57]. It was promulgated on 8 August 2018, even before the respective European Directives of CEP were approved. In fact, the Piemonte Law was edited based on the Italian Law 221/2015, that establishes the "*Strategia per lo Sviluppo sostenibile*" (Oil free zones) in the country [58]. The purpose of this was to limit the use of oil and its derivatives, and to facilitate the production and exchange of energy generated mainly from renewable sources. It was also aimed at improving efficiency and reducing energy consumption. The Puglia Region, in turn, enacted the Regional Law n. 45/2019, on 9 August 2019, also named "*Promozione dell'istituzione delle comunità energetiche*" [59]. Both regional laws are very similar [57, 59] and although they constitute an important stimulus to the development of the first EC projects, they cannot overcome barriers imposed by national laws, which means that the initiatives could only start in March 2020, after the release of the Milleproroghe Decree [28, 56].

## METHODOLOGY

The present work used multiple research methods [60], blending case study [61], semi-structured interviews and systematic literature review [62] with data collection and discourse analysis [63] and triangulation [64] for data analysis. We perform qualitative, applied, descriptive and exploratory research.

In the pre-research phase and during the preparation for the interviews, an exploratory literature review was carried out and then this was later consolidated through a systematic literature review, including Scorpus and Science Direct data bases, from the period of 2000 to 2020. This was done in English, using the terms: “energy community”, “distributed generation”, “Italian electrical legal framework”, “energy transition”; “collective energy scheme”; “renewable energy”, “Italy”. Gray literature such as legislation, regulatory agency documents (ARERA and RSE/GSE), technical reports (IRENA, IEA and European Commission) and international media news, among others, were also selected and analyzed.

It is important to highlight that no scientific study was found that addressed the Italian Milleproroghe Decree framework or the GECO: Green Energy COmmunity project. Only 32 results simultaneously meet the search criteria associated with the terms “energy community”, “distributed generation”, “energy transition” and “Italy”, clearly showing the originality of this study and its contribution to academia.

In order to extract broad and detailed knowledge, the GECO Green Energy Community project in Bologna, Italy was selected. This case study was chosen given the ease of access to the places, data and direct interaction with the stakeholders involved. The case also has characteristics that are complementary to the literature review as, despite the difficulties, it attempts to institute a bottom-up approach.

Although the GECO project started in 2019 and will be concluded only in 2022, the local initiative to build an energy community in the area started much earlier. Many research activities took place during the execution of the Project Neighborhood Economics, the embryo to GECO, executed during 2018, covering areas such as renewable energy, energy efficiency, mobility and social inclusion, with the express aim of building a community among people, companies and financing organizations in the district.

It is also understood that for the purposes of the present study, attendance to public events and interviews conducted in the period are sufficient for the analysis of the selected themes. Furthermore, since the main objective is to provide legal recommendations for the definitive Italian framework on CSC and ECs, waiting until the end of the project would make the objective unfeasible.

Semi-structured interviews were used to access particular perspectives and in-depth narratives, providing access to people's experiences, motivations, beliefs and understandings regarding the subject [60, 63]. This method was also used to validate the hypothesis with the experts, since being policy and regulatory propositions, there is no experimentation possible to validate them. In total, seven semi-structured interviews were performed with representatives of local associations and residents of the communities, specialists and scholars in the energy sector. Several on-site visits were made for direct observation of the situation and meetings.

The authors are aware that interviews and case study methods are inductive and exploratory by nature and as such are vulnerable to researcher and interviewer bias and social desirability bias [60]. In order to reduce this undesirable but also inherent aspect of the research, the discourse analysis and triangulation methods were applied in the interpretation of all the data collected [63, 64].

Discourse analysis was used to interpret the content of the interviews so as to capture meaning and perceptions about the role of the institutions involved in the subject. Power structures and agency model related to the problems and objectives selected were examined. To perform the analysis, the framework selected focused on elements such as: a) how the discourse is structured; b) what functions the discourse serves; c) what is the substance of the discourse; and d) how the discourse is performed.

In scientific works, the technique of triangulation consists of combining the analysis of sets of different sources of information or the combination of different methodologies in the study of similar phenomena, either through the combination of different methods or even of different researchers [64]. It is understood that the use of multiple observers assists in overcoming subjectivities, personal bias and deficiencies emanating from a single investigator or the use of just one method. The triangulation carried out in the present work consisted of collecting data from various sources, using different methods and through the application of multiple perspectives and hypotheses, based on the use of researchers with different theoretical baggage to analyze the study problem, in attempt to reduce individual bias and subjectivities.

This research aims to investigate the following refutable hypothesis according to the methodological strategies indicated above:

- *(i)* the ECs schemes presented in the CEP are vague and the national framework about the theme to be implemented in the EU member states will be extremely relevant to fulfil the legal gaps;
- *(ii)* the Italian energy sector is very complex and closed, with barriers that discourages new entries and privileges to large players to the detriment of smaller ones, making the allocation of resources in a non-optimal way;
- *(iii)* the broad participation of citizens in the energy markets is necessary to speed up and implement a fair energy transition to a sustainable and low carbon electricity grid, and finally;
- *(iv)* improvements to Italian regulation on ECs are needed to ensure that these initiatives take-off.

The research, therefore, was divided into the following stages: *(i)* survey of literature for the characterization and analysis of the current energy context and framework, nationally and at European level, with a focus on ECs; *(ii)* analysis of the political and socioeconomic context of Italy and of the impacts of regulations in the development of the Italian electricity sector in recent years; *(iii)* preparation of the script for interviews and the first round of interviews; *(iv)* selection and evaluation of the so-called determining factors; *(v)* construction of hypotheses that contemplate regulatory proposals to improve Italian regulation in the EC scheme framework; *(vi)* second round of interviews; *(vii)* analysis of the material and writing up.

Based on a study of the laws enacted so far and through the literature survey, interviews and case study analysis, the present work aims to collaborate to promote the current implementation process of ECs established by the Directives of the CEP in Italy. Suggestions are made to improve the creation of the legal framework of the electricity sector for ECs in

the country. The suggestions presented attempt to offer a more coherent national framework for ECs, improving flexibility and resilience in the electricity grid through the lenses of eco-efficiency, social equality, safety and energy democracy.

## RESULTS AND DISCUSSION

### Case Study: the GECO Community in Bologna

The GECO (Green Energy COmmunity) project, launched in July 2019, will lead to the creation of the first energy community in Emilia Romagna Region in 2021 according to the new EU model, in the districts of Pilastro and Roveri, in Bologna, Italy. The community will be built in a virtual manner, using the existing network and including an area where the electricity consumption is currently equal to 430 MWh per year [65].

The GECO project will focus on the action of citizens and local companies who will play an active role in the process of creating, producing, distributing and consuming energy at local level [66].

The project includes a residential area with 7,500 inhabitants, 1,400 of whom live in social housing, a 200,000 square-meter commercial area which houses an agri-food park, two shopping centers, and an industrial area of over 1 million square-meters. There are photovoltaic systems for a total of 16 MW on the roofs of the Agri-food Center of Bologna - CAAB and of the FICO Foundation, and solar systems for a total of 2 MW in the Roveri industrial area [65, 66].

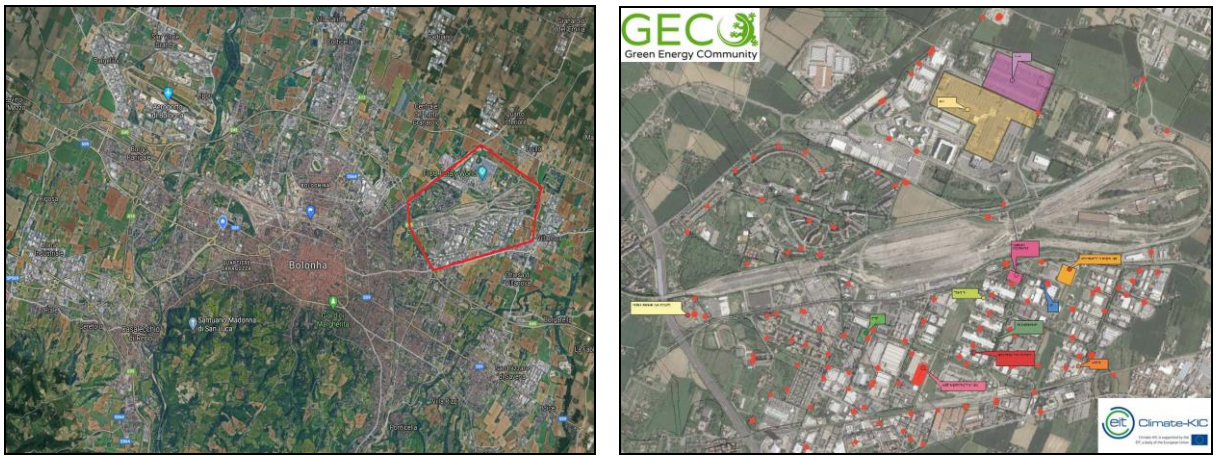


Figure 2 and 3. Spatial view of the town of Bologna, Italy, showing the GECO area (left): Google Maps accessed on 10/06/2020 and the GECO area with Mt/Bt transformation feeders (in red) and local actors involved in the project until January 2020 (right).

The project will promote the set up of at least 6 new renewable sources facilities with storage systems in the area, transforming companies and citizens into prosumers. In particular it is planned to 2020/2021 period: *(i)* 200 kW PV plant for the CAAB / FICO agro-industrial center with storage and e-vehicle recharge columns to be built in the parking area and a 20 kW (electric) and 30 kW (thermal) biogas plant for the disposal of organic waste; *(ii)* a 100 kW PV system serving several social housing buildings; *(iii)* 200 kW PV for the Pilastro

shopping center and for the neighboring apartment buildings; *(iv)* two more PV plants of 200 kW each on the roofs of the companies of the Roveri Zone.

In total 1 MW of new PV systems will be built in the area, which by 2023 will produce over 15.4 million kWh / year, saving 120 MWh / year of energy and avoiding the release into the atmosphere of 58,000 tons of CO2 / year.

The GECO project is originated from previous projects such as the Project Neighborhood Economics and the Roveri Living Lab executed in 2018. These were thanks to the co-financing of the European EIT Climate-KIC, AESS (Agency for Energy and Development Sustainable), ENEA (National Agency for New Technologies, Energy and Sustainable Economic Development) and the University of Bologna, with the participation of citizens, local associations and local businesses, for example, from the Local Pilastro Development Agency and CAAB.

**Comparative analysis between the concepts of Citizen Energy Community and Renewable Energy Community**

As seen in the literature review, there are two definitions of ECs: Citizen Energy Community (CEC) which is contained in Directive (EU) 2019/944 (recast Electricity Directive) [27] and Renewable Energy Community (REC), which is established in Directive (EU) 2018/2001 (the recast Renewable Energy Directive) [26]. Table 1 shows that the two Directives have different periods for transposition by the Member States. However, this does not mean that they cannot be regulated by Member States in a single law or even fused in only a single type of EC. The present work suggests that ECs should be disciplined under a single national law, but that they should not be merged into a single type due to particularities such as proximity aspects and energy sources.

The table below synthesizes the main aspects of the each, facilitating a comparative analysis of the concepts.

Table 2. Comparative Analysis of REC and CEC

| | **Renewable Energy Community** | **Citizen Energy Community** | **Observations and Distinguishing Aspects** |
|---|---|---|---|
| **Directive** | Directive (EU) 2018/2001 | Directive (EU) 2019/944 | Different EU Directives |
| **Transposition deadline** | June, 30 2021 | December, 31 2020 | Different deadlines for transpositions |
| **Participation** | Voluntary and open, natural persons, local authorities, including municipalities or small and medium enterprises | Voluntary and open, membership of citizen energy communities should be open to all categories of entities | CEC can be integrated for large enterprises, REC no. |
| **Control** | Autonomous, effectively controlled by shareholders or members that are located in the proximity | Natural persons, local authorities, including municipalities, or small enterprises | REC as an autonomous principle is controlled by members located in the proximity of the RES generation projects. CEC non have such limitation. |
| **Activities** | Generation, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric | Generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or | Similar activities, but the REC can operate only with renewable and the CEC can operate only with electricity |

| | | | |
|---|---|---|---|
| | vehicles or provide other energy services to its members or shareholders (Related only to renewable) | charging services for electric vehicles or provide other energy services to its members or shareholders | |
| **Limitation** | Just Renewable Sources | Just Electricity | See above |

If the purpose of the two ECs is the same (to provide environmental, economic or social benefits, rather than financial profits), the differences, as summarized in the Table 2, are substantial. An example is the fact of the REC can operate with energy in a broad spectrum (heating & cooling, electricity, gas), but only if generated from renewable sources [26]. The CEC, on the other hand, can operate with electricity alone, but without limitation of sources [27].

However, according to Checchi [67] the true potential of the CECs may lie in integrating the management to all energy consumption at local level, expanding in the future to also include electric mobility management, heating & cooling and waste.

It is also important to point out that the two Directives [26, 27] guarantee that the ECs can participate across the market without discrimination and on a level playing field with other market actors. However, only in the case of REC are Member States required to actively promote their development. Member States are also required to take RECs into account when developing renewable support schemes, to provide more information for citizens regarding participation in a REC, and to integrate provisions about RECs into local urban plans.

It is also important to highlight that the EU Directives [26, 27] do not limit ECs to any legal form, as long as they conform to the criteria of non-profit scope, contained in their definitions.

**Comparative analysis between the Regional Laws about Energy Communities enacted in Italy**

The two Regions in Italy that have already enacted specific laws about ECs (Piemonte and Puglia), used just one concept of EC that does not limit generation within the community exclusively to renewable sources nor impose the proximity aspect as necessary criteria [57, 59]. Considering that both laws were enacted before the approval of the Directive (EU) 2019/944 [27] (namely the Piemonte law, in fact, prior to the approval of all CEP Directives), the proposal of two different types of ECs was already known by the entities, since the CEP Directives were initially proposed in 2016, see Table 1.

Table 3 provides a schematic comparison between both regional laws [57, 59] in their main points.

Table 3. Comparison Between Italian Regional Laws on Energy Communities

| Item | Piemonte Region - Regional Law, n. 12/2018 | Puglia Region - Regional Law n. 45/2019 | Analysis / Result |
|---|---|---|---|
| **Title** | "Promoting the establishment of energy communities" | "Promoting the establishment of energy communities" | Equal |
| **Promulgation Date** | August 8, 2018 | August 9, 2019 | Different |
| **Scope** | promotes the establishment of energy communities, as non-profit organizations | promotes the establishment of energy communities, as non-profit organizations | Equal |

| | | | |
|---|---|---|---|
| **Goals** | in order to overcome the use of oil and its derivatives, and to facilitate the production and exchange of energy generated mainly from renewable sources, as well as forms of efficiency improvement and reduction of energy consumption | favor the production and exchange of energy produced mainly from renewable sources | Substantially the same |
| **Technical Aspect (Document)** | specific agreement protocol | specific agreement protocol | Equal |
| **Community Members** | public and private subjects can participate | public and private entities can join | Substantially the same |
| **Self-Consumption Share** | share of the energy produced for self-consumption by members is not less than 70 percent of the total | share of energy produced from renewable sources destined for self-consumption by members is not less than 60 percent of the total | Substantially the same (shares of 70% and 60%) |
| **Technical Aspect (Discussion Space)** | Permanent technical work table between the energy communities and the Region | permanent technical work table in which the representatives of the energy communities participate, the most representative associations of the environmental, energy and renewable sectors and the managers of the competent regional sections | Substantially the same |
| **Technical Aspect (Document)** | within six months of their establishment, an energy balance | within six months of their establishment, an energy balance | Equal |
| **Technical Aspect (Document)** | within twelve months of their establishment, a strategic document that identifies the actions for the reduction and consumption of energy from non-renewable sources and the efficiency of the energy consumption. | within twelve months of their establishment, a strategic document that identifies the actions for the reduction of energy consumption from non-renewable sources and the efficiency of energy consumption | Equal |
| **Activities** | It does not specify activities, it does not speak of aggregation, it narrows to be local | distributed generation of energy from renewable sources and the performance of management activities of the energy distribution, supply and aggregation system at the local level | **Substantially different** |

It is also important to note that both laws establish more stringent criteria for the implementation of ECs than the EU Directives or the Mileproroghe Decree [28]. They limit to non-profit entities and establish a minimum of 60% share of self-consumed energy within the community for Puglia and 70% for Piemonte, to maintain the characterization as an EC. It is important to take in consideration the fact that, according to Checchi [67], in Italy the percentage of the self-consumed distributed electricity is 20% for PV and less than 5% for biomass, the two main widespread small scale renewable sources in Italy. These are the two that the GECO project intends to use [65]. In fact, from all energy sources, currently only fossil fuel reaches more than 50% of self-consumption [67].

Both laws [57, 59] also identify the need to meet certain technical aspects, such as making a specific agreement protocol, participation in a permanent technical roundtable between the ECs and the Region, besides drawing up an energy balance and preparing a strategic document that identifies actions for the reduction of energy consumption from non-renewable

sources and the efficiency of energy consumption. These requirements add substantial complexity to the development of EC projects by citizens given the high level of data and engineering expertise required.

It is also important to point out that the subsequent promulgation of the Puglia's law [59] brings some improvements in relation to Piemonte's law [57], such as the possibility of aggregation activities, as well as a bias aimed at combating energy poverty.

The potential of aggregation of residential storage system in the Italian electricity grid has been simulated in a recent study of RSE, conducted by Pellegrino and Sandroni [68]. Their results show that even on a cloudy day, when PV production is very low (even less than one equivalent operating hour) and the storage does not work (after it is discharged), the flexibility margin offered by the virtual aggregation can provide grid services. Pellegrino and Sandroni [68] also showed that virtual energy aggregation can provide up to 25 MWh for upward or downward to the grid per day, providing services to the national electricity network.

Regarding to the energy poverty, it is noteworthy that the Puglia's Law on ECs was accompanied by the promulgation of a law about energy income (Regional Law n. 42/2019) [69], which seeks to favour users in conditions of socio-economic disadvantage through the guarantee to its beneficiaries to entitled free self-consumption of the electricity produced through the system in the period of not less than twenty years from the connection and by a specific budget allocation of €5.600.000,00 in 2019/2020 for funding the new systems and storage in social households.

It is understood that the creation of energy income schemes can be extremely effective in combating energy poverty and promoting ECs. In fact, the GECO project is trying to activate in the Emilia Romagna Region a process to promote the creation of a regional energy income law, insofar as it believes it may be determinant to the rapid activation and take-off of future ECs in the Italian Region [70]. The area of implementation of the GECO project, for example, has 18.7% of the residents living in social housing, corresponding to around 1400 inhabitants [66].

Merging the CEC and REC definitions, however, is not seen to be the best decision here, since this limit the possibilities of applying different schemes, narrowing the options.

Finally, it should be noted that the Regions of Sardegna and Umbria are also making progress in this regard. The former is in the process of discussing its law on ECs (Regional Bill Project No. 47 of 4 September 2019) and the latter on the theme of energy income (Regional Bill Project presented on October 14, 2019). However, these bills promote no significant improvement in the regional laws already enacted by the Piemonte and Puglia Regions [57, 59].

**Analysis and suggestions for the Italian national legal framework on Energy Communities**

The Milleproroghe Decree [28] is the only national law in Italy to regulate the collective energy schemes such CSC and ECs to date. It is a transitory regulation, since it will be replaced in future by the national law which will make the definitive transposition for the Directives about ECs in the Italian legal framework [26, 27]. However, it constitutes an

important phase of experimentation and the suggestions and insights collected at this stage are fundamental for the implementation of changes and adjustments in the final regulation about the theme.

In this regard, it is important to point out that access to information and data, which are indispensable for the planning and constitution of ECs, has not been sufficiently addressed in this phase. Fundamental data has not been guaranteed for the users, as in the case of the clear identification of the medium-low tension transformation feeder they are connected to or even the aggregated consumption profile of it. Without such data, it is practically impossible for an interested party to calculate the real benefit and economic convenience of creating an EC in their locality. As seen in the literature review, all the members of the EC should be connected to the same feeder and the incentive is due to the energy self-consumed collective by them.

In the case of the GECO project, those data are being gathered with the local distribution system operator (DSO) through a specific collaboration and data disclosure agreement protocol [65]. However, this cannot be the ordinary solution, since it makes the implementation of ECs extremely hardworking and casuistic, consequently it cannot be easily disseminated and is not scalable. This makes the role of specialized technical bodies crucial to the success of a community energy endeavour, making it virtually impossible for regular citizens or even small enterprises, such as ESCOs and PV installers, to perform or start such initiatives. To guarantee access to the data, it is essential to have a simple method available that allows the user to identify which MT / BT feeder their meter is connected to, noted on the electricity bill perhaps, together with the meter number, for example. Another option would be to make this information available on the DSO website and upon simple telephone request from the user.

The current regulation does not establish a minimum percentage of self-consumption to the energy generated in the CSC and CE schemes, as the regional laws, however, the limitation imposed on the system size and the typology of the incentives, directly connected to the energy self-consumed, overvalued even more this aspect. In fact, the limitation of 200kW as the maximum power of the facilities and the financial incentive resulting almost exclusively from the energy consumed instantaneously and shared between the members, means that the projects must have self-consumption rates of close to 90% to be economically viable (payback time in less than 10 years).

If the balance and coincidence between production and consumption is extremely important and it is considered a positive aspect, however little attention has been paid to measures to promote flexibility or reduce peak demand, which could alleviate the electricity fluxes in the grid must be taken into account. The reduction of fossil generation cannot rely only on building up an intermittent generation fleet at risk of causing stability problems for the electricity network or require the provision of a large amount of reserve energy.

Another fundamental aspect that was neglected in this phase was the contribution that the storage ensemble with a generation systems and demand response can provided to the grid, especially when build upon fast-response ion-lithium batteries and smart electric heating and cooling devices. Greater consideration and incentive for the installation of batteries together with the generation systems and new opportunities to perform ancillary services in the dispatch market would be able to increase the resilience and flexibility of the grid. Measures in this directions could reduce peak demand and the amount of rotate power reserve,

generated by gas power plants and used to maintain the inertia and provide stability to the grid given the variation of the RE outputs.

Furthermore, prohibiting the incorporation of existing generation systems in the CSC and ECs schemes, with the valorisation of the energy currently not self-consumed and injected into the grid, it is justified by the fact that such systems have already received incentives in the past and there is a need to promote a high number of new generation systems to achieve the decarbonisation goals in the electricity sector. However, this legislative option does not reward those who were pioneers in the past. This slows down the deployment and emergence of community projects.

This is the case of the GECO project, which had the initial support of the Bologna Food and Agriculture Center (CAAB) and aim to allocate energy not self-consumed to the low income households in the area. CAAB has the largest rooftop photovoltaic system in Europe, with 15MW installed capacity. However, it had a self-consumption rate of nearly 20% regarding the energy produced [65]. Many other projects in Italy are in a similar situation, such as the project *Comunità Energetica del Pinerolese*, in the Piemonte Region and the *Comunità Cooperativa di Melpignano*, in Puglia, both partially responsible for pushing forward the regional law about ECs in these areas and which aimed to take advantage of the synergies that exist between various RE systems already installed in the regions.

The areas where pioneer stakeholders have already developed significant renewable projects and initiatives in past are more likely to first engage and promote the new possibilities delivered by the new regulation on collective energy schemes, making them pioneers once more.

Based upon the evidence collected with the study case, the present study suggests that the use of energy from existing systems should be conditioned to the installation of storage systems. This would attribute value to the pioneering initiatives and open space to accelerate the diffusion of storage, important for the supply of auxiliary services and to balance the grid network.

Regarding to the possibility of testing different business models and technical arrangements using a "learning by doing" approach, all the interviewees unanimously agreed about the importance of the experimental phase started with the Milleproroghe Decree [28]. It was also clear from the interviews that focusing on only one type of EC, adopting a simple and virtual form and a small size for the systems, was the only way to achieve a consensus from all in the political spectrum in Congress. This is fundamental to pass the amendment to include the article 42-bis in the Milleproroghe Decree [28] on time.

As mentioned, the importance of storage for the electricity grid has not been adequately valorized and the prohibition on including existing generation systems has prevented the implementation of business models that could enhance the pioneering action of various actors, enabling the a quick take off of several initiatives. These two aspects can be understood as a consequence of the need of political consensus in Parliament, necessary to be able to approve the legal measure. However, those restrictions narrow the actions on this experimentation phase to just few possibilities, restricting and limiting interesting business options that could be tried and thrive.

Finally, it is also important to point out that the obligation of ECs to give customized feedback to users on energy savings and carbon intensity reduction, based upon the data gathered was not included. As a result, behavioural changes are not encouraged and also members are not able to respond to price signals. All the interviewees agreed that this measure could be a very cost effective way to drive consumer awareness, promote cultural changes and encourage building retrofits, boosting energy savings and emission reductions. Such measures are not included in the current regulation, because, as already commented, this phase aims to experiment and collect data about CSC and ECs. Nevertheless, it is worth noting that it should be included in the definitive regulation about ECs.

## CONCLUSION

Energy community initiatives can promote economic, social and environmental value to society. This goes beyond the mere benefits derived from the provision of energy services or economic savings. Access to ECs schemes need be granted on fair and cost-reflective terms for all citizens. A safe supply of modern decarbonized electricity must be guaranteed for the full implementation of Agenda 2030 and the Paris Agreement. ECs can be an effective pathway to achieve these goals.

Energy communities can also advance energy efficiency at the household level and help fight energy poverty, by strengthening social and community cohesion. At the commercial and industrial level, it can provide greater competitiveness to the local economy, reducing consumption and lowering supply tariffs.

If the regulation about ECs is put in place correctly, it has the potential to start a positive feedback loop in the sector. Bold government policies, citizen and business initiatives can reinforce each other, and together can take climate action to the next level.

Policy design fundamentally shapes how different electricity systems work. As we have attempted to demonstrate in this paper, the experimentation phase started with the Milleproroghe Decree, before the enactment of the national law to receive the CEP Directives about the theme, is very important. However, it should be an opportunity to test different business models and technical arrangements “learning by doing”. By focusing on only one type of EC, and failing to properly recognize the importance of storage for the electricity grid and not allowing business models to include existing systems, restricts interesting options that could be tried and might thrive.

Italy has a long way to go to advance and properly develop this segment of the energy market. The prohibition that was in force until 2020, not allowing the creation of CSC or ECs ("one to many" or “many to many” collective schemes) hampered development. The main challenge of the country is to forge a fair energy market for the new imperatives of a decarbonized sector in which citizens and local business have a role.

The case study of the GECO project illustrated important aspects and gave insights that should be analyzed to establish mechanisms to guarantee a fair evolution of the legal framework of the energy sector. This policies can be calibrated and pushed forward with “corrections”, “adjustments” and “boundaries” foreseen in the implementation of the Italian national law about ECs.

This study also suggests greater consideration toward mandatory customized feedback to users on energy savings. Based upon the data gathered, this could be a very cost effective way to drive consumer awareness and behavior, promote building retrofits and boost energy savings.


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## NOMENCLATURE

| | |
|---|---|
| **AESS** | Energy and Sustainable Development Agency (Agenzia per l'Energia e lo Sviluppo Sostenibile) |
| **ARERA** | Authority for Electricity, Gas and Water System (Autorità di Regolazione per Energia Reti e Ambiente) |
| **CAAB** | Agri-Food Center of Bologna |
| **CEP** | Clean Energy Package – Clean Energy for All Europeans |
| **CG** | Centralized generation |
| **DG** | Distributed generation |
| **DSO** | Distribution system operators |
| **ENEA** | National agency for new technologies, energy and sustainable economic development (Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile) |
| **ERR** | Emilia Romagna Region |
| **ESCO** | Energy Service Company |
| **EU** | European Union |
| **IoT** | Internet of things |
| **IT** | Information technology |
| **GECO** | Green Energy Community Project |
| **GHG** | Greenhouse gas |
| **GSE** | Energy Services Manager (Gestore dei Servizi Energetici) |
| **MWp** | Mega Watt Peak |
| **RE** | Renewable Energy |
| **SDG** | Sustainability Development Goal |
| **SMEs** | Small and medium-sized enterprises |
| **PV** | Photovoltaic |
| **TSO** | Transmission system operators |
| **TERNA** | Italian National Electric System Operator |
| **UNIBO** | University of Bologna |
| **UVAM** | Mixed Enabled Virtual Units (Unità Virtuali Abilitate Miste) |

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