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REGULATING ENERGY COMMUNITIES IN EUROPE: FROM THE ORIGINS TO THE EU DIRECTIVES

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Abstract

The concept of energy community in Europe originated in Denmark in the 1970s, then spread to other Northern European countries, and, consequently, since the beginning of the new millennium, across all Europe. The development of energy communities has made it possible to analyze its impact from the social, economic and environmental points of view, as well as their organization and, the incentives and financing exploited by European countries. The push towards energy transition and a system with neutral carbon emissions have contributed to turn citizens into active participants of the energy market. In fact, energy communities were first introduced into the EU legal system through the *Clean Energy for all Europeans Package* in 2018 allowing for a more consistent clarity of the concept even though at the same time that has left a wide discretion for Member States to translate the concept into national laws. This work evaluates the on-going implementation of the two directives - *Directive on common rules of the use of energy from renewable sources* and the *Directive on common rules for the Internal Electricity Market* - within the national legislation of some European countries.

Contents

Introduction

As analyzed by Cunha, Carani, Nucci, Castro, Silva & Torres (2021), energy consumption in European cities in 2020 accounted for 66% of global end-use and 70% of greenhouse gases emissions. This looks set to increase by 20% due to continued urbanization as the urban population is expected to grow from the current 55% to 70% by 2050, with the total population increasing from 7.7 to 9.5 billion people (new statistics recently showed that world population has cross the 8 billion mark). In the face of these numbers, energy communities are considered excellent collective energy schemes for a green revolution in the energy sector - promoting decarbonization, democratization, digitization and decentralization - that, according to Cunha et al. (2021), in 2050 they will generate up to 45% of the grid renewable electricity allowing for an efficient way of managing energy at the local level.
At the international level, the need for action in the climate crisis was recognized in 2015 through the Paris Agreement. This agreement established a global framework to avoid dangerous climate change by limiting global warming to below 2°C and pursuing efforts to limit it to 1.5°C (European Commission, n.d.). In terms of energy systems, the main transformation is calling for the phasing out of predominant energy sources such as fossil fuels, veering towards a future based on clean and secure energy with low carbon emissions. One scenario resulting from this transformation is the transition from centralized energy systems, which prioritize profit, to decentralized energy systems, which focus on providing affordable energy, which consequently give rise to economic, social and political challenges, as well as environmental ones. The main actors in this new model are citizens who act as both producers and consumers of energy (the so-called *prosumers*), who are willing to participate in energy markets and are able to develop different decision-making processes and different organizational forms (Inês, Guilherme, Esther, Swantje, Stephen & Lars, 2020).
In simple terms, an energy community is a set of people or public/private entities who share energy, in an exchange between peers. They represent an innovative model for the production, distribution, and consumption of energy, which often comes from renewable sources. This model bases its values on the fight against energy waste and the sharing of a fundamental good at a competitive price, thanks to innovation that is revolutionizing the energy market. In 2018, the first European regulation in this regard was implemented through the *Clean Energy for all Europeans Package*, allowing citizens to more easily form energy communities, but also to produce, store and sell their own renewable energy. Although regulation at the European level has only happened as of 2018, various energy communities have been developed in Europe since 1970; in Denmark, the first prototypes were created becoming the blueprint of what we

know today as energy communities. These energy communities were initially developed mostly in Northern European countries and in most cases were organized through cooperatives.

The recast of the European Union (EU) directives, as part of the Clean Energy Package, has mobilized Member States to transpose European legislation by June 2021 but, for most countries, complete legal frameworks do not yet exist.

Therefore, this work aims to perform a comparative research on the impacts of national policies regarding energy communities, investigating both past regulations that were not specifically regulated by any European directive, and national regulations after the inherent 2018 European directives.

We proceed as follows: Chapter 1 focuses initially on the emergence of the first energy communities, particularly in Denmark, Germany, and the United Kingdom, and then on the energy communities that developed in France, Italy, and Spain, concluding with the introduction of the European directives in 2018 - the *Directive on common rules of the use of energy from renewable sources* (EU 2018/2001 - RED II) and the *Directive on common rules for the Internal Electricity Market* (EU 2019/944 - IEM) - contained in the *Clean Energy for all Europeans Package*. Chapter 2 analyzes the main benefits and limitations of energy communities, especially considering economic, social and environmental impacts, then continuing with an analysis on the more economic side of the topic, i.e., organizational business - in particular on cooperatives that are considered the most used legal form for energy communities - and possible methods to finance and incentivize energy communities, concluding with some numerical data on energy communities with the available information found on some research articles; finally. Chapter 3 dwells, in the first part, on the phase of transposition of European directives by some European countries, while, in the second part, the REC of Magliano Alpi developed in Italy in 2020 is analyzed.

From this work emerges how the national policies of European countries before the introduction of the European directives were very different from country to country according to their predisposition to the creation of energy communities, for example according to their culture or their political direction. The introduction of the *Clean Energy for all Europeans Package* has allowed not only to define a single concept of energy community in Europe, but also to start a process of standardization of the general lines for the creation of energy communities in European countries, at least with regard to the characteristics that they must have to be defined as such. In fact, it is clear that, although the European countries are still in the process of transposition, the national directives issued contain similar principles with some facets on the areas in which the European directives leave more room for manoeuvre.

Chapter 1: The history of energy community

Energy communities (ECs) have existed for decades in the European Union but have long been overlooked as a way to facilitate the energy transition. Increasingly aware of their potential for socio-cultural and economic changes, the EU is exploring these communities as key players in the energy transition.

Energy communities emerged in the 1980s and today, according to Bierens and Skapoula (2021), there are over 1,900 projects across the EU involving over 1,250,000 citizens.

In 2019, as part of Horizon 2020, the EU began to develop a policy framework to promote the functioning of these energy communities. A policy document was published defining energy communities in legal terms distinguishing between Renewable Energy Communities (RECs) and Citizen Energy Communities (CECs).

The European Commission estimates that by 2030 energy communities, led by citizens, could own up to 17% of wind energy and 21% of solar energy. These developments demonstrate that the EU sees the value of RECs and CECs within the broader energy transition.

Thus, it can be seen that energy communities only received a legal definition in the EU in 2019, 40 years after their inception, demonstrating a long history of neglect (Bierens & Skapoula, 2021).

1.1. The first energy communities

The first country to develop a collective investment model, and specifically in renewable, was Denmark in 1970. This new way of producing energy and consequently owning energy facilities can be considered the basic model on which today's energy communities were arrived at.

Denmark can be considered as the pioneer country given the development of a type of energy community with obviously completely different characteristics to those regulated nowadays.

The beginning was in 1973 with the rise of the oil crisis due to the Arab oil producing countries that decided to increase the oil price by 70% and to scale back production on a monthly basis by 5%. This was only the fuse that began to mobilize countries towards renewable energy (RE) and then to the idea of energy communities because already twenty years after the end of World War II some European countries began to consider the limited reserves of fossil fuel, and the increase in cost and pollution due to the extraction of oil and gas. Therefore, in addition to considering a solution from the economic point of view, it was already perceived an attention

from the environmental side, even if probably the crisis of 1973 (with cases of schools without heating and Sundays without cars) made clearer the consequences of depending too much on oil imports. From that moment, renewable energy became a political issue and an interesting area of research. This issue was not only tackled by politicians, but as in the Danish town of Ulfborg, citizens also gave a lot of help to solve the problem, although as mentioned above, the project developed in Ulfborg was completely different from what are the energy communities today. However, this represented the first step in the development of them.
How described by the specific report of REScoop.eu (2015) called *"The energy transition to energy democracy"*, in 1974 the teachers in the schools in Tvind, in the city of Ulfborg, decided to build, together with more than 400 people, the wind turbine to produce the energy needed by the schools, replacing the nuclear plant in the city. In 1978 the wind turbine was completed and began producing electricity. This project started an exponential increase of big wind turbines in various countries but first of all it was considered a best practice of organizing energy generation and consumption. The most important outcome of the Danish project was the production of energy needed for schools in the Tvind area. Afterwards, the project contributed to represent at that time a solid argument in the popular debate against the introduction of nuclear power. It showed the strength and power of the people who together built the Twind plant constituting the power of self-reliance, and it served to understand that wind energy in a long-term perspective would be economic given the impossibility of monopolizing wind. Even if in a cruder way, the answers just analyzed are the principle of energy communities we find today.
Gorroño-Albizu, Sperling and Djørup (2019) affirm that during these first years of evolution the ownership of wind turbines by citizens was limited by two criteria introduced by the Danish governement: the residence criterion and the consumption criterion. The first one fixed a maximum distance that could exist between the residence of the entitled owners and the wind turbines. On the other hand, the consumption criterion - introduced a few years later in 1985 - imposed a limit on the shares that could be purchased in a collective park based on the consumption of the purchasers' families. The consumption criterion introduced in the 1980s made it necessary to open up the project to other local residents. In fact, this can be confirmed by the fact that the promoters of the wind cooperatives - i.e., small groups of local residents - invited all local residents to participate in the development and ownership of a wind turbine or farm in their vicinity. The implementation of these projects was made possible through the information offered to citizens, their involvement in the design phase, and the opportunity citizens had to participate in the decision-making process. The various factors described in this

first phase of adoption and the testing of "energy communities" has succeeded in creating an attractive environment, as well as wide acceptance, for local wind cooperatives in Denmark.
In these years, since energy communities were not yet considered as such and therefore were not regulated by any European state, the Danish state took the route of investment subsidies for wind turbines that included tax exemptions for wind turbine revenues, and, from the late '90s, introduced support mechanisms such as fixed Feed-in Tariffs (FiT) including guaranteed grid connection, priority transmission for energy producers and buy-back obligations. Essential, however, were tax exemptions and Feed-in Tariffs that allowed for greater investment security for wind projects thereby ensuring stable incomes and financing from banks at reasonable interest rates (Bauwens, Gotchev & Holstenkamp, 2016).
In the following years, i.e. from 1985 to 2000, the aforementioned consumption and residence criteria were relaxed by increasing the number of shares and distance. In addition, the limitation on the number of shares per adult was abolished and since 2000 local ownership constraints were removed, resulting in an adjustment in 2009 to make it mandatory to offer 20% of the shares at cost price to local residents also due to the increase in turbine size and capital investment (Gorroño-Albizu et al., 2019).
The repowering schemes, more restrictive wind planning, and loosening of ownership regulation, just described, brought obvious changes starting with the increase in individual ownership (especially among farmers and families) of citizens in the 1990s. An example of individual ownership cited by Gorroño-Albizu et al. (2019, p. 6) is "that of Skinnerup in the municipality of Thisted in Denmark, where a farmer installed a 0.66 MW wind turbine in 2000 of which about 0.05 MW was used for self-consumption and the rest was sold to the grid."

Another example that helps to understand why Denmark can be considered the pioneer country regarding the development of energy communities is located on the island of Samsø. The project began in 1997 when the island was named the winner of the Danish competition as a renewable energy island with the consequent right to funding - the energy plan submitted in the application phase, but not including the construction of infrastructure. The goal was to make the island energy independent by entrusting the local population with regard to financing and to the decision-making.
According to data obtained from Moroni, Alberti, Antoniucci and Bisello (2019) the island became energy independent in 2005, but the thing to emphasize was the mobilization of a large part of the island population which in 2008 numbered 4,000. From then on, the local municipal office, responsible for the development of the project, was replaced by the local society with the help of Samsø Energy Agency.

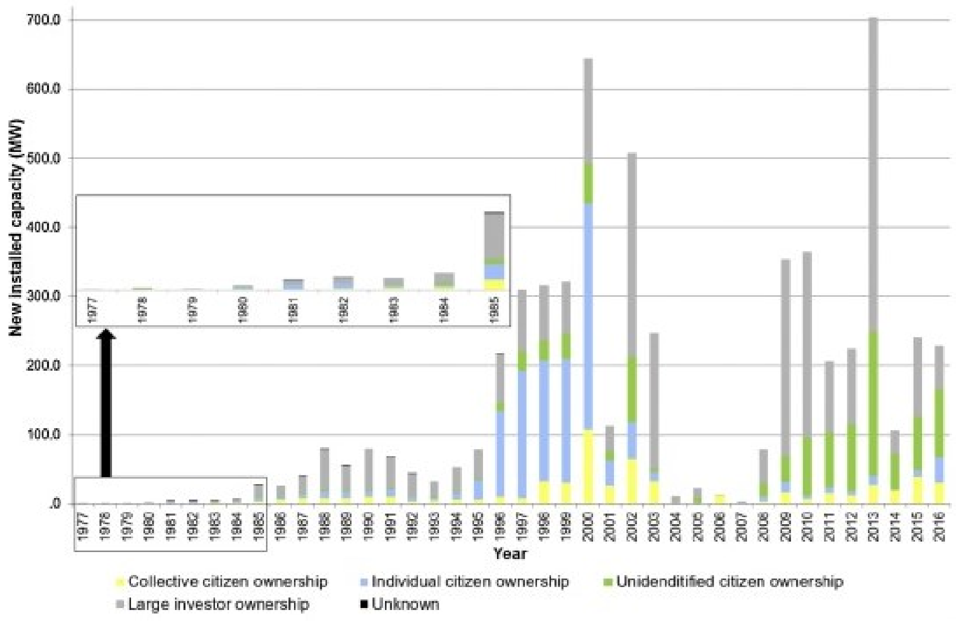
In the first phase of the project's start-up, a total of 21 turbines were installed on the island, spending a total of "about 55 million euros: 8 from national public institutions and EU funding, 47 from island residents and other private companies and municipalities." (Moroni et al., 2019, p. 49).
Since 2007, the community's interest shifted to the circular economy through new projects on communication, public transport, waste, and agriculture. This community of producers and users structured in cooperatives, associations and companies could then be identified as the energy community of Samsø.
The creation of the project on the island of Samsø was feasible for two main reasons: being the winner of the Danish competition, but especially the participation of citizens was essential.
These two reasons were essential because during this period, in 1999, wind turbines received a 25% lower FiT and a limited payment period, reducing the economic feasibility for wind projects and slowing down the creation of new cooperatives.

A further change in the financial support mechanism occurred in 2003, after the election of a new liberal-conservative government, in which a fixed Feed-in Premium (FiP) scheme was implemented. This entailed that "producers received the Nord Pool market price and a fixed maximum premium. Moreover, all new producers had to market their electricity directly on the wholesale market" (Bauwens et al., 2016, p. 140). As a result, the fixed premium was too low to compensate for Nord Pool's low wholesale prices, and price volatility was perceived as a major risk by ordinary citizens leading to a halt in the birth of new and many existing cooperatives. In fact, a few years later the government instituted new incentives for repowering old turbines leading to the purchase of turbines by larger commercial players deemed capable of addressing the problems just faced.
Another change was made in 2009 by increasing the fixed premium payment and, thus, making cooperative wind projects economically feasible again. The problem, however, stemmed from price volatility within the Danish FiP and consequently moved the cooperatives to look for more and more alternative financing resources.

In terms of planning policies, Bauwens et al. (2016, p. 140) argue that Denmark from the beginning supported ownership of wind energy by local citizens, businesses, and cooperatives through specific planning schemes and regulations, specifying that "in 2000, cooperatives, single owners, and farmers owned 80% of all wind turbines in Denmark because the government restricted ownership of wind turbines to local actors who living or being registered in geographic proximity to the turbine they owned". These restrictions, however, were deregulated after 1999 by granting ownership to commercial actors. The situation was further exacerbated by the increased cost of planning due to the growing impact of larger turbines, leading the way to commercial players who were able to have greater economic autonomy and faster decision-making compared to cooperatives. Since the early 2000s, local ownership of wind farms declined sharply and for this reason in 2007 the Danish government began to consider increasing local resistance against wind projects. In 2009, the Danish government took counter-moves by forcing "wind turbine developers to offer at least 20% of the ownership to local citizens living within a 4.5 km radius of the turbine and established a public guarantee fund to support the financing of appraisal, design, etc. activities by local wind cooperatives" (Bauwens et al., 2016, p. 140).

Finally, it is necessary to highlight how the development of these energy communities in Denmark have been made possible by the strong tradition of local energy activism (such as anti-nuclear protests) and the positive attitude towards the cooperative model born since the first half of the nineteenth century in which the first cooperatives in the agricultural sector arose, becoming one of the most widespread forms of business activity in the country.

Graph 1: Installation of wind capacity in Denmark by type of owner



Source: *Gorroño-Albizu et al.* (2019)

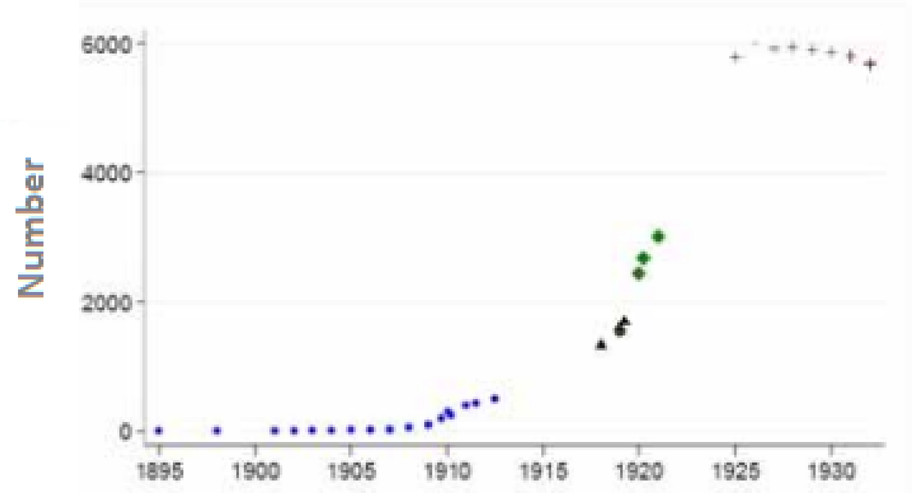
According to RegalGrid (n.d) the Danish model of collective investment in renewable energy led in 2002 to 40% of installed turbines owned by the community and in 2013 this percentage rose up to 80%. However, as it is possible to see from graph 1, despite the high percentage of ownership by the community, the latter was not able to produce a high amount of energy, probably, as mentioned before, due to the small plants owned in comparison to large investor-ownership.

A country similar to Denmark, which can be considered as a leading country in the distribution of renewable energy in Europe and mostly in the development of energy communities, is Germany. In the years following 2010, community ownership - in this case of wind power - is estimated to hold a share of about 20% although in the early stages of wind power development Germany held a much higher share. One of the reasons for this decrease can be explained by the trend towards professionalization and commercialization of this specific sector.

Germany, however, in addition to considering this type of renewable energy, has since the early 1990s focused on several community-owned solar energy projects to arrive in 2014 with 50% of photovoltaic (PV) production owned by communities (Regalgrid, n.d.).

The first real example of an "energy community" in Germany dates back to 1991 after the Chernobyl nuclear disaster in Ukraine. The initiative was taken by a citizens' initiative that led to the creation of an association called ElektrizitätsWerke Schonau (EWS). Despite the fact that the energy market was not yet liberalised and there were no financial support systems in place, in 1991 EWS bought the grid and reorganised it using ecological principles. So "to transform the grid and energy production, EWS encouraged citizens to install renewable energy production units by facilitating their connection to the grid and by paying special feed-in tariffs" (REScoop.eu, 2015, p. 43). This was the first "energy community" in Germany, which in 2009 became a cooperative, but even cruder forms of electric cooperatives began to appear after the First World War. The world economy underwent a sharp decline due also to the destruction of much infrastructure, forcing people to fill the gaps in the electricity supply. Therefore, in this period of crisis (especially between 1918 and 1925), citizens formed electric cooperatives mainly made up of operators of their own electricity network in rural areas that in 1932 reached about 6000 electric cooperatives (see graph 2). However, the number of cooperatives declined sharply due to several motivations: the arrival of the Nazi regime in the 1930s, the phenomenon of diseconomies of scale due to financing problems, and the increase in bureaucracy due to legislation on distribution networks and renewable energies.

Graph 2: Electricity cooperatives created in Germany (1895-1935)



Source: *REScoop.eu* (2015)

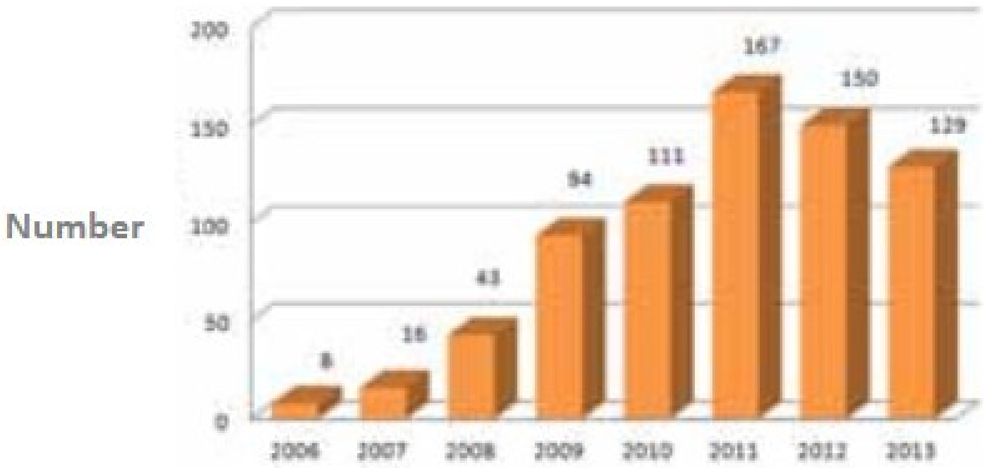
Since the early 2000s, several small communities have sought to embark on the path of local generation of electricity, and heat, to meet their own needs. The main characteristics that these communities had to possess were what we can also consider today. They were based on the push of the inhabitants towards a desire and a need for energy independence, the concentration on the use of local resources - such as biomass, solar, wind -, the will to find a solution that could ensure the stability of the energy cost in the medium and long term with the consequent security of not incurring in sudden increases in taxation or fuel prices.
Another concrete example of a "bioenergy village" was implemented in the village of Jühnde in 2006, an agricultural village in Lower-Saxony with a population of 780 residents. The village focused on producing both heat and electricity 100% from renewable energy resources - in particular through a biogas combined heat and power plant - thus meeting the energy needs of the investor community. The project - as analyzed by Dóci and Vasileiadou (2015, p. 45) - "was paid one third by governmental and regional funds and the rest by the residents and some business investors." The idea to develop this project was originated from the University of Göttingen in 2001 as an experiment to completely eliminate fossil energy production. Initially, the university actively contributed to the organization of the work, but in the following years it gave more independence to the villagers by involving them in every decision-making process. According to Dóci and Vasileiadou (2015), the main motivation that attracted the villagers' attention was gain, followed later by normative and hedonistic considerations. Considering the gain motivation, residents relied heavily on prices and savings on heating costs in the long run, as well as financial support from the regional and national government. In addition, a key driver

was the German Feed-in Tariff introduced through the EEG (Erneuerbare Energien Gesetz - Energy Sources Act), i.e., a feed-in policy that guaranteed a fixed price for renewable energy sold above the market price. This then guaranteed a stable income for the villagers of Jühnde.
The field experiences from this first project have been so positive and encouraging that more than 130 other small towns have followed suit. These local-scale renewable energy sources in most cases were able to provide 100% of electricity and at least 50% of heat needs (Battisti, 2014). Additionally, in almost all cases, the initiator and developer of the project was not a company such as a technology provider, but a group of citizens committed to environmental sustainability issues. The help and availability of local artisans and installers as well as specialized consultants within the community contributed in a fundamental way to the success of the initiative.
On the other hand, from the organizational point of view, the form most frequently chosen was that of the cooperative society, as in Denmark for the creation of small wind farms. This form of society was able to offer the adhering citizens a high degree of determination and influence while ensuring a contained risk of insolvency. The cooperative choice, moreover, showed that the aim of the project, from a financial point of view, was certainly not the maximization of profit as much as obtaining a secure and stable price for the energy supply in the following years. The possibility of providing direct participation by the cooperatives among other things helped to contain costs, thanks to the voluntary work of some citizens, and ensured a better acceptability of the proposed project.

In the early years of the new millennium, Germany was considered an international promoter of energy democracy, but from 2010 it fell behind in terms of community energy. This situation essentially occurred with the new reform in 2014. Before this reform, the citizen-driven energy transition was essentially promoted by the German government's Renewable Energy Act (EEG), which offered financial incentives. However, the EEG regulations changed in 2014 instituted that new investors had to purchase the electricity they generated through the wholesale market which offered no guarantee for the fixed price, thus making it risky and difficult to generate electricity. In addition, the inclusion of a variable premium, which was less reliable than fixed tariffs, greatly reduced the calculability of the project. Thus, these new regulations may have had a negative influence on the profit motivation in future projects by discouraging community investors from making new investments. This motivation in fact is mostly confirmed by Bauwens et al. (2016, p. 142) stating that "profitability expectations played a more important role in Germany than elsewhere." Moreover, with the 2014 reform, new incentives were established to encourage citizen projects to participate in auctions.

Finally, according to Radtke and Ohlhorst (2021, p. 1) "complex regulations, requirements, and procedures made the implementation of new wind farms so expensive and risky that the projects were only manageable and profitable for established energy companies."
In fact, looking at the numerical data from the studies of Radtke and Ohlorst (2021) it is indicated that the community energy projects developed in Germany between 1995 and 2020 were about 1800 of which only 71 from 2015 to 2020. Confirming this, Brummer (2018) states that in the first period just mentioned, "Germany soon adopted a Feed-in-Tariff scheme to support the installation of renewable energy which also helped build a strong EC movement."

Graph 3: Foundation of energy cooperatives since 2006



Source: *REScoop.eu* (2015)

Observing at the number of energy cooperatives founded in different years in Germany on graph 3, it is possible to see this trend just analyzed, although data from 2014 (a crucial year for the implementation of the German reform) is not present.

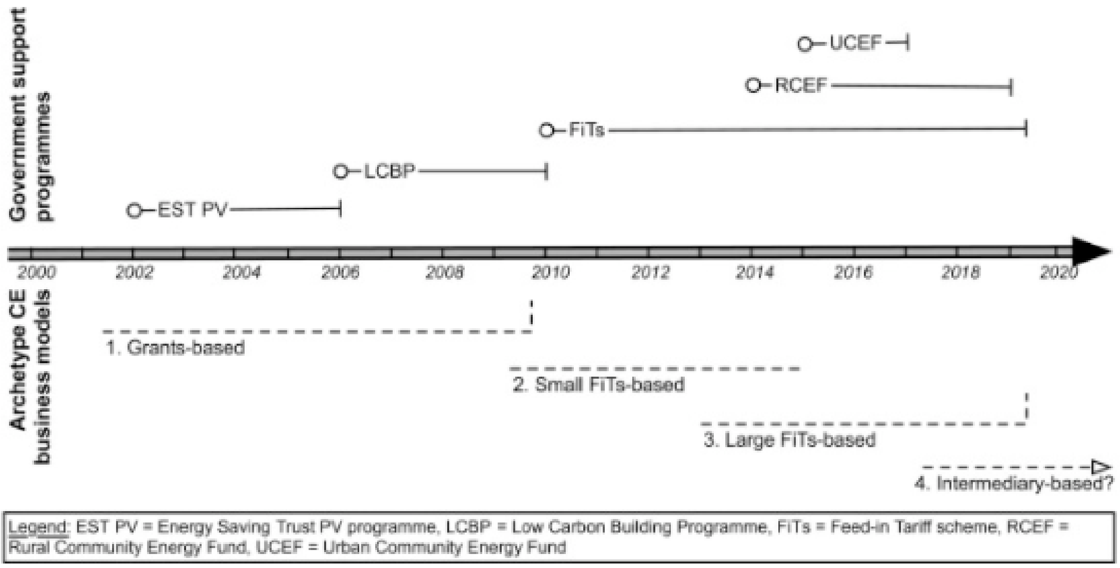
A European country that has sought to follow the footsteps of Denmark and Germany since the early 2000s by adopting community energy is the United Kingdom. This country cannot be considered as a pioneer of this initiative but immediately supported the implementation of renewable energy technologies providing at the same time the capacity to develop energy communities.
The first grant programs from the British state were launched in 1974 through the Renewable Energy Support Program (RSEP) and in the late 1990s through the SCALAR program with the aim of developing renewable energy technologies.

Since the beginning of the new millennium, these policies have also focused on community initiatives such as Community Action for Energy (CAfE) which first aimed to inform citizens about what an energy community was and how it should be developed. As specified by Nolden et al. (2020), in 2002, the UK government began issuing programs to provide grants to support photovoltaic installations (Energy Saving Trust Photovoltaics), arriving in 2006 to introduce the first program designed to support the inclusion of solar PV on a community and household scale (Low Carbon Buildings Program, LCBP).

The first photovoltaic systems, initially small in size, were installed on community buildings allowing those who lived there to take advantage of the electricity generated and consequently to feed excess electricity into the grid (in the first period the energy fed in was considered irrelevant by the District Network Operator, DNO). Thus, this early business model was primarily focused on savings and supported by subsidies, thus, making the projects economically viable. The benefits that brought citizens to community projects stemmed from several factors such as the increasing of social cohesion, the fighting of energy poverty, and the developing of energy independence.

One of the first English territorial communities to take advantage of locally available resources was Gorran Highlanes, in the town of St. Gorran in central Cornwall. Since 2008, approximately 100 members of this community-invested in the construction of a wind turbine facility "initially contributing £80,000 to the building of two 80 kW turbines which have been operational since 2011" (Moroni et al., 2019, p. 48). This community was part of the Community Power Cornwall cooperative society, which consisted of a non-profit and a charity. Its goal was to act as an intermediary between financial institutions and citizens by making it easier to build energy systems thereby promoting the necessary conditions for community-owned renewables. In the years that followed, the characteristics of this project were replicated in other places acting as a pilot case given the success of the initiative.

Figure 1: Timeline of direct government support programmes and archetypal community energy business models identified



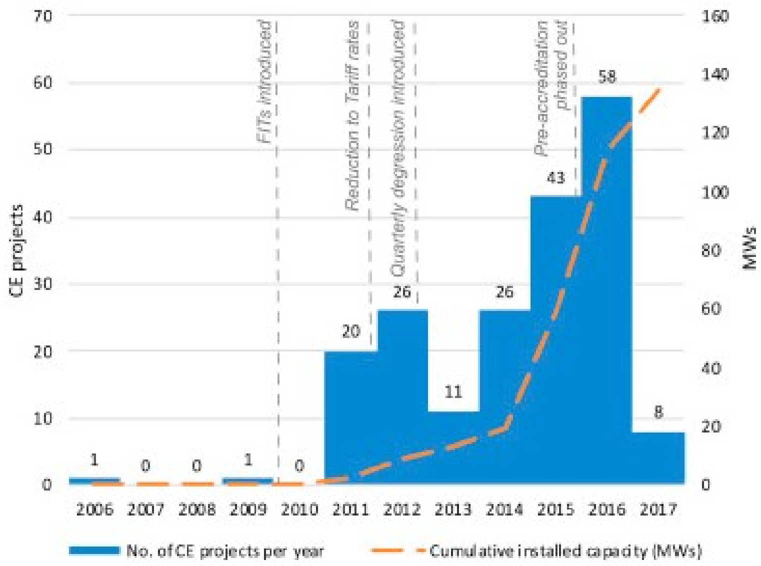
Source: *Nolden, Barnes & Nicholls* (2020)

From 2010 onwards, the mass deployment of solar PV modules due to falling production costs provided the main stimulus for the rapid growth of this sector. As can be seen from Figure 1, the introduction of the UK Feed-in Tariff Scheme was of fundamental relevance given that it aimed to bridge the gap between producer and consumer by encouraging the production of electricity to those players who had no incentive to do so. This incentive mechanism was open to all, schools, businesses, heads of households and obviously also included community organizations that used solar photovoltaic systems between small and medium scale (maximum power of 50 kWp). Therefore, this new business model allowed the community group to pay back investors.

Another type of incentive scheme, the Enterprise Investment Scheme (EIS), indirectly supported community energy projects by rewarding investors capable of taking additional development risks, "enabling community groups to attract investment at a rate which allowed a significant reinvestment of profit for community benefits, increasing the overall viability of community renewable energy investment" (Nolden et al, 2020, p. 5).
Finally, again referring to Figure 1, since 2014, new community groups have been able to access two different funds based on the different geographic area in which the community was being created. The Urban Community Energy Fund (UCEF) and the Rural Community Energy Fund (RCEF) have been able to decrease project risks and have aided preliminary planning and feasibility studies of energy communities through substantial funding. Thus, these two funds

have decreased transaction costs during the project development phase by attempting to identify suitable vendors, verify project suitability, and identify the appropriate location to implement the project.

Graph 4: Share of community solar generation capacity in England



Source: *Nolden et al.* (2020)

As can be seen from Graph 4, the FiT policy in 2010 was the launch pad for developing EC projects in England (and the UK) given that it provided regular income streams for community groups and allowed them to undertake additional energy projects without the need to apply for new funding. The key concept that came through was that renewable energy communities, in addition to benefiting the environment by reducing carbon emissions, also provided income from excess energy sales that could be used to fund other carbon reduction measures and the establishment of other energy communities, thus paying even greater attention to the social and environmental spheres. As analyzed by Nolden et al. (2020, p. 6) "an annual income stream of £80-£280 per kW of installed capacity provided modest returns for reinvestment into the local community" but, despite the good economic contribution received by energy communities, they had to wait for the revenues to accumulate and then decide how best to distribute them.

Table 1 below is useful to have a synthetic view of the main policies implemented by Denmark, Germany and United Kingdom with their specific time references that, as mentioned in this first part of the work, sees Denmark as the first country active in this field.

Table 1: Synthetic table on support mechanism

	Germany	Denmark	The UK
Support mechanisms	**1991**: first law that allowed for the feed-in of RES.	**Before 1999**: low-risk investment conditions due to tax exemptions, fixed FiTs.	Main support mechanism: quota system.
	2000: Renewable Sources Act. Objective: create more stable investment conditions.	**2003**: establishment of FiP and obligation to market electricity directly to wholesale market as major obstacles to the creation of new cooperatives.	**2010**: introduction of a FiT for installations <5MW.
	2014: Replacement of the FiT by a FiP and obligation to market electricity directly.	**Since 2009**: increase of premiums, improved investment conditions and emergence of new cooperatives.	Launch of various programs to back up the development of community energy.
			2014: reform of the tax relief schemes. New tax relief scheme not available for cooperatives.

Soruce: *Bauwens et al.* (2016)

1.2. The emergence of other energy communities

Since the 1970s, community energy initiatives have been the means for citizens to take ownership of renewable energy production. Local communities in Denmark were able to develop wind projects representing an alternative to nuclear power, followed by communities in Germany in the late 1980s (Roberts, 2020). These communities were essential to promote the community renewable energy movement in Europe as well as the development of early community energy policies at the national level. They often consisted of economic incentives such as support schemes with fixed remuneration like loan programs, or focused on keeping citizens up to date through online information and advice, or other countries took a more strategic approach by introducing energy planning through the achievement of certain targets. However, the perception from communities - and academics - is that community renewable energy projects have been successful despite the countries' supportive policies. Indeed, in some cases, as seen for Denmark and Germany, the instability of national policies applied have damaged investment expectations and relative confidence in these initiatives.

Although community energy has developed primarily based on local and national legal and socio-political frameworks, it has received increasing attention from European Union policy since approximately 2010.

For example, the first directive that supported citizen adoption of renewables was the Renewable Energy Directive (Directive 2009/28). This directive sought to begin putting in place provisions on the simplification of administrative procedures for small installations, preferential grid access and dispatch rules for renewables, as well as the introduction of binding national targets that encouraged national renewable support schemes by helping to develop community renewable projects (Roberts, 2020). Another important factor prior to this European directive was also the liberalization of several activities concerning the energy market (i.e., unbundling of activities such as generation, supply, distribution of vertically integrated energy companies) that, though their primary role was to create an integrated European electricity market, they allowed energy cooperatives the supply to their members of proprietary renewable energy.

The first problems from EU policy came from the 2014 with the introduction of the Energy and Environmental Aid Guidelines (EEAG) in which were introduced "several limitations on how Member States could financially support investment in renewables, in particular requiring a transition to market-based forms of financial support. This means that fixed forms of remuneration like FiTs were generally forbidden. Furthermore, the EEAG introduced a requirement for Member States to transition towards competitive bidding (i.e. tenders or auctions) open to all generators" (Roberts, 2020, p. 235). For this reason, the EEAG regulation created extensive problems for states that relied heavily on FiTs, such as Germany.

France has been one of those European countries to follow the community energy initiatives started by Denmark, Germany and the United Kingdom, even if with some wide differentiations.

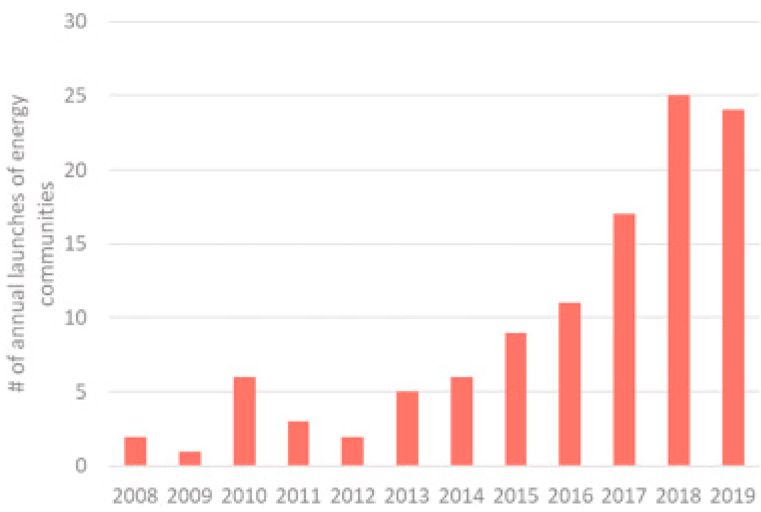
The energy economy of the French country was characterized in the '70s and '80s by the construction of about 30 nuclear reactors allowing the French country to no longer depend on to fossil fuels. To have a confirmation, in 2000, French nuclear power accounted the 75% of its electricity production, meeting national and export needs. However, nuclear waste was a major problem with nuclear power, leading the country to reduce the use of nuclear reactors and fill the gaps left with renewable energy sources.

One of the first moves that gave hope of developing energy communities to French citizens was the liberalization of the energy market in 2007, although at the same time the French electricity market remained among the most centralized in Europe through the historical national electricity operator Électricité de France (EDF), the market and grid leader. The next step was done by the national federation of Community Renewable Energy Projects (CREP), called EPA (Energie Partagée Association), which defined CREPs as those initiatives that allowed participatory investments in projects led by industrial developers whereby citizens injected capital - i.e., increased crowd-equity - and at the same time gained access to project governance. Thus, EPA excluded projects that only allowed for participatory financing through crowd-funding platforms.

These good intentions for energy community development were also faced for the first time by the French state through the Energy Transition Law for Green Growth (LTECV) in 2015 helping to increase CREPs launches (see Figure 5). This law introduced a dedicated incentive to promote two types of projects (those defined by the EPA but also those that allowed only participatory financing) by granting additional public support (between 1 and 3 euros per MWh) to projects that met a certain threshold of participatory financing (10% of total financing or 40% of the equity capital provided by citizens and local authorities) for a minimum period of three years (Sebi & Vernay, 2020).

French CREPs were characterized by investments made by citizens to purchase, install, operate, and sell renewable energy through power purchase agreements, but with the obligation to sell their energy exclusively to EDF in order to benefit from FiT programs. Like other European countries, these communities could benefit from Feed-in Tariff or Feed-in Premium depending on the size of the CREPs.

Graph 5: Number of annual launches of CREPs in France



Source: *Sebi & Vernay* (2020)

In short, as analyzed by Sebi and Vernay (2020), CREPs were used by the French state as a tool to contribute to energy transition and democracy. From an economic point of view, these communities generated most of their revenues by selling kWh of renewable electricity and benefiting from support schemes through the FiT program that however were different for power plants generating energy beyond the eligibility threshold established for the FiT program. For these larger plants, in fact, the FiP mechanism was introduced. While, with regard to the governance structure, some CREPs granted voting rights based on the principle of equality

regardless of subscribed capital (the logic of one member, one vote) and others offered to members legal and financial responsibilities proportional to their capital contributions.
After these initial incentives, in 2018 the French government funded the development phase of large CREPs through a special national fund managed by EPA, called EnRCiT, with the aim of providing adequate financial resources to support technical, economic, and regulatory studies of the projects in order to obtain the necessary authorizations before construction (Sebi & Vernay, 2020). However, these specific incentives did not seem to fully exploit the capacity for which these energy communities were developed since it seemed that citizens were only being used as a means to fund the energy transition.
Furthermore, in the years between 2014 and 2017 (before the EnRCiT fund was introduced), some individual regions of France also launched calls to assist this new citizen movement by including communications assistance as well as targeted project feasibility study grants and investment subsidies (e.g., in Occitanie, bank guarantees were also included for projects that won the call).
Despite the rapid growth of CREPs - according to Sebi and Vernay (2020) their number quadrupled between 2014 and 2019 counting in the last year 240 energy communities in the French territory, they found difficulty to generate interest to those who did not have a strong ecological mind-set since citizens could only invest money in energy communities without the possibility of consuming the energy produced by the same community and linking it directly to their energy bill. Therefore, in order to better influence citizens, French policy should have firstly promoted and facilitated collective self-consumption by making the contribution of citizens more tangible and creating a greater sense of belonging to the community; secondly, it should have allowed CREPs to benefit from the FiT program independently of the suppliers to whom the energy was sold, while at the same time creating greater bargaining power on the part of CREPs.

A similar timeline regarding the development of French energy communities has been experienced in Italy. Italian EC projects started from the second half of the 2000s, especially from 2010 onwards, due to the rapid increase in the installation of renewable energy plants after the implementation of renewable energy support measures.
Prior to this period, however, it should be noted that some energy communities were already present, especially in the form of energy cooperatives, mainly in the northern part of the peninsula. For example, as described in a guide published by GECO (2020), in 1921 the "Società Elettrica Santa Maddalena" was founded in South Tyrol, which today is called FUNES as the valley in which it is located. Today, the electricity - used locally in this valley - is

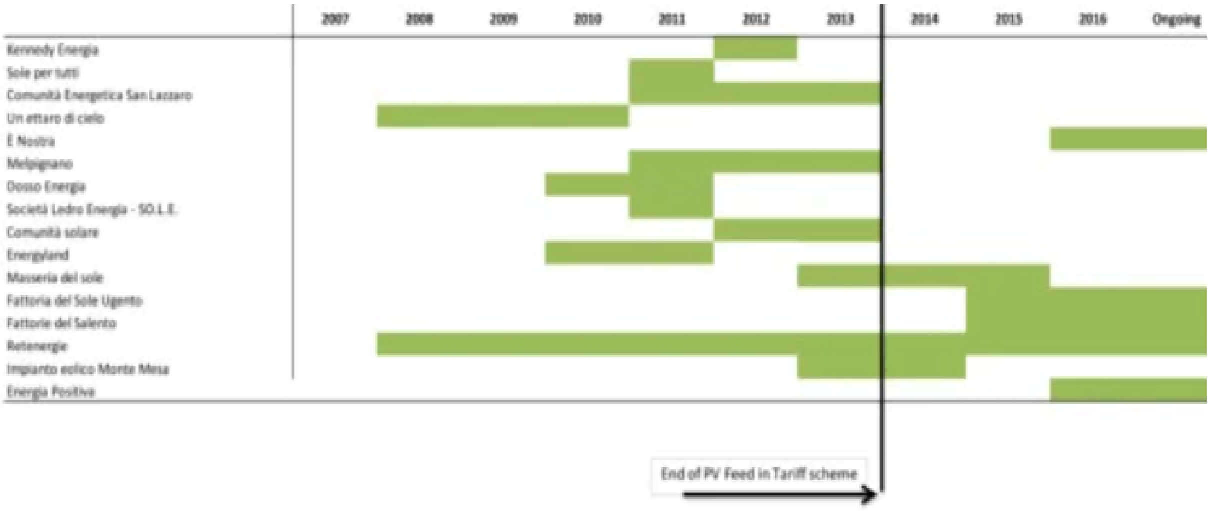
produced by three hydroelectric power plants, a photovoltaic plant, and two biomass district heating plants. This revolution, started already in the first decades of the twentieth century, has led today the citizens to join - in the form of a cooperative - making the valley able to produce more electricity than the one consumed, obviously 100% renewable. The excess electricity is then fed into the national grid and the revenues are reinvested in the same area, translating into discounts on bills or investments for new plants. In addition to this initiative, in the first decades of the 20th century, there were other "energy communities" such as the Ewerk Prad (Prato allo Stelvio cooperative) founded in 1923 or the Alto But electric cooperative founded in Friuli in 1911. These experiences, however, remain exceptions in the Italian context, largely attributable to the presence of historically rooted institutionalized networks based on a strong territorial and ethnic identification.

Instead, it is only in recent years, starting from the second half of the 2000s, that some new cooperative experiences have emerged for the shared realization of plants from renewable sources, in particular solar photovoltaic plants, given the substantial incentives they enjoyed from 2005 to 2013. These experiences have taken in most cases the form of the cooperative that can be divided into three major groups. The first are those cooperatives that try to combine a strong territorial rooting with a motivation of value-type to a general transition of energy production-consumption models in the perspective of a greater environmental and social sustainability. The second type of cooperatives, on the other hand, are characterized by a more entrepreneurial vocation, while the last is characterized to a greater extent in a local sense and is developed mainly in small rural municipalities.

Renewable energy support measures that also led to the development of EC projects were enacted between 2008 and 2013. 2008 was the crucial year in which a "*Resolution on Terms and Conditions for Access to the Grid*" was issued. It imposed no restrictions on the size of renewable energy plants installed for self-generation and, additionally, it imposed no limit on the amount of electricity that could be fed into the grid. Further, there was an obligation imposed on the system operator to purchase electricity from renewable energy producers, with the possibility for individual self-consumers to sell electricity to the grid (Inês et al., 2020). During this time frame, PV technologies have benefited from generous and unrestricted FiT schemes that have provided long-term fixed tariffs and on-site exchange to PV system owners. This support, combined with significant reductions in the cost of PV modules since 2010, has made the investments in this type of renewable energy quite profitable and relatively low risk in the broader context of the Italian energy sector, encouraging the development of the Italian EC

sector by those not equipped to deal with large projects and especially considered of high risk (Candelise & Ruggeri, 2020).
In 2013, the reduction in FiT support not only contracted the Italian PV market, but also contributed to a negative downsizing of the Italian EC sector. In fact, as can be seen from graph 6, it can be seen that most renewable energy installations were developed between 2008 and 2013, the period in which FiT schemes were active.

Graph 6: Timing of renewable energy plants development across EC initiatives



Source: *Candelise & Ruggeri* (2020)

Until 2013, small EC initiatives, locally oriented, exploited the most of this sector by investing in smaller projects (conducted by community or municipality) to focus their activities on investments perceived to have less impact on the local environment and with greater sustainability. In fact, as shown on graph 6, it can be seen that the larger nationwide energy cooperatives - such as Retenergie, Masseria del Sole, or Energia Positiva - developed new community energy initiatives even beyond 2013, despite the fact that most of these investments stemmed from the acquisition of PV systems operating on the secondary market that still benefited from FiT support.

EC initiatives involved some forms of financing or ownership by citizens against which a monetary return is offered. As specified by Candelise and Ruggeri (2020) the returns on investment offered to citizens could vary quite substantially from 1% up to 8%. This variation was very large considering that most of the initiatives have invested in the same technology, photovoltaic systems. One of the reasons for this large difference in returns came from the size of the system because larger systems installed on the ground allow greater economies of scale in the investment - both in terms of initial capital costs and transaction costs - compared to smaller systems installed on rooftops. Another essential reason stemmed from the type of initiative. In fact, initiatives whose main activity was the production of electricity from a renewable energy plant - having as their main objective the distribution among their members of the revenues derived from the management of a renewable generation project - will have higher returns on investment than those initiatives created not only to develop renewable energy plants and aggregate citizens around their financing and ownership, but also to offer other energy and social services for the benefit of both the cooperative's members and the wider local communities (Candelise & Ruggeri, 2020). In fact, in the first case, revenues (averaging around 7%) were usually distributed in monetary terms or in savings on electricity bills, while in the second case, financial returns were much lower (between 0% and 3%) because these initiatives tend to have more complex financial and organizational structures as well as redistributing revenues into renewable generation projects across a broader set of activities including those that do not generate monetary benefits for their members (Candelise & Ruggeri, 2020).

A good example of an EC initiative established in 2008 in Piedmont - continued after 2013 - is the cooperative society Retenergie. The cooperative's mission included the production of renewable energy from plants built through popular shareholding and the sale of the energy produced to members (Moroni et al., 2019). Moreover, this cooperative also aimed to create a new economy based on the principles of environmental sustainability and on active participation of members in this process.

The background of this initiative comes from the forms of mobilization and socialization of the solidarity economy. In particular, in 2008 the project "Adopt a kW", by the non-profit organization Solare Collettivo, aimed to raise awareness for the construction of a 20 kWp photovoltaic system to be installed on the roof of a social cooperative in Mondovì, Piedmont (Magnani & Patrucco, 2018). In fact, this project turned out to be relevant since one hundred thousand euros were raised for the investment with a subscription participated by about forty members from different Italian regions.

Table 2: Projects developed by Retenergie

Plant Location	Secondary Market	Plant Operating Year	Operating Year by Retenergie	Total Investment Cost (k€)	Technology	Plant Size (kWp)
Piemonte, Cuneo	No	2011	2011	171	PV	50,63
Piemonte, Isola Bene vagienna	No	2011	2011	108	PV	30,38
Emilia-Romagna, Savigno	No	2011	2011	59	PV	15,51
Piemonte, Fossano	No	2011	2011	131	PV	44,65
Lombardia, San Giuliano Milanese	No	2011	2011	111	PV	29,44
Piemonte, Boves	No	2012	2012	655	PV	255,36
Piemonte, Lagnasco	No	2012	2012	44,5	PV	19,85
Sicily, Capizzi	Yes	2013	2015	499	PV	92,23
Sicily, Capizzi 2	Yes	.	.	.	PV	.
Veneto, Vicenza	NA	NA	2016	50	Energy Saving	NA
Sardegna, Nulvi	No	na	2016	330	WIND	59,99
Umbria, Bevagna	Yes	2011	2017	na	PV	47,25
Umbria, Bevagna	Yes	2011	2017	na	PV	198,65

Source: *Candelise & Ruggieri* (2020)

As can be seen from Table 2, there were 13 projects developed by 2017, seven of which were developed with FiT support and some acquired on the secondary market given the discontinuity of FiT support in 2013.

Table 3: Retenergie, summary of activities

Summary of Activities	2009	2010	2011	2012	2013	2014	2015
Cumulative number of PV plants	0	0	5	7	7	7	9
Cumulative capacity installed (kWp)	0	0	171	446	446	446	630
Cumulative investment by citizens (k€)	0	0	628	1278	1278	1278	1575
Cumulative number of members	147	230	368	541	694	814	911
Return on capital	0	0	0	0	0	0	0
Return on social lending	3.5%	2.5%	2.5%	3%	3%	2%–3%	1.5%–3%

Source: *Candelise & Ruggieri* (2020)

At the same time, it is possible to analyze (Table 3) how the cooperative has grown steadily, gradually involving a greater number of members through public meetings, campaigns in collaboration with environmental and social associations, and other players active in the Italian solidarity economy.

The construction of renewable energy plants by the cooperative was financed largely by contributions from members/citizens, constituting about 70% of the total investment with the remaining 30% covered by debt. Citizen contributions were derived from the purchase of shares in the cooperative whose return depended on the cooperative's annual profits and the willingness to redistribute them, or through social loans whose return ranged from 1.5% to 3% (Candelise & Ruggieri, 2020). In addition to this mode of financing, Retenergie also supported a number of other services with a minimum participatory fee that allowed discounts on different services and products such as banking services or insurance and collective purchasing groups for photovoltaic.

With the aim of providing electricity in Italy, a new cooperative (ènostra) was born in 2014, of which Retenergie was a founding member together with other energy cooperatives. In March 2016, when ènostra began operating and selling energy, Retenergie transferred to the cooperative the energy from its plants that did not have an all-inclusive incentive tariff (FiT). In this way, ènostra could sell cooperative energy to its own members and those of Retenergie. The intention was to close the circle between production and consumption as was already the case for many energy cooperatives in Europe (the French Enercoop or the Spanish Som Energia).

A complicated point resulted from the point of view of communication to consumers, given the difficulty in explaining to potential new members of Retenergie that they had to join Retenergie

to support the production and ènostra to buy the energy, buying the two shares to benefit from the activities of the two cooperatives.
As described by Candelise and Ruggeri (2020), it is necessary to wait until the middle of 2018 to establish the first Italian cooperative - derived from the merger project in which Retenergie merged with ènostra - able to provide both production and supply of renewable electricity and to serve a national community of prosumers, with the aim of allowing them to access the supply of electricity at better conditions than the traditional market.

Despite the development of these energy communities managed by groups of citizens or companies (cooperative and non-cooperative), the institutional recognition of energy communities is very much suffered since, for example, in the National Energy Strategy (SEN) presented in November 2017 by the holders of the Italian Ministry of Economic Development and Ministry of Environment, "energy communities" appear only once and in a quite generic passage dedicated to new aggregators (Facchini, 2018).
To conclude, it is important to underline how the Italian experience has had EC initiatives mainly developed on the local dimension, even if only a few initiatives (about a quarter) were developed with a bottom up approach, i.e., marked by a strong involvement of citizens in the development of the project, relying instead with a top down approach, i.e., characterized by an institution (to be considered also the important role of municipalities that often acted as facilitators of the initiatives) leading the process.

Another important country to analyze is Spain. In 2015, for example, in contrast to other European countries, the cooperative movement of Renewable Energy Sources (RES) was still considered to be in a broad stage of early development, despite the Spanish country is endowed of a great RES potential, particularly in solar energy. The late development of these initiatives is due to a hostile regulatory and economic environment with the consequent operational and organizational restructuring to deal the state resistance.
As analyzed by Capellán-Pérez, Campos-Celador and Terés-Zubiaga (2018) the reasons for the delay in the development of modern RES cooperatives in Spain compared to other European countries are different. It is due by a traditionally high concentration of economic power in the energy sector, by the absence of a culture of municipal electricity companies in the country, and by the fact that the promotion of renewable energy sources between 2000 and 2010 was also driven by "grey capital" – i.e., agents who defend a slow change in the energy model by guaranteeing the capital interests of fossil and nuclear business models - in the absence of participatory projects.

Going more specific through the analysis of Capellán-Pérez et al. (2018), the initial phase of development of RES movements arose in recent years as a reaction to various factors.
First, it was realized that, despite the beginning of the liberalization process of the Spanish electricity sector in 1997 with the Spanish law that transposed the EU Directive 96/92/EC opening the competition of electricity retail generation, the related market was still dominated by a small number of private companies since clusters were formed that allowed national utilities to cover all economic activities from generation to electricity retail with the aim of circumventing regulation. New regulation also contributed to making investments in renewable energies more attractive by supporting them through a combined system of tariffs and buy-back premiums between 2004 and 2012 which, however, were mostly exploited by the largest traditional companies in the electricity sectors.
A second point that favoured the reaction to the development of energy communities was the economic crisis of 2008. This economic crisis led to a reduction of about 10% of electricity consumption in Spain, thus a reduction in demand, resulting in a high installed capacity due to the promotion in the early 2000s of new RES technologies but especially caused by a significant growth in installed capacity of combined cycle gas. This led to a situation of great overcapacity in which the electricity market favoured the generation of electricity by traditional plants.
A further point derived from the legal possibility of cooperatives to sell energy at retail level since 2010 which increased social awareness on energy issues and thus favoured the start of RES cooperative activities in the country. To be highlighted is the difference Spain had in comparison with other European countries that despite the favourable period for the diffusion of RES before 2012, no cooperative focused on renewable energy was created.
Another relevant factor was the increasing politicization of the energy issue by the 15M movement, a social movement of citizens, which mobilized a peaceful protest from below against the Spanish government for the serious economic situation in the country during the economic and financial crisis that broke out in 2008, aiming to promote a more participatory democracy in the energy field.
The last major factor that triggered a reaction was the shift in Spanish government policies against renewables since 2012 with the subsequent legislation under RD 900/2015 that applied a tax on any electricity produced and self-consumed from renewable energy resources leading to high fines in case of non-compliance by prosumers (Inês et al., 2020).
Although Spanish RES cooperatives were born in a hostile economic and regulatory environment, they took advantage of the various pressures - climate change, fossil fuel depletion, economic crisis, policies against the promotion of renewable energy sources from

2012 onwards - to strengthen their position by showing a remarkable ability to adapt to different scales and eventualities and to become a legitimate actor (Belda & Pellicer, 2016).
At the end of 2014 there were additional factors (fourth highest price of electricity for domestic consumers in the EU-28 due to the liberalization process in 1997 thus implying energy poverty rates above 15%) that allowed Spanish society to increase awareness of the importance of energy issues. These issues stimulated the active participation of society in the promotion of renewable energy resources, thus creating the conditions for their development by citizens and communities (Capellán-Pérez et al., 2018).
This fact is confirmed by the fact that in mid-October 2017, the Spanish energy cooperative "Som Energia" picked up one million euros in less than two hours through the launch of a voluntary social capital collection to finance three photovoltaic plants. There were 1.500 members who immediately invested in Som Energia's proposal, supporting two "green" projects in the Seville area and one in Almería, generating a total of 7.2 GWh per year, which was the equivalent of the electricity needs of 2.900 households (Facchini, 2018). This initiative was one of the first to put citizens at the centre of the project, who thus had the opportunity to be producers, consumers, and sellers at the same time thanks to the collection of capital among members.

As we have seen in this first part of the work, which does not go beyond 2017, each energy community or energy cooperative has acted through its own model of action also derived, if any, from national regulations and, albeit minimal, European directives.
The key point, however, is the understanding of the need by European countries of the transition from the centralized production of large utilities to the decentralized production of small producers-consumers called prosumers. In fact, on January 17, 2018, the European Parliament began debating on some important amendments on "promoting the use of energy from renewable sources" with the aim of ensuring that citizens are at the centre of the energy transition by engaging European states to define long-term strategies to facilitate the production of energy from renewable sources by renewable energy producer/consumer communities and autonomous consumers.

1.3. The Clean Energy for all Europeans Package

Energy communities represent one of the fundamental tools in the fight against climate change. The European Union, a key player in this fight in the global scenario, has committed to reducing its climate-changing gas emissions by implementing targeted policies for energy efficiency, reduction of consumption and emissions, efficient use of resources and mitigation of environmental impact. Notably, in December 2018, the European Commission published the *Clean Energy for all Europeans Package* (CEP), a package of key standards for achieving a climate neutral economy by 2050 (Pioppi, Piselli & Pisello, 2020).
By the 1990s, however, decentralization of the energy market had already entered the European agenda. Directive 96/92/EC, adopted in 1996, was the first European energy package to liberalize energy markets, thus allowing third-party access and functional pooling. In 2003, other regulations were adopted that aimed to determine the independence of market regulators and at the same time a competitive retail market (Directive 2003/54/EC, Directive 2003/55/EC, Regulation (EC) No 1228/2003). The last energy package before the recent directive of 2018 focused on the liberalization of energy markets by addressing the existing rules on unbundling network operators, to increasing the independence of national regulatory agencies and establishing ACER (EU Agency for the Cooperation of Energy Regulators) through Directive 2009/72/EC, Directive 2009/73/EC, Regulation (EC) No 713/2009, Regulation (EC) No 714/2009, Regulation (EC) No 715/2009 (Biresselioglu, Limoncuoglu, Demir, Reichl, Burgstaller, Sciullo & Ferrero, 2021).

To continue to guide European countries towards the global energy transition and energy market decentralization, the European Commission introduced the *Clean Energy for all Europeans Package*. This package addressed five different dimensions of the European Union's energy, namely the energy security, the internal energy market, the energy efficiency, the decarbonization of the economy and finally the research, innovation and competitiveness (European Commission, 2019). The energy package just mentioned sets out the legislative and regulatory framework for the European Union's energy and climate policy to achieve the new European targets by 2030, with a view to a full decarbonization roadmap by 2050. The mechanism outlined at the European level provides the contribution by each Member State to the achievement of the common targets by setting national targets. Thus, Member States, in addition to drafting an *Integrated National Energy and Climate Plan* (NECP), have also been called upon to implement two other directives: the *Directive on common rules of the use of energy from renewable sources* (EU 2018/2001 - RED II) and the *Directive on common rules* *for the Internal Electricity Market* (EU 2019/944 - IEM). The latter two directives seek to put in place appropriate legal frameworks to enable energy transition and to empower citizens in the energy sector. In particular, the RED II introduces the "jointly acting renewable self-consumers" and "Renewable Energy Communities " - REC, while the IEM directive introduces the "jointly acting customers" and the "Citizens Energy Communities" - CEC (Zulianello, Angelucci & Moneta, 2020). Thus, "energy communities", and the related concept of "energy sharing", are mentioned and defined in both the RED II and the IEM, with the difference that the IEM aims to regulate the completion of the internal market, while the RED II specifically supports the use of renewable energy sources for energy production and the acceptance of renewable energy among Europeans. However, at the same time, both directives explicitly see the consumer at the centre of energy markets by defining the consumer, individually or jointly, as an "active consumer" for the IEM directive and as a "renewable self-consumer" for the RED II directive (Lowitzsch, Hoicka & van Tulder, 2020).

The main objectives of the *Clean Energy for all Europeans Package* are to promote public acceptance and development of renewables at a decentralized level, to promote energy efficiency, to promote market participation by users who would otherwise be excluded, to provide energy at affordable prices, and, finally, to combat energy poverty by reducing energy supply and consumption costs through efficiency (De Luca, 2021).

The RED II directive, endorsed by the European Parliament and the European Council, establishes a common framework for the promotion of energy from renewable sources by setting a binding European Union target for the overall share of energy from renewable sources in the Union's gross final energy consumption in 2030. It also lays down rules relating to financial support for electricity from renewable sources, the self-consumption of such energy, the use of energy from renewable sources in the heating and cooling sector and in the transport sector, administrative procedures, information and training. In particular, however, as mentioned above, it defines the self-consumers of renewable energy acting collectively, Article 21, and the "Renewable Energy Communities", Article 22 (Interreg Alpine Space, 2020).

The key aspect, and interesting for this work, is the introduction of the legal establishment of RECs by the directive.

In Article 2/16 of the RED II directive, renewable energy communities are defined as "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" (Eur-Lex, 2018).

According to Article 22/1 of RED II, RECs have the right to self-organize renewable energy sharing within the community and to access all eligible energy markets directly or through aggregation in a non-discriminatory manner. For the most part, RECs, in addition to being place-based as seen in item of Article 2/16, are limited to renewable energy technologies and can be active in all energy sectors.
Another key element of the energy transition is described by point f of Article 22/4 in which it is made explicit that participation in a REC should also be accessible to low-income and vulnerable[1] households. However, as analyzed by Inês and al. (2020), despite the call for inclusivity in the article just mentioned, RED II does not provide explicit guidelines and measures to ensure that RECs are accessible to low-income households.
In order to promote the existence of energy communities, all regulatory barriers that prevent people from being able to join should be removed.
Basic rights, regulated by Article 22/2, allow energy communities to:

(a) "produce, consume, store and sell renewable energy, including through renewables power purchase agreements;

b) share, within the renewable energy community, renewable energy that is produced by the production units owned by that renewable energy community, subject to the other requirements laid down in this Article and to maintaining the rights and obligations of the renewable energy community members as customers;

[1] A vulnerable consumer is defined by the European Commission as a consumer, "who, as a result of socio-demographic characteristics, behavioural characteristics, personal situation, or market environments:
- Is at higher risk of experiencing negative outcomes in the market;
- Has limited ability to maximize his-her well-being;
- Has difficulty in obtaining or assimilating information;
- Is less able to purchase, choose or access suitable products; or
- Is more susceptible to certain marketing practices".
The context of vulnerability then is a set of conditions or deprivations that lead to certain lifestyle or consumption choices. These conditions often lead to or recreate circumstances such as energy poverty (Hanke & Lowitzsch, 2020).

c) access all suitable energy markets both directly or through aggregation in a non-discriminatory manner" (Eur-Lex, 2018).

Renewable self-consumers are considered another legal institution introduced by the RED II directive. In fact, in confirmation, Article 2/14 defines the renewable self-consumer as "a final customer [...] who generates renewable electricity for their own consumption, and who may store or sell self-generated renewable electricity, provided that, for a non-household renewables self-consumer, those activities do not constitute its primary commercial or professional activity " (Eur-Lex, 2018).
Thus, according to the article specific to self-consumers of renewable energy (i.e., Article 21), they - individually or through aggregators - are allowed:

a) "to generate renewable energy, including for their own consumption, to store and sell their excess production of renewable renewable electricity;
b) To install and operate electricity storage systems;
c) To maintain their rights and obligations as final consumers;
d) To receive remuneration" Art.21/2 (Eur-Lex, 2018).

Thus, renewable self-consumers located in the same building or condominium may act jointly being considered by the directive a type of self-consumer rather than a community.
Regarding smart metering or data sharing, the RED II directive did not include any provision and in fact this gap has been filled by the 2019 IEM.

Directive 2019/944 IEM, also introduced by the European Parliament and Council, establishes common rules for the generation, transmission, distribution, storage, and supply of electricity, along with consumer protection provisions, in order to create truly integrated, competitive, consumer-centric, flexible, fair, and transparent electricity markets in the European Union (Interreg Alpine Space, 2020). In particular, Articles 15 and 16, define protections for jointly acting active and Citizen Energy Communities.
The purpose of the Internal Electricity Market Directive is to organize competitive electricity markets, provide choices for final customers, improving consumer engagement and empowerment, provide new business opportunities, competitive prices, efficient investment signals and higher service standards, and ultimately to contribute to security of supply and sustainability (Biresselioglu et al., 2021).

In a part of European states, the right of people to generate electricity for their own use was recognized but was under-utilized due to administrative and legal procedures, and high perception of risk and financial costs.
Therefore, the directive was also useful in introducing the important concept of CEC, a legal institution parallel to the REC defined in RED II.
According to Article 2/11 of the IEM directive, "Citizen Energy Community' means a legal entity that:
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" (Eur-Lex, 2019).

Article 16/1 of the IEM focused on the need to provide Member States with an enabling regulatory framework for citizen energy communities, ensuring that:
(a) "participation in a citizen energy community is open and voluntary;
b) members or shareholders of a citizen energy community are entitled to leave the community;
c) members or shareholders of a citizen energy community do not lose their rights or obligations as household customers or active customers;
d) relevant distribution system operators cooperate with citizen energy communities to facilitate electricity transfers within citizen energy communities;
e) citizen energy communities are subject to non-discriminatory, fair, proportionate, and transparent procedures and charges, including with respect to registration and licensing, and to transparent, non-discriminatory, and cost-reflective network charges" (Eur-Lex, 2019).

Articles 3, 16 and 17 are essential to require states to remove all restrictions that prevented CECs from accessing electricity markets in a non-discriminatory manner.
As analyzed by Biresselioglu and al. (2021), energy efficiency, the key principle of EU energy policy, was emphasized in the regulation through the involvement of citizens in the energy market and through the facilitation of related procedures. Technology, an important tool in all

phases, and the regulation have given priority to the modernization of distribution networks through the introduction of smart grids and meters.

As mentioned above, it is necessary for energy market authorities to allow CECs to operate in the market according to principles of fair competition without having to face discriminatory procedures. In fact, according to Article 16/3 (Eur-Lex, 2019) CECs should:

(a) able "to access all electricity markets, either directly or through aggregation, in a non-discriminatory manner";

b) be "treated in a non-discriminatory and proportionate manner with regard to their activities, rights, and obligations as final customers, producers, suppliers, distribution system operators, or market participants engaged in aggregation";

e) share the electricity generated by the community with its members and shareholders without preventing their rights and obligations as final consumers.

The new European regulatory framework created through the RED II (promotion of the use of energy from renewable sources) and IEM (common rules for the internal electricity market) directives represent a profound watershed because they formally recognize the possibility for energy consumers to play, both individually and collectively, an active role in electricity markets and in the transition to a low-carbon energy system (Rossetto, 2021).

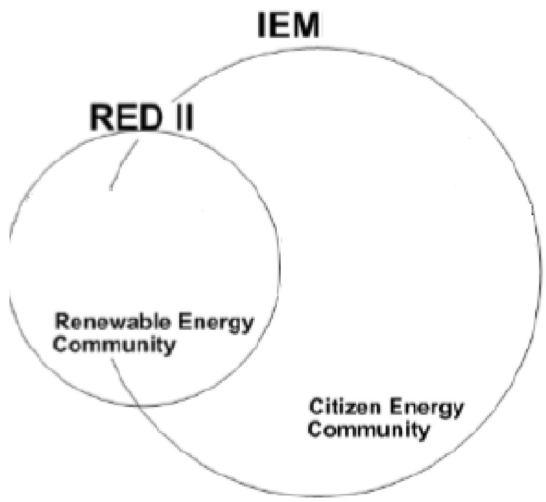
Both directives describe energy communities as non-commercial legal entities, based on the open and voluntary participation of their members (households, public authorities and medium-sized enterprises) with the condition that their main activities are not energy-related. Another feature in common is the participation, in all or a part, of the decision-making process in operational control by community members and the use of potential revenues to provide local services/benefits. However, as analyzed by Reis, Gonçalves, Lopes and Antunes (2021, p. 2), these definitions differ in:

- “the geographical scope, since REC require participants to be in the vicinity of renewable projects, while CEC does not set physical boundaries;
- the activities performed, as CEC comprise generation, distribution, supply, consumption, aggregation, energy storage, electric vehicles (EV) charging, energy efficiency (EE) or other energy services, while REC promote the engagement into generation, trading, storage and supply of energy from renewable sources;
- the generation technologies, since REC only allow renewable technologies whereas CEC are technology-neutral, meaning that both renewable and fossil-based technologies are acceptable; and

- the membership rules, as CEC consent large companies to participate as members or shareholders as long as their business is not energy-related, contrarily to REC. This distinction allows communities to be fully controlled by small end-users aiming to benefit from renewable energy or to be deployed in partnership with commercial stakeholders or social entrepreneurs".

In addition, in the IEM directive, CECs can set themselves up as owners or operators of the distribution network or as a closed distribution system and it aims to create a level playing field for communities. The RED II directive, in contrast to the IEM directive, uses RECs as a tool to remove barriers and promote renewable energy development. At the same time, RECs can be considered as a subset of CECs because as stated by Gerasina (2020, p. 39) "the relationship between the two definitions is quite clear – RECs represent a specific, more favoured by the legislator, form of CECs. However, RECs also have an own area of operation not falling under the IEM as far as other types of energy are concerned". Figure 2 shows the relationship between renewable and citizen energy communities.

Figure 2: Relation of the Renewable Energy Community and Citizen Energy Community



Source: *Gerasina* (2020)

Currently, both legal definitions of energy communities coexist in the same legislative package. Now, the task of the Member States is the transposition of both directives into national legislation, ensuring that the necessary conditions for the development of energy communities are met by mitigating the existing financial, regulatory and technical barriers according to the different national realities. Therefore, the new European regulations should attract private and public investments and incentivize new innovative business models. Thus, as described by

Roberts (2020), first, national frameworks must ensure the removal of unjustified regulatory and administrative barriers. Second, new guidelines must help building the capacity of communities to develop projects, particularly by providing tools to access funding and information. As mentioned earlier, assistance should also be available to low-income and vulnerable consumers so that they can participate in energy communities. Finally, national enabling frameworks should provide regulatory and capacity-building support to local authorities so that they can directly support or participate in energy communities.

Although establishing a first step towards harmonizing what is meant by energy community, the definitions presented by the directives are somewhat vague, regarding the concept and implementation. If, on the one hand, this wide scope definitions may provide the adaptability required to adjust energy communities to different national contexts and to boost innovation, on the other, the door is open for the concepts to be used inappropriately, at the risk of missing the sustainable community development and energy democracy goals (Reis & al., 2021).

Chapter 2: Energy community development

The emergence of the concept of energy communities essentially goes against centralized structures, environmentally harmful technologies, and powerless participation. Although the EC initiative and its continued success is based on the community itself, the political framework nevertheless plays an important role in providing the conditions in which an EC movement can emerge.
The challenge of creating an energy community is based on defining an organization that effectively represents a local community and its contextual composition, taking into account the social and environmental, as well as economic, sustainability aspects perceived by all the actors involved in the development and management phases.

2.1. Benefits and limitations

Nowadays, the main greenhouse gas (GHG) emissions come from the energy sector. What we are trying to address in Europe - see the two European directives analyzed in the previous chapter - is the transition to renewables and the consequent decentralization of the energy system. In fact, to confirm this, the *Joint Research Center* of the European Commission, through the report "Global Energy and Climate Outlook", highlighted how electrification plays a primary role in the energy transition given the increasing rate of electrification in all sectors. For this reason, Europe has focused on giving importance to energy efficiency, with a view to self-consumption and collaboration, thus giving relevance to population centres that, according to the report of the European Commission, generate about 70% of global CO_2 emissions.
The development of renewable energy communities at the city level can be an important enabler for the development of Net Zero Carbon Cities[2], progressively enabling the electrification of streets and neighbourhoods, and promoting energy efficiency. The benefits of energy communities, however, do not end with the sphere of environmental sustainability alone.
The most evident change that emerges from this transition is the new role of consumers who go from being passive beneficiaries of energy services, completely detached from the processes of

[2] Net Zero Carbon Cities means that cities must succeed in achieving net zero emissions. Net zero emissions will be achieved when all Greenhouse Gases (GHG) emissions released by human activities are offset by removing GHGs from the atmosphere in a process known as carbon removal. First, human-caused emissions should be reduced as close to zero as possible. Any remaining GHG emissions should then be offset with an equivalent amount of carbon removal through, for example, forest restoration operations (Levin, Frasen, Schumer, Davis & Boehm, 2019).

energy governance, to a situation of active evaluation of consumption choices. This phenomenon takes place both through the reduction of demand and through first-person participation in the generation and storage of energy, thus assuming greater relevance in the energy sector. This change initiates the existence of *prosumers*, i.e., individuals who are both producers and consumers of energy. Mostly, this self-production and self-consumption become collective from the moment that actors become part of the energy community, where users collaborate with each other.
Energy communities therefore aim at strengthening the role of citizens as an active part of the energy system by producing social, economic and environmental impacts.

2.1.1. Economic impact

Before analyzing the specific economic impacts derived from energy communities, it is important to look more broadly at the benefits and barriers associated with renewable resources. According to the analysis of Sen and Ganguly (2017), economic growth can be associated with the shift from burning conventional fossil fuels to higher quality electricity. Clean energy is a symbol of human development and contributes to income generation and decreasing poverty levels, and given the decentralization of RE technologies, they can play an important role in rural development. Then, the analysis continues by investigating possible market failures caused by human activity. In the case of developing renewable energies, Sen and Ganguly (2017) analyze some points that could be encountered:

- Underinvestment in R&D programs of RE technologies because initiators cannot benefit from exclusive property rights for their efforts;
- Unpriced environmental impacts due to external costs of GHG emissions that are not priced at an appropriate level;
- Monopoly in energy sector reduces the competition among suppliers and demanders, it also reduces the opportunity for free market entry and exit;
- Too high initial investment cost for RE systems that may be unaffordable to most potential customers;
- All power projects have financial risks due to uncertainties in future electricity prices.

Concerning energy communities, as analyzed in the report "Energy Communities in the EU - Task Force Energy Communities" of the *Bridge Horizon 2020* the main economic impacts concern the local value creation, employments opportunities and financial benefits.

The fundamental principle of local value creation is the maintenance of added economic value within the community and the ability to create local economies. An example is the German cooperative EWS Schönau - already mentioned in chapter 1 - which, in addition to owning the local distribution network, it entrusts maintenance work on the network to local businesses. This example helps to understand how taxpayer money for grid maintenance is kept within the community. Thus, one of the purposes of energy communities results in generating income for communities located near renewable energy generators that are often located in marginalized regions with economic disadvantages. As noted by Brummer (2018), part of the economic benefits can also be a funding to the small towns and villages that are shareholders in them to provide additional community services such as sports centres, day-care centres, or otherwise useful services to the citizens of the community. Therefore, the ability of energy communities to share earnings among their members is important to allow for long-term sustainability.
At the same time, the employment opportunities are a concept that is very much related to the one just observed. First, energy communities allow the stimulation of the local/regional economy by creating jobs installing and maintaining renewable energy systems. This is necessary because these jobs require outside specialists with technical knowledge and skills, outside of the energy community itself. More specifically, this concept allows the creation of local job opportunities that prevent a migration of potential talent to larger cities. Referring again to the EWS Schönau cooperative, it mostly employs young people who grew up in the community in which it is developed.
Finally, according to Hannoset, Peeters and Tuerk's (2019) analysis, a key economic impact - which in the case of Germany is crucial for citizens - is the financial benefits that are realized through reduced electricity bills (as in the case of EWS Schönau). Thus, members can benefit from financial gains in relation to energy costs by including a reduction in their bill given the higher affordability in comparison to the retail tariff, the inclusion of lower grid tariffs due to aggregation effects, and, moreover, ensures better local security of supply in case of power disturbances elsewhere in the grid (Caramizaru & Uihlein, 2020).

In many cases, the primary motivation for citizen participation in energy communities is the opportunity to invest money in renewable energy, along with the possibility of a good return on investment and economic incentives. The latter can take many forms, as EC initiatives can adopt a wide variety of business models with different funding arrangements. As an economic incentive, EC organizations that supply energy directly to their members can offer a lower energy price than their competitors (Bauwens, 2019). Indeed, in the region of Flanders, the Ecopower cooperative provides electricity to its members at a lower price in comparison to competitors, spurring many people to become members of the cooperative (Bauwens et al., 2016). In some cases, members of energy communities can also build an additional source of economic incentive by adopting cost-saving or energy efficiency measures.

In contrast, in terms of possible benefits generated from direct financial gains, energy community members can refer to revenue generated from the sale of energy produced, land/roof leases, or tax revenues (Brummer, 2018). Despite these possible benefits, EC projects very frequently are non-profit organizations (especially after the European directives) whose return on investment is subject to a cap, thus making them less attractive to investors seeking to maximize their economic return (Bauwens, 2019).

As mentioned earlier, local energy allocation can decrease local peak demand and payment for grid services, but at the same time can increase costs somewhere else in the system. Network costs are distributed equally among system users because the same type of network provides the same cost allocation. Therefore, the grid operator will try to compensate for the resulting loss of revenue by increasing the tariff for the remaining customers in the system who may not own a renewable energy facility. This regressive effect creates a social discrepancy between community members and non-members; the latter include those individuals who cannot afford to invest in renewable energy, but indirectly support the former group by contributing to renewable energy support schemes (Caramizaru & Uihlein, 2020).

A good analysis focusing on economic indicators on consumers and investors was developed by Gjorgievski, Cundeva and Georghiou (2021). On the consumer side, the authors use bill savings as an indicator to describe the economic performance of community renewable energy. For example, in the case of PV investments, community systems and energy sharing can outperform individual systems. A clear demonstration they made concerns multi-apartment residential buildings with PV panels that can save up to 90 euro/year in Austria, 970 euro/year in Germany. The diversity of these savings depends on local electricity rates, legislation, and system size. This type of benefit appears to be more easily realized collectively than individually, mostly involving greater responsibility on the part of end users. On the investor side, i.e., the parties investing in the energy community infrastructure, economic performance was studied based on total costs, including investment costs, operating costs, and other costs such as those arising from environmental taxes. The results of the Gjorgievski et al. (2021, p. 1150) analysis show "that by forming an energy community, the total cost associated with investment, operation and maintenance can be reduced by about one third."

The economic performance of energy community projects on the basis of indicators more typically used in project planning - such as Net Present Value, Internal Rate of Return, or the payback period - are also essential to the study of investor-centric economic indicators but deserve an in-depth analysis that will not be studied in this work. Certainly, as mentioned by Gjorgjevski et al. (2021), optimal sizing and comprehensive scenario analysis can significantly improve the economic performance of energy systems.

In terms of barriers to the establishment of energy communities, the high costs of investing in infrastructure and the resulting reduced access to financing are held in higher regard. The acquisition of initial funding is a complex process that requires a lot of effort, research, and networking, and it is highly dependent on national incentive programs. In fact, for most cases, researchers see a lack of long-term funding in addition to serious problems in acquiring inception funding (Brummer, 2018). Energy communities struggle to have financial resources to invest in high-risk projects with uncertain probabilities of success. This implies that the work is basically done by volunteers since the financial cost of outside expertise is a limiting factor.

Regarding policy issues, Brummer (2018) analyzes the lack of suitable incentives for EC - such as uncertainty about the level of FiTs - a threat to their establishment. More generally, small ECs (which make up the majority of the population in energy communities) face greater difficulties in accessing financing, loans, and contracts than large companies. In addition to these initial funding issues, the costs of maintaining systems are also significant.

In addition, the way earnings are shared among members turns out to be one of the most determined factors affecting community stability given the difficulty in determining a fair and meritocratic mechanism through which value is shared within a community (Gjorgievski et al., 2021).

To conclude, it is useful the observation of Ruggiero, Isakovic, Busch, Auvinen and Faller (2019) which analyzes how to promote the expansion of energy communities from an economic perspective finding the following points essential:

1. Provide long-term and low-interest investment funding schemes which is rated as one of the main barriers;
2. Eliminate regulatory barriers;
3. Provide economic support. EC projects are often considered as initiatives that depend on subsidies.
4. The citizens in many EC projects make investment decisions with a long-term perspective in mind. Therefore, is essential that all investors can operate within a stable policy framework.

2.1.2. Social impact

The primary component of the energy community concept is the consumer. In fact, the more consumers want to be involved, the more energy community initiatives will be constituted. For this reason, it is of relevant importance to analyze the factors that influence consumers' willingness to be involved in energy communities. Lazdins, Mutule and Zalostiba (2021) found that the adoption of energy communities depends also on factors related to consumers such as age - for which it was found that younger people are more willing to be involved in community participation than older people -, wealth - there is a positive correlation between participation rate and income -, and political views - for which a more conservative political stance means less interest in energy communities.

An overview of the major benefits of energy communities from a social perspective by the observation of Hannoset et al. (2019) relates the energy democracy, the energy justice, the education, the social cohesion trust and the energy autonomy. Briefly, the energy democracy concerns the ownership and decision-making power of energy communities' members over their energy production and supply by deciding on the development and management of new energy projects either directly, through a general assembly, or indirectly, through the board of directors; the energy justice follows the principle that those who are affected by a project should receive, at the same time, some of its benefits; the education refers to the awareness of citizens on climate and energy issues; the social cohesion and trust concerns the nurturing of a culture of cooperation; finally, the energy autonomy aims to create energy independence and security of local supply.

The evaluation by citizens to participate in energy communities is derived from different points of view. It is therefore essential to also understand the individual motivations behind the decision to invest in renewable energy. People perceive each situation in their own way by distinguishing three different goals:

- "Hedonistic goal. People want to improve the way they feel. The goal has a short-term time horizon and it motivates people to increase their pleasure and to avoid situations that negatively affect their well-being.
- Gain goal determines the motivation to increase or protect resources. It has a time horizon of medium or long term, which means that the goals to be achieved are in the upcoming or far future.
- Normative goals. People act appropriately and behave ethically or morally. Their primary goal is to meet the norms expected by themselves or by the community". (Dóci & Vasileiadou, 2015, p. 42-43)

After looking at the three main motivations that drive people to invest in renewable energy, it is necessary to be aware that only one of the objectives will be the dominant. It will determine the way in which the person will interpret the situation and his way of acting, leaving in the background the motivations of the other two objectives that reinforce or weaken the dominant one.

However, in addition to analyzing individual motivations, in this case it is necessary to understand why people want to be part of energy communities. A first simple answer comes from the fact that people are social beings with a need to belong to a group in order to obtain benefits. Moreover, according to Olson (2009) collective action is not necessary if people can pursue their goal individually. Therefore, groups are formed in case people have a common and unorganized interest in which individual action is unable to achieve the specified interest, or in case the realization of an individual interest involves a greater sacrifice and effort in comparison to collective realization.

Firstly, specifically analyzing the two points just mentioned, one of the reasons why people decide to invest in a technology jointly is the possibility of reducing transaction costs that besides to money are composed by time, energy and also the costs of negotiation (Dóci & Vasileiadou, 2015). Secondly, community projects can gain local acceptance more easily than others, especially from local residents educated through trainings for a better understanding of renewable energy technologies thus promoting proactive energy saving behaviour. Indeed, Caramizaru and Uihlein (2020) note how educating and mobilizing citizens on these topics empowers citizens towards joint action to combat climate change along with municipalities and local authorities as well. At the same time, the community participation in the planning process led to a greater acceptance of energy communities (Brummer, 2018) also allowing to substantially mitigate the so-called "Not In My Back Yard" or NIMBY, effect (Capellán-Pérez et al., 2018). It indicates the protest by members of a local community against the implementation of public works with significant impact in an area that is felt by them as strictly personal. Finally, the third motive stems from the opportunity that participants in ECs have to avoid individually fulfilling other transaction costs - such as contract monitoring and implementation costs - that may arise if the provider does not comply with the contract.

In collective action, the risk (transaction costs, technology failure, financial losses or changes in regulations) and its consequences are distributed among all members of the group, which therefore makes a greater investment possible by allowing greater risks to be taken than in the case of individual action. Collective actions, in this particular case of energy communities, can also be based on norms and values in addition to the elements of gain just observed. In fact, as analyzed by Dóci and Vasileiadou (2015), the most important reasons from people to the participation of energy communities are ideological reasons such as improving the conditions of neighbourhoods, being a good example for others or strengthening the local community. Beyond that, people might join community energy projects because of direct and indirect social pressures, in addition to the fact that the participation on ECs can increase the person's short-term pleasure such as increasing self-esteem or strengthening the relationship between members.

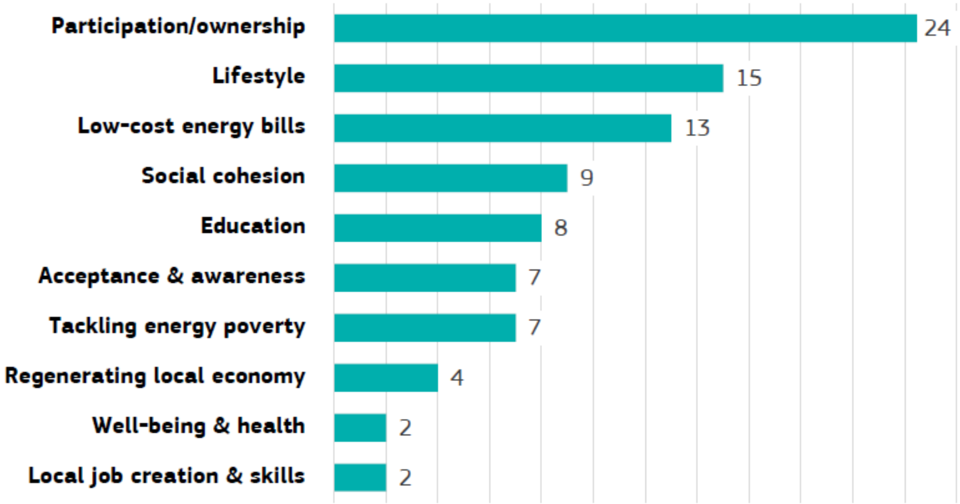
According to Brummer (2018), one of the key social impacts identified in ECs is the support of the community itself at various levels. The involved communities are brought up to date giving them more options to make their own decisions and build a stronger community identity consequently helping citizens identify more with their community and also increasing their interest in community activities. These communities can also enable another degree of self-actualization by participants through feelings of enthusiasm and pride in achievements, as well as social cohesion, i.e., the creation of a community feeling and trust.

In addition to the factors just highlighted, Bauwens (2019, p. 843) also considers two other dimensions that influence membership in an EC initiative. The first is the spatial dimension that distinguishes "communities of place, which imply a set of social relationships embedded in a particular spatial context, and communities of interest, which are formed by networks and social relationships that can extend beyond specifically place-based networks". Because of the spatial proximity and the consequent greater social interactions between community members, the community of place seems to have stronger environmental and social motivations than communities of interest. The second dimension is the temporal one. It emphasizes the tendency for non-economic factors to predominate for early members during the pioneering phase of initiatives. Over time, however, financial aspects become more important as the initiative tends to move toward professionalization, thus attracting more profit-oriented investors.

Caramizaru and Uihlein (2020) point out that community energy empowerment is also strongly reflected in lifestyle improvements including the desire to be self-sufficient and to foster a sense of community. Moreover, lifestyle choices are also associated with anti-nuclear sentiments and pro-environmental attitudes.

Given the point made about economic and social impacts, it is useful the Graph 7 from the research article of Caramizaru and Uihlein (2020) which, through the use of 24 case studies, analyzes which socio-economic goals provide the push for the community-driven energy initiatives.

Graph 7: Socio-economic benefits corresponding to 24 case studies



Source: *Caramizaru & Uihlein* (2020)

2.1.3. Environmental impact

As described by Sen and Ganguly (2017), climate change mitigation is a major driving force behind the increasing demand for renewable energy. The action to reduce the impact of climate change appears fundamental through the increase of renewable energies to consequently meet climate goals without slowing economic growth and without reducing welfare.

According to Bauwens (2019), environmental considerations have been highlighted as one of the drivers for joining EC initiatives. In fact, environmental concerns are among the most relevant factors in influencing a consumer's willingness to participate in an energy community project. Energy communities help climate protection both indirectly, through educational means, and directly, through the transition to renewable energy. Additionally, Brummer (2018) reports some studies that show how ECs in the UK can influence people's lifestyle choices by helping to develop a more sustainable attitude. This means that people involved in EC activities are generally more receptive to ethical and environmental engagement.

Unlike fossil fuels, renewable energy is site specific. For example, the output of a wind turbine depends on wind speed and other related properties. As a result, a wind-based energy system only makes sense in some particular regions with certain characteristics. Thus, the problem lies in the availability of minute and detailed quality data of specific areas, and on updated modelling to get an accurate idea of the system output (Sen & Ganguly, 2017).

So as briefly described by Hannoset et al. (2019), at the environmental level, energy communities allow to produce locally zero-emission energy by increasing local renewable energy shares and they allow to avoid air pollution through the decreasing of the use of fossil fuels to produce electricity.

2.2. Business model and finance

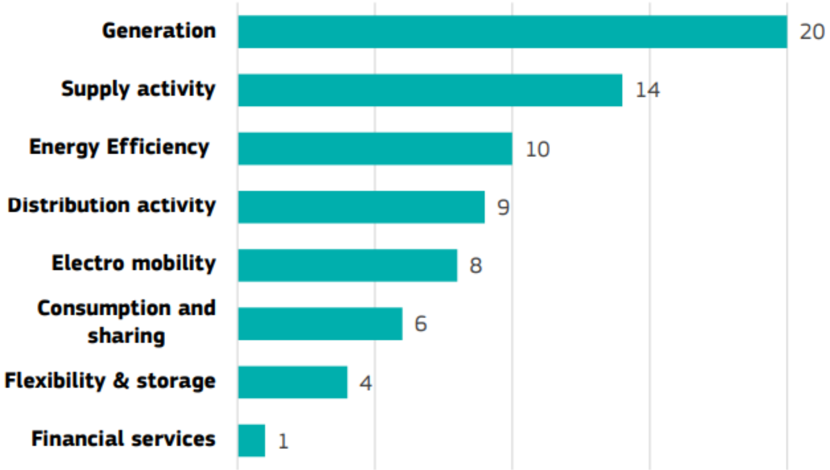
2.2.1. Organizational business

Before analyzing the organizational level of energy communities, it is necessary to emphasize how they can carry out traditional activities, but, at the same time, can engage in new business models. Caramizaru and Uihlein (2020, p. 12) have analyzed the possible activities that energy communities can engage in:

- "Generation: community energy projects collectively using or owning generation assets (mostly solar, wind, hydro) where members do not self-consume the energy produced but feed it into the network and sell it to a supplier.
- Supply: the sale (and resale) of electricity and gas to customers (electricity, wood pellets, biogas and others).
- Consumption and sharing: the energy produced by the energy community is used and shared inside the community. This includes both consumption (individual and collective self-consumption) and local sharing of energy amongst members that is produced by the generating installations within a community.
- Distribution: ownership and/or management of community-run distribution networks, such as local electricity grids or small-scale district heating and (bio)gas networks; often cooperatives can do both energy generation and distribution, but the network infrastructure is central to their business.
- Energy services: energy efficiency or energy savings (e.g. renovation of buildings, energy auditing, consumption monitoring, heating and air quality assessments); flexibility, energy storage and smart grid integration; energy monitoring and energy management for network operations; financial services.
- Electro-mobility: car sharing, car-pooling and/or charging stations operation and management, or provision of e-cards for members and cooperatives.
- Other activities: consultation services to develop community ownership initiatives or to establish local cooperatives, information and awareness raising campaigns, or fuel poverty measures".

An analysis conducted on 24 case studies by Caramizaru and Uihlein (2020) allows to take advantage of an overview of the activities that are mostly conducted by energy communities. The Graph 8 shows that the first activities carried out by ECs are those considered typical and therefore not innovative.

Graph 8: Overview of activities corresponding to the 24 case studies



Source: *Caramizaru & Uihlein* (2020)

Energy communities can be managed and organized by citizens, especially in the last years that they have been regulated by, in particular, two European directives, already mentioned in the first chapter.

Citizen-led initiatives do not necessarily need a legal form. Actions such as crowd-funding or collective self-consumption are activities that can be carried out without necessarily having a legal form. However, as described by REScoop.eu (2020) in a report called "Financing Guide", when initiatives related to infrastructure, supply or production are being developed, a legal form is mandatory. A legal form allows the energy community to be protected at the level of its investment (it allows investors to be responsible for the costs of the organization up to the level of their investments), to access investments more easily, to participate in some cases in the target market and to provide services to its members, and, finally, it allows facilitations on governance.

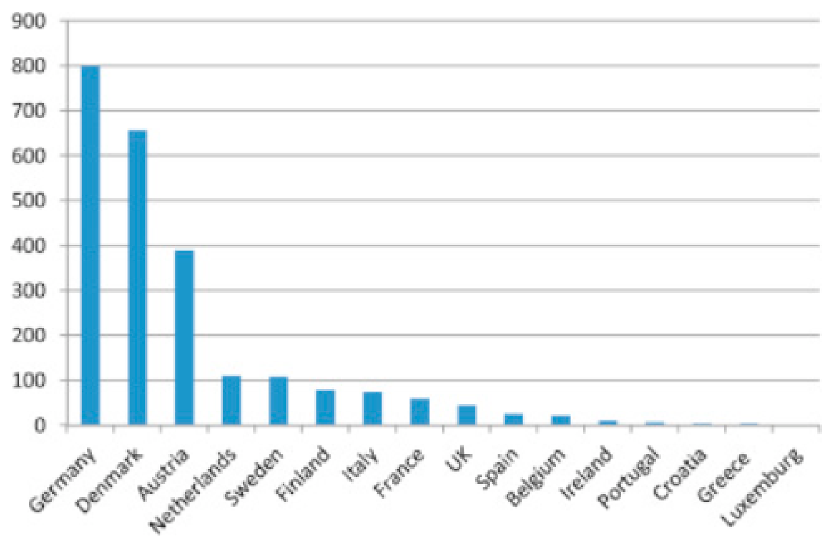
As analyzed by Caramizaru and Uihlein (2020) various governance models enable citizen participation in community projects. Energy communities can be different in terms of governmental structure, accountability, and decision-making processes depending on the legal form chosen. Thus, the two authors, Caramizaru & Uihlein (2020, p. 14) list possible compatible legal structures for energy communities:

- "Energy cooperatives: This is the most common and fast-growing form of energy communities. This type of ownership primarily benefits its members. It is popular in countries where renewables and community energy are relatively advanced.
- Limited partnerships: A partnership may allow individuals to distribute responsibilities and generate profits by participating in community energy. Governance is usually based on the value of each partner's share, meaning they do not always provide for a one member - one vote.

- Community trusts and foundations: Their objective is to generate social value and local development rather than benefits for individual members. Profits are used for the community as a whole, even when citizens do not have the means to invest in projects (for-the-public-good companies).
- Housing associations: Non-profit associations that can offer benefits to tenants in social housing, although they may not be directly involved in decision-making. These forms are ideal for addressing energy poverty.
- Non-profit customer-owned enterprises: Legal structures used by communities that deal with the management of independent grid networks. Ideal for community district heating networks common in countries like Denmark.
- Public-private partnerships: Local authorities can decide to enter into agreements with citizen groups and businesses in order to ensure energy provision and other benefits for a community.
- Public utility company: Public utility companies are run by municipalities, who invest in and manage the utility on behalf of taxpayers and citizens. These forms are less common but are particularly suited for rural or isolated areas."

Energy communities organized as energy cooperatives are by far the most common in Europe. As analyzed by Reis et al. (2021) through REScoop.eu there are currently about 1,500 energy cooperatives members of the European Federation of Citizen Energy Cooperatives serving more than one million European citizens. However, the actual number of such initiatives can be described as uncertain since an inventory conducted by REScoop.eu was able to identify more than 2,400 renewable energy cooperatives across Europe.

Graph 9: Approximate number of renewable energy cooperatives in European countries (2014)



Source: *Bauwens et al.* (2016)

In non-cooperative approaches, users selfishly manage their system to maximize their own economic benefits while neglecting the achievement of maximum social welfare. However, in

the case of typical energy communities, users are generally not interested in direct trade, preferring to delegate this role. It is easy to understand how a cooperative approach is considered more appropriate, especially considering the social objective of community policies expressed by the European Union.
In general, renewable energy cooperatives allow citizens to collectively own and manage renewable energy projects at the local level with the goal of achieving the most economical solution. As analyzed by Fioriti, Frangioni and Poli (2021, p. 3), "according to the cooperative game theory, the stability of a coalition depends on the cost/profit allocation that shall adhere to two main principles: rationality and efficiency". Rationality seeks to ensure that no group of users benefits from leaving the community, while efficiency specifies how all the benefits given by the community must be fully distributed among all its components.

The ownership model is different from conventional business organizations, especially from an economic point of view, since - unlike for-profit companies that are owned by investors - their members own them. A further well-defined difference stems from net earnings that "are usually divided pro rata among the members - not according to their shareholding - but according to the volume of transactions they have conducted with the firm" (Bauwens et al., 2016, p. 136). However, in order to protect the cooperative, in case the net profit is allocated as return on equity, the profit distribution is defined by a cap, emphasizing that the maximization of the return on equity does not turn out to be a key objective. Moreover, democratic governance is the basis of how renewable energy cooperatives are structured, implying equal individual voting rights and no barriers to entry for new members (Bauwens & Eyre, 2017). The governance is usually in the hands of shareholders such as households, small and medium enterprises, and public entities, who can be supplied with renewable energy and, at the same time, are compensated through revenues that in one part are reinvested in the community and in the other part can be distributed among shareholders according to cooperative statutes. Return expectations remain often lower than those of profit-oriented investors, and as a result, private members of cooperatives focus on environmental and social aspects that thus determine their participation (Hanke & Lowitzsch, 2020). In fact, as described by Reis et al. (2021), energy cooperatives are generally established as local non-profit corporations created to supply specific local regions (communities of place) based on self-consumption and surplus sales, reinvesting the financial results back into the community. Mostly, energy cooperatives can assist in the management and operation of regional low-voltage distribution networks by acting as the operator of the local distribution system, thus allowing them to set billing conditions, to incentivize self-consumption through dynamic rate schemes, and to exempt cooperative members from paying certain rate systems.

In addition to the importance of the actors in the design of the governance system and of the roles played by social culture and norms, the importance of the coordinated actions taken must be emphasized. Coordinated actions make it possible to reduce transaction costs with the associated increase in revenues from electricity sales for producers. Resource sharing and the benefit of economies of scale from a larger portfolio of renewable energy projects give cooperatives a way to increase investment security for RE projects and their economic viability. Second, coordinated actions help strengthen the bargaining power of cooperatives in the face of large incumbent energy players who have a greater capacity to resist change (Bauwens et al., 2016). Thus, coordinated actions can be seen as a way to achieve a more balanced distribution of political power in energy markets that is still largely unbalanced in favour of large players.

However, the weight of the cooperative sector in renewable energy varies enormously across Europe, being well established in some countries and remaining marginal in others. In fact, through the analysis of Bauwens et al. (2016), it turns out that in countries where the cooperative movement has a long and established tradition, people are aware of this legal structure and are aware of its benefits. In the opposite case in which countries have less familiarity – i.e., low awareness and knowledge of the model - it can prove to be a cognitive barrier. Initiatives based on joint investment will also take other forms if some countries have had unwelcome experiences with a specific type of cooperative model (negative historical legacy).

As seen so far, energy communities are composed of a variety of organizations, different types of technologies, and varying degrees of uptake of community participation. Each combination may include different financial, management and governance features such as the well-known energy cooperatives or through co-ownership schemes between local charities, private companies and municipalities. However, in our case, community energy enterprises share ownership among local individuals and allow both to support investments in local energy projects and to open the project in a participatory way with the aim of producing social, economic and environmental benefits among the local community.

It is of paramount importance to analyze the possible stakeholders that enable to achieve the feasibility conditions of energy communities. Tricarico (2021, p. 3) conducted the analysis of the process highlighting mainly the following actors:

- "The Local Authorities (LA), the municipalities involved in the process, provide spatial and financial assets in order to assure the technical feasibility of the electricity production plant.

- The Local Organisations (LO), the stakeholders that have facilitated the community engagement before and during the share offer, to support the communication and the implementation of the project and its organisational features.
- The Project Managers (PM), the technicians who have led the implementation of the project in terms of technological and financial requirements, producing technical knowledge in order to achieve investor engagement.
- The Community of Investors (CoI), here defined as the group of citizens which have invested in the selected energy community."

In addition to these various types of actors, of paramount importance in establishing a new energy community are intangible and structural resources. Intangible resources are defined, again by Tricarico (2021), as organizational and relational capacities (human and organizational capital), intellectual competencies (technical, communication, financial skills) and also the various forms of trust between the community of investors and stakeholders that have fostered the mobilization to overcome the barriers that hinder the initiatives of the energy community. As for structural resources, they include national policies (incentives and tax breaks), local policies (purchasing agreements or other forms of collaboration and project financing), financial schemes, communication campaigns and territorial assets.
In order to achieve these proactive citizen groups, the community of investors is crucial in deciding how their energy is generated. These members must be considered in the planning, implementation and operation of the overall arrangement, influencing how the value of the energy community is generated through also sharing risks and costs. Although energy communities are not primarily operated for profit, their business model must be able to provide to their shareholders a return on their investment by benefiting from a cheaper energy supply through the sale of excess generation or shares, or by self-consumption, i.e., reducing dependence on the electricity grid. In order to consider energy communities economically viable, it is necessary to first consider the possible costs and revenues arising from them, thus defining a basic business model. The cost structure considers the economic feasibility studies to assess the possibility of developing the community project, the costs of licensing and planning, the capital cost for the construction of generation facilities, storage, management and distribution, the cost to use the public distribution network, and the costs to expand the existing infrastructure in addition to the costs of operation and maintenance of the infrastructure. The energy community will have to consider the costs of energy supply in case it is not able to meet the energy needs of the participants. On the revenue side are considered energy contracts with suppliers or other external actors to whom excess production is sold, share sales, and possible subsidies under national legislation or other long-term contracts between renewable energy

producers and the government. Beyond the economic dimension, the business model also focuses on the environmental contribution that ECs can make by focusing on social innovation (energy decentralization) and the ability to generate renewable energy.

According to Reis et al. (2021), essential resources to be able to develop an energy community are the members given the social and financial value they bring to the projects, the availability of the area to build generation and storage facilities, the financial resources for the implementation and management of the project through both members and partners, the technical know-how that can be outsourced, and finally the availability of incentives for renewable energy producers, as well as enabling regulatory frameworks.

Thus, very briefly, Reis et al. (2021) summarize energy communities dedicated to *prosumerism* as communities of place created by prosumers, who play the role of decision makers, investors, and customers, who join together to benefit from special financing conditions in acquiring assets, to gain size to participate in markets, to benefit from collective initiatives, or to participate in local energy markets. Community members can either sell all of their electricity within community boundaries by exempting participants from paying tariff components related to medium and high-voltage distribution and transmission grids, or they can establish transactions with non-community energy suppliers but imposing tariffs. The potential revenues obtained will then either be distributed to prosumers to repay their investment or reinvested in the community to improve social infrastructure and expand installed generation capacity. However, the larger the size of the community and the complexity of the project, the more likely it is that one will have to formally organize the process or rely on outside help (Dóci, 2020). Therefore, the formation and organization of ECs will depend on the size of the community and the complexity of the technology to be used.

2.2.2. Possible support mechanisms

The issue of support mechanisms for establishing and managing an energy community is a very complex one. Funding and possible incentives are not well defined by European directives and consequently are at the discretion of national policies implemented in the respective countries.

As mentioned earlier, in terms of cost, energy communities using RE technologies are not very competitive with conventional technologies for energy generation according to current energy market models. For this reason, since the establishment of the first "energy communities", support mechanisms have been developed to address this issue, thus stimulating the use of RE technologies and making EC initiatives economically feasible.

Picking up the examples cited in the first chapter, Feed-in Premiums (FiPs), Feed-in Tariffs (FiTs), and citizen share obligations have been the types of mechanisms most used to encourage investment in energy communities, particularly those generating renewable energy. According to Mitchell, Bauknecht and Connor (2006) the large number of created cooperatives result from the fact that they are more likely to benefit from these support mechanisms given the reduction in risk that consequently stabilizes the transaction costs of financing and managing these initiatives. Moreover, as Bauwens et al. (2016) point out, whether a support mechanism is market-dependent or market-independent is an important factor in risk reduction. FiTs, which are considered market-independent mechanisms, offer fixed remunerations that are independent of electricity price volatility and are often accompanied by repurchase obligations. This provides greater investment security through low transaction costs and predictable cash flows. FiPs, on the other hand, are considered market-dependent mechanisms that are based on electricity price volatility. They give to generators the incentive to control the evolution of electricity prices resulting in higher transaction costs for marketing electricity. Therefore, for energy cooperatives - which are considered small - independent mechanisms such as FiTs are to be considered more favourable. Moreover, FiTs allow entrepreneurial risk to be minimized by giving the RE producer a clear expectation of returns for feeding its energy into the grid. Thus, this financial security helps mobilize the private capital of community members. In contrast, auction systems, which have replaced FiTs in some countries, have contributed to overburdening the scarce administrative resources of EC groups, thus providing a large comparative advantage to commercial producers who could exploit economies of scale (Busch, Ruggiero, Isakovic & Hansen, 2021). The extensive use of FiT by countries such as Denmark, Germany, and the United Kingdom created a certain degree of dependence on these tariffs, thus making projects vulnerable to FiT declines, as in fact happened in Germany.
Direct subsidies have also contributed to the establishment and operation of ECs in Denmark, Germany, and the United Kingdom, as well as indirect subsidies in the form of preferential loan terms (Busch et al., 2021). However, in case the availability of capital for investment in ECs becomes a major barrier, the policy coordination is necessary. This, for example, was the case in the UK, where government-guaranteed loan schemes and grants were able to overcome banks' reluctance to lend.

However, the fundamental concept for funding and establishing energy communities is based on capital contributions from members and in some cases, if possible, through funding from outside sources. The ability to raise sufficient funding to establish and operate energy communities is often very challenging. Just looking at the preliminary stages of developing EC

initiatives, the need for funding for project feasibility studies or, for example, bank guarantees is a significant risk for non-professionals.
According to the "Financing Guide" report provided by REScoop.eu (2020), there are several methods to finance energy communities besides the injection of cash by citizens through the acquisition of shares. One of the simplest methods comes from donations made by citizens or local organizations. The energy community only has to make sure that, according to national policies, the type of financing is possible, and that the money is used for investment within the community. As for debt financing, it is a method that avoids impacting the ownership structure of the energy community. However, as mentioned earlier, energy communities find it difficult to retrieve this type of financing. Therefore, traditional financing institutions represent a barrier to the development of EC projects. Instead, on the development side of energy communities, ethical banks offer the same services as traditional banks but, often, also assess the social and ecological impact of the project as part of the review process.
A substantial help in financing energy communities is also played by mutual funds established by some European countries. For example, Genervest is an investment fund with the Greenpeace's support, with the goal of financing and supporting community projects in Greece. This fund is funded by private investment and launched its first crowd-funding in 2021. Another fund is called MECISE (Mutual for Energy Community Investment Society). It is a mutual fund that brings together energy cooperatives and communities to support citizen transition projects. In other cases, energy communities can be directly funded through crowd-funding. As in some cases in France, it enables fundraisers to collect money from a large number of people via online platforms. In others, the energy community may need guarantee, i.e., an insurance policy for the project being developed.
Despite these various forms of funding, RE projects, especially in the beginning, find it difficult to raise sufficient capital given the limited access to credit due to the size of the project, and the lack of guarantees and risk assessment. Thus, as stated above, funding often depends on monetary contributions from community members. However, as the example provided by Hanke and Lowitzsch (2020), the average individual contribution in RE cooperatives in Germany amounts to € 3,899 with an average minimum contribution of € 511. As described by these two authors, such high contributions constitute a barrier for the participation of vulnerable consumers with limited financial means whose participation, moreover, does not immediately translate into financial benefits but only unfolds over time. This represents a barrier for low-income segments of society and means that the benefits of participation in energy communities are predominantly absorbed by already privileged segments of society (Hoicka, Lowitzsch, Brisbois, Kumar & Camargo, 2021). According to data from Bouzarovski, Thomson, Cornelis,

Varo and Guyet (2020) 82.3 million households find it difficult to pay their electricity bills and as a result they see these vulnerable groups excluded from the energy transition. The issue of vulnerable consumers is closely related to the issue of energy poverty. The latter concept can be defined as a household's attitude of not being able to achieve a certain necessary level of household energy service. In fact, as defined by Hanke, Guyet and Feenstra (2021, p. 2), energy poverty addresses three different categories of inequities: "inequalities in income impacting energy affordability; in housing accessibility, quality and affordability driving energy needs with adverse effects on comfort and health; and in energy policy (e.g., energy tariffs, feed-in tariffs, their financing and consumer protection regulations) increasing energy vulnerabilities." The ability of vulnerable consumers to participate in energy communities would therefore mitigate energy poverty through reduced energy consumption costs and the possible additional source of income that participants would derive. To address the issue of vulnerable and energy poor groups, it would be essential, therefore, to decrease the prices of membership fees for participation in ECs and provide energy rates lower than the market price.

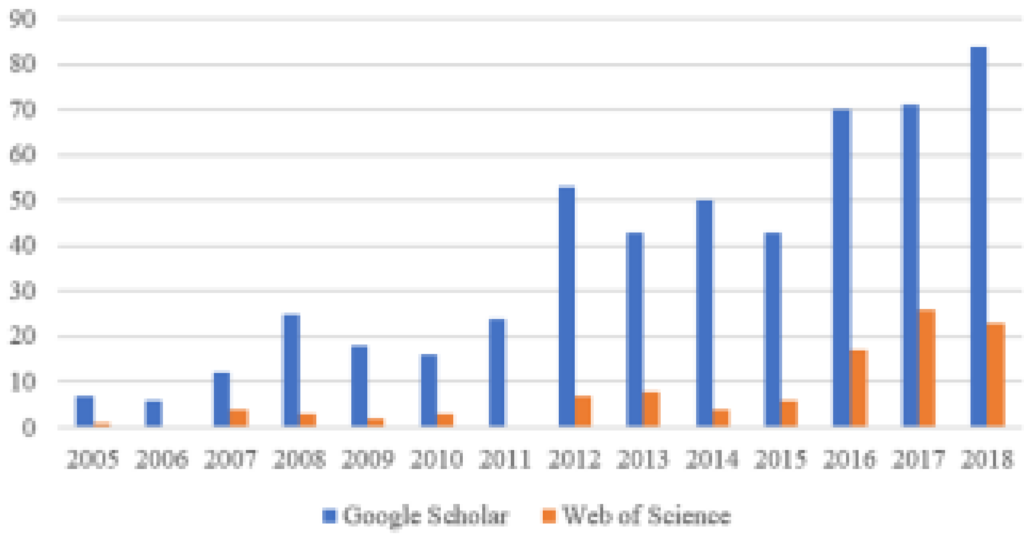
Despite European directives do not indicate how to include vulnerable consumers in the energy transition, and thus in the participation of energy communities, the Danish state has experimented with and granted low-interest loans on the island of Ærø to finance their participation in community energy projects (Hanke & Lowitzsch, 2020). In the Belgian city of Elko, good practice has also taken place in favour of this specific group. The city government purchased shares of local energy communities and then transferred them to local energy poor households, providing them with access to lower energy prices (Hanke et al., 2021).

After this analysis, it is easy to see how there is no shortage of ways to support energy transition through energy communities, even if vulnerable consumers are not well considered. However, these energy communities have the potential to facilitate the inclusion of marginalized households by offering them the opportunity to improve their economic situation. Therefore, these issues will need to be part of the national regulatory frameworks of EU Member States as soon as possible, given the lack of specificity of this topic by European directives. In fact, the policy framework plays a key role since given that, as stated by Brummer (2018), the right incentives and regulations can stimulate a great participation from citizens but, at the same time, their lack can be considered a big barrier.

2.3. Numerical data on energy communities

The numerical data available regarding energy communities are still limited despite the fact that the topic is increasingly at the centre of attention given also the recent related European and national directives to regulate energy communities. This is confirmed by the Graph 10 realized by Verde and Rossetto (2020) in which it is shown the number of articles from 2005 to 2018 that use simultaneously in the title the words "*community*" (or "*communities*"), "*energy*" and "*renewable*" in the two search engines *Web of Science* and *Google Scholar*. As can be seen, in recent years the growth of articles has increased significantly, particularly since 2012, confirming the increased interest in the topic.

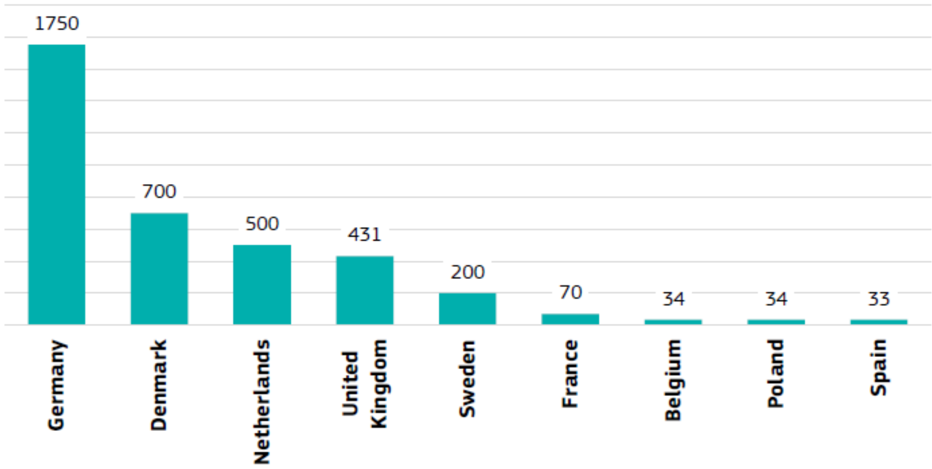
Graph 10: Identified publication on energy communities (2005-2018)



Source: *Verde & Rossetto* (2020)

Energy communities have been transposed differently within the European Union. As mentioned in the first chapter, there have been pioneer countries that have addressed energy communities since the late 20th century and still remain the countries with the largest number of ECs initiatives nowadays. As indicated by Caramizaru and Uihlein (2020) through the *Joint Research Centre* (JRC) analysis in Graph 11, the top three countries in terms of the number of energy communities are Germany, Denmark, and the outsider Netherlands, followed then by the United Kingdom. After these four countries, there are countries that have had different timelines, and in some cases even a different methodology for developing energy communities.

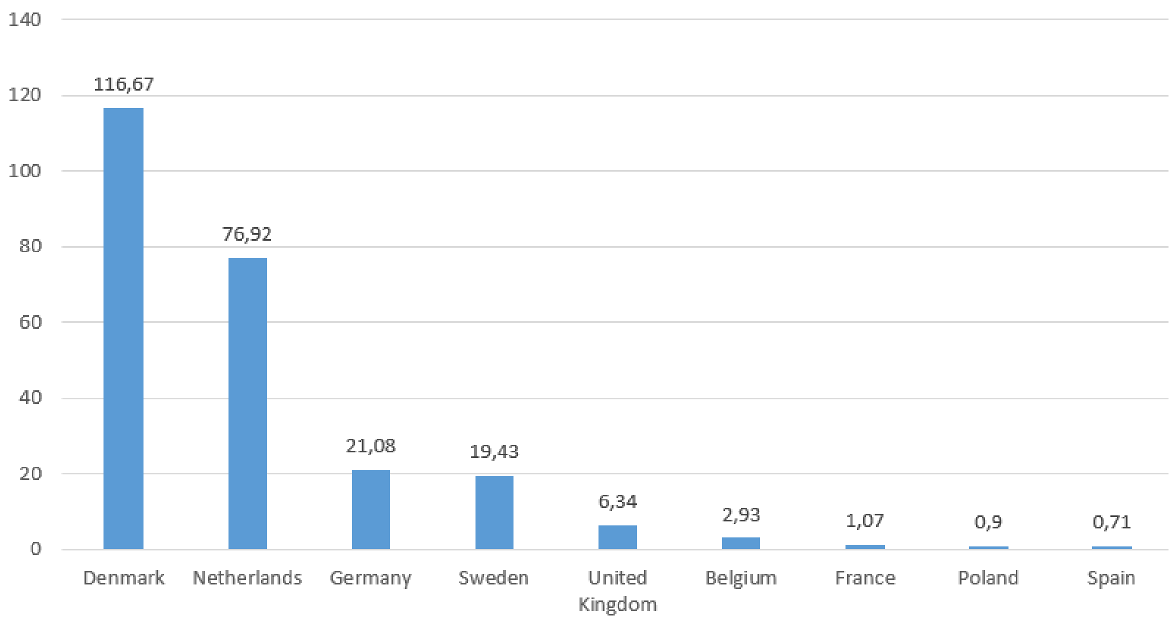
Graph 11: Approximate number of community energy initiatives from nine countries in Europe (2019)



Source*: Caramizaru & Uihlein* (2020)

Through the data in Graph 11, it is possible to calculate on average how many ECs are present per million inhabitants for each country, thus finding more meaningful information based on the country's population (Graph 12).

Graph 12: ECs per million inhabitants (2019)



Source: Authors' elaboration on *Caramizaru & Uihlein (2020)* data

A useful depiction of the number of energy communities in Europe comes from Facchini's (2018) article that processed information found on REScoop.eu to provide the number of energy communities run by citizen groups or corporations, cooperative and non-cooperative.

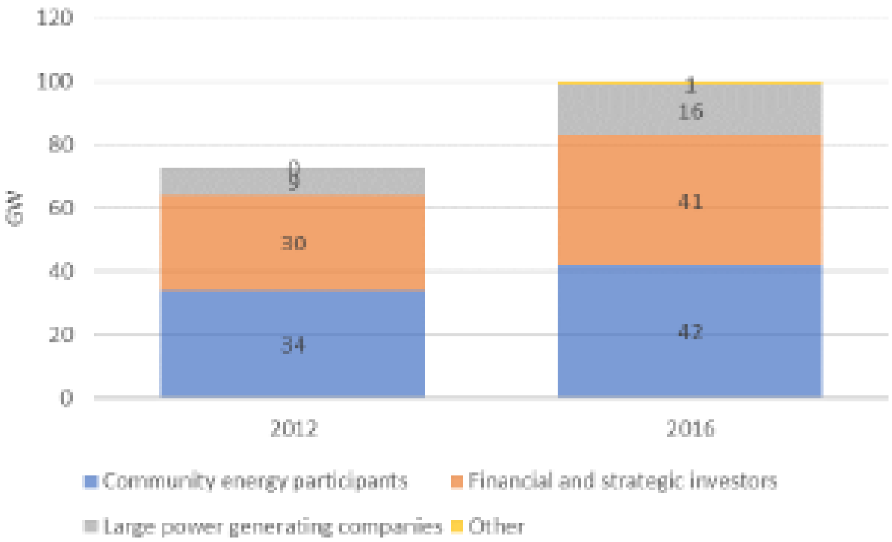
Graph 11 and Figure 3 find substantial differences because the energy communities shown in Figure 3 are members of the European Federation of Renewable Energy Cooperatives (REScoop), while those in Graph 11 indicate approximately all energy communities in Europe.

Figure 3: Energy communities in Europe (2018)

Source: *Facchini* (2018)

As reported by Facchini (2018) from the study "The potential of energy citizens in the European Union" carried out by the research center *CE Delft*, it says that in 2050 45% of European citizens could produce their own renewable energy, of which one third would derive precisely from the activities of energy cooperatives. As analyzed by Di Silvestre, Ippolito, Sanseverino, Sciumè and Vasile (2021), Germany already reached 25% of total community-owned wind power capacity in 2012 and 50% of photovoltaic production was community-owned in 2014. Tounquet, De Vos and Kielichowska (2020) also analyzed through *Energy Atlas 2018* the investments made by German energy communities in renewable energy pointing out that in 2012 communities collectively produced about 46% of the total renewable energy, decreasing in 2016 to approximately 42% (Graph 13). The data are different from the analysis done by Di Silvestre et al. (2021) because Tounquet et al. (2020), besides to considering all renewable energies and not just wind and solar, included in energy communities citizen participation (e.g., fund investment, minority in operating companies), community-owned producers (e.g., regional energy cooperatives and majority interest in operators) and individual owners (e.g. individuals, farmers and cooperatives).

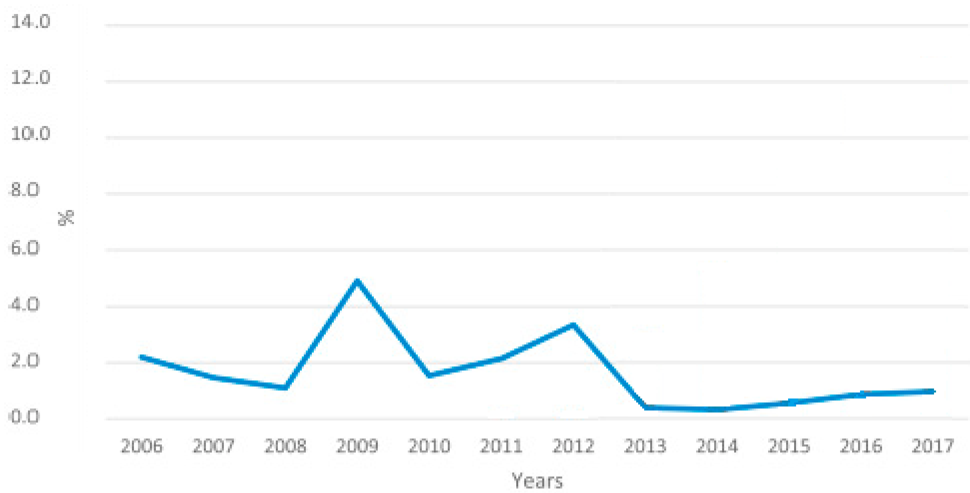
Graph 13: Renewable energy community growth in Germany, 2012 - 2016



Source: *Tounquet et al.* (2020)

With regard to the United Kingdom, specifically taking solar energy into consideration, communities in 2009 owned about 4% of PV systems as a result of pioneering projects in a relatively nascent solar PV market (Nolden et al., 2020). Despite rapid growth on property in the early years of development (see Graph 14), the community share of this fast-growing market subsequently declined to less than 2% in 2017.

Graph 14: % of total capacity of PV systems that is community owned in England (2006 – 2017)



Source: *Nolden et al.* (2020)

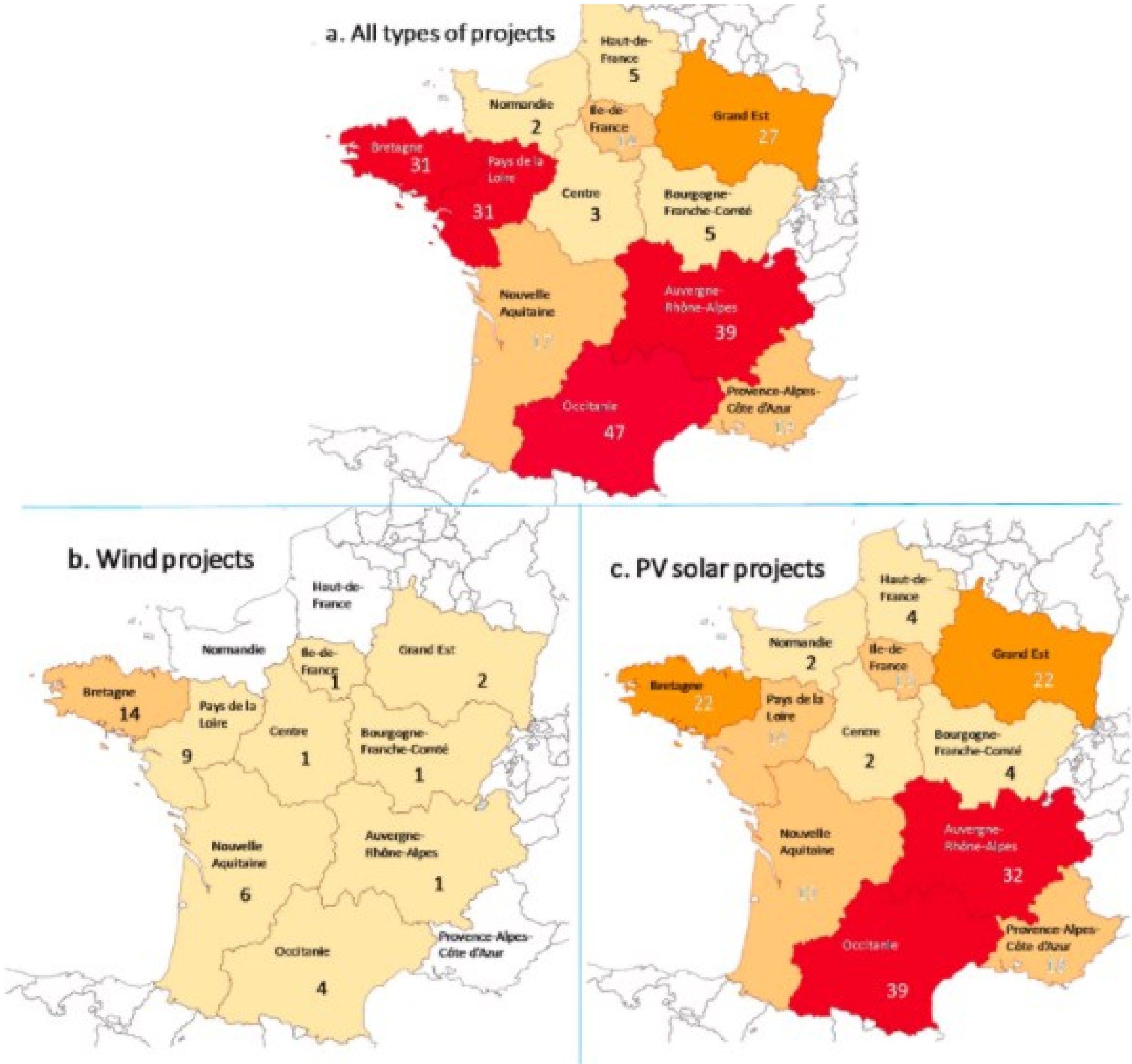
On the other hand, from the geographical point of view, Figure 4 shows where the renewable energy communities are mainly developed considering solar and wind energy. In this case are shown the renewable energy communities that are part of REScoop, of which most are located in rural areas.

Figure 4: REC members in REScoop

Source: *European Network for Rural Development* (2020)

Looking specifically at the French territory, one can observe the geographical distribution of the various energy communities. The highest concentration of community projects is found in Occitanie with about 20% of the projects in France. Figure 5b and 5c show the distribution of projects developing wind farms and solar installations, respectively. As mentioned in the 2.1.3. sub-chapter about environmental impact, biophysical conditions partly explain the observed differences: more wind-based renewable energy communities in the Loire countries or Brittany where wind speeds are higher, and more solar PV communities in the south of France, such as in Occitanie, where solar hours are higher (Sebi and Vernay, 2020).

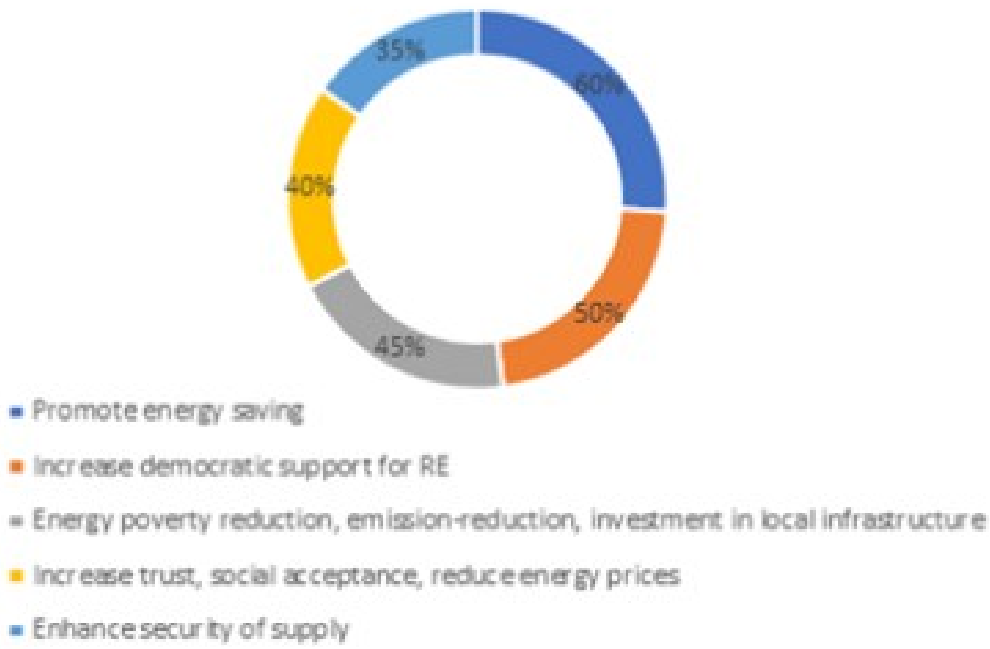
Figure 5: Geographic distribution of energy community by region in France (2019)



Source: *Sebi & Vernay* (2020)

Finally, according to a questionnaire presented by the *Bridge Horizon 2020* report entitled "Energy Communities in the EU - Energy Communities Task Force", the broadest societal benefits derived from energy communities are depicted in the Graph 15 below. In addition to the five benefits represented in the graph, three other benefits were found: foster local economic growth (30%); generate jobs (20%); and provide return on investment (15%).

Graph 15: Overview of most prominent societal benefits provided by energy communities (top 5), 2019



Source: *Hannoset et al.* (2019)

Chapter 3: Energy Communities after European Directives

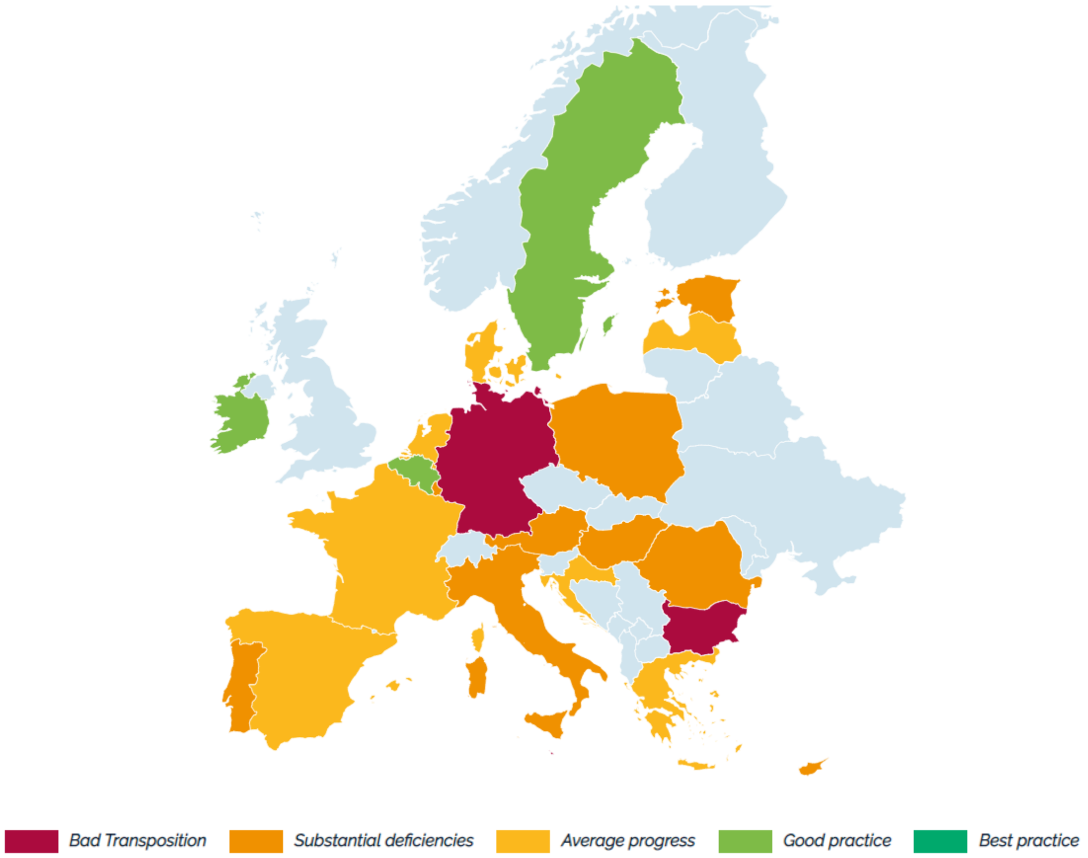
The transition towards a more sustainable society is largely facilitated by the growth in the use of renewable energy sources in the European energy market. An active and prominent role in the energy policies of the European Union and its Member States has been entrusted to citizens by the already mentioned *Clean Energy for All European Package*. This framework highlights the role of citizens who collectively create, share and consume energy, in addition to define the role of the individual citizen. Specifically, energy communities have been introduced into European legislation through Directive 2018/2001 (RED II), dwelling on Renewables Energy Communities (RECs) and specifically on the promotion of the use of energy from renewable sources, and by Directive 2019/944 (IEM) defining Citizens Energy Communities (CECs) and common rules for the internal electricity market.

3.1. Transposition by European countries

Europe is currently undergoing a significant transition in its energy system. The involvement of citizens in energy policies and practices is not a new issue, although it has never been regulated by European legislation. In contrast to the traditional approach in which an industrial entity from outside the territory initiated projects with the goal of maximizing economic interests at the expense of local environmental and social sustainability, energy communities are characterized by a greater balance between the interests of investors in developing new plants and the needs of local communities by providing environmental and social services to the community, without pursuing financial goals as the main objective (Zulianello et al., 2020).

The RED II and IEM directives invite each of the European Member States to introduce two similar categories of Energy Communities in their legislation, with some differences in terms of usable sources (renewable only for RECs), proximity (absent for CECs; not specifically defined for RECs), and type of energy (electricity and heat for RECs; electricity only for CECs). These new directives recognize citizens as important actors in the energy market by outlining governance principles and activities for energy communities (REScoop.eu, 2022). The contribution of individual European countries to actively support the creation of energy communities, however, is of paramount importance. To get an initial overview of the status of transposition of the REC and CEC definitions in European Member States, the overall assessment map of REScoop.eu.'s transposition of the two definitions in Figure 6 is useful.

Figure 6: The progress of the transposition of RED II and IEM



Source: *REScoop.eu* (2022)

This energy transition will require a considerable investment that will be paid by the citizens as consumers, taxpayers or money savers being them at the centre of this transition. The national legislation of European countries is of paramount importance in adopting the RED II Directive and the IEM Directive in each country in order to regulate this specific market.

Now, below, we will look more specifically at how the adoption of RED II and IEM is progressing in the national legislation of a sample of countries in Europe.

3.1.1. Austria

Austria was one of the first countries in Europe to introduce legislation on collective self-consumption and, consequently, on energy communities.

Regarding the collective self-consumption, with an amendment to the national energy law, the electricity grids in the condominiums have been defined as private, thus opening the possibility to produce electricity, especially photovoltaic, to be distributed to the users of the condominium itself. One of the first examples of this solution is a building in Lavaterstrasse, Vienna, in which the electricity generated by photovoltaic modules installed on the roof is directed to the various users according to their instantaneous consumption needs. Users who have chosen to purchase solar electricity (this option is not an obligation for apartment buildings) pay 11 euro cents per kWh consumed, with savings of about 30% compared to grid rates (Battisti, 2020).

Energy communities, prior to 2017, had no possibility of being created, either within the building boundary or between multiple buildings. In 2017, prior to the implementation of European directives, Austria began a process of developing a comprehensive regulatory framework for energy communities by amending the Electricity Industry and Organization Act (Fina & Fechner, 2021). This amendment allowed for energy sharing within the boundaries of a single property (as described above), although the primary goal was to allow ECs to be established within individual multifamily buildings. The implementation of the CEP and related European directives in 2019 forced Austria to revise national legislation so that energy communities could be established beyond the building boundary. In fact, in September 2020, a legislative package established the Renewable Energy Expansion Act (Erneuerbaren-Ausbau-Gesetz, EAG). This new law established a structure for RECs, while provisions on CECs were introduced in the EIWOG (Austrian Electricity Act), which already dealt the collective self-consumption regime (Frieden, Tuerk, Neumann, d'Herbemont & Roberts, 2020).

The provisions regarding RECs indicate that they may be able to generate, store, and deliver electricity, but also - unlike as regulated by RED II - act as an aggregator and provide energy services. Although the provisions focus particularly on the electricity sector, RECs also have the ability to operate district heating networks given the neutrality of the technology used. From the organizational point of view, RECs can be organized through many legal forms such as cooperative, partnership, association or company. Regarding the proximity requirement, it has only stated that they must be located within a network area and must be limited to local or regional level. The primary incentive for RECs comes from the reduction of grid rates for the transfer of electricity between participants based on the type of grid used. If a medium voltage grid is used, grid rates will be reduced less than if low voltage grids are used. As analyzed by Fina and Fechner (2021), this decision is questionable, as it is not determined whether RECs actually reduce grid load. In fact, as a result of this uncertainty, there is the possibility of a change in grid tariffs in 2024 following the publication by the regulator, E-Control, of a cost-benefit analysis. Although, as mentioned several times, the main purpose is not to generate financial benefits, rather it is important for citizens to increase the profitability of REC participation by reducing, for example, network tariffs.

With respect to CECs, Austrian regulations are less extensive. The legislation indicates the possibility of these energy communities to generate, store and sell electricity, as well as to provide energy efficiency services or charging services for electric vehicles. An additional

element that is specified is the effective control that is limited to individuals, local authorities, and small businesses as determined by the IEM directive (Frieden et al., 2020).
Instead, as cited by Cejka (2020), the exemption to the energy tax, the reduction of grid tariffs, as well as the exemption to the green electricity surcharge that is charged per kWh, is only granted for RECs based on the amount of energy that was actually consumed by the community. In conclusion, the comparison between the national law and the European directives reveal, on the one hand, the capacity by the part of the Austrian legislators to integrate most of the European requirements for, in particular, RECs; on the other hand, the difficulty to fully examine some issues such as the one related to grid tariffs that causes uncertainty among project developers and the subsequent adoption of RECs. From that, it can be deduced that to fully develop the complex topic of energy communities various experts from all relevant sectors of ECs will need to be involved.

3.1.2. Denmark

Denmark, being one of the pioneer countries in creating energy communities, had long since allowed collective self-consumption on the scale of buildings and certain ECs. Unlike other countries, in Denmark the generation plant and consumers had to be connected by a private grid through the use of a common meter. A proposal to amend the Danish Electricity Supply Act was accomplished by defining ECs and addressing the rights and obligations of aggregators and active consumers. Some provisions highlighted by Frieden et al. (2020) emphasize that CECs should be exempted from delivery obligations by allowing the community the exclusive right to consume the energy produced within, in addition to the fact that citizen energy communities are not authorized to independently own, purchase and operate distribution networks. Denmark therefore presents a definition of CEC, but not yet a definition of REC. The CEC definition, besides defining in some detail how to avoid control by other companies, includes all of the relevant criteria in the IEM Directive definition, except on the statement of permitted targets for CECs. In fact, the definition reflects those of the European directives regarding the characteristic of energy communities to be open and voluntary, of the development of internal non-discriminatory eligibility criteria reflecting the entry and exit of members, and of the prohibition of participation in CECs to individuals and legal entities engaged in commercial activities in the energy sector as their main economic activity. In addition, it is indicated that legal entities such as associations, cooperatives, partnerships, or corporations are allowed. Two significant shortcomings in the Danish legislation are the lack of definition regarding geographical proximity and on size requirements for enterprises that are limited to exercising effective control over the energy community (REScoop.eu, 2022).

3.1.3. Sweden

Compared to countries such as Denmark or Germany, Sweden has limited experience with energy communities. The main reason stems from the centralized structure of the Swedish energy market - notably owned by a few national companies - as well as the fact that municipalities play a key role in electricity and gas supply.

There are currently no regulations on ECs in Sweden, but the Swedish government - although it has yet to formally propose legislation to transpose energy communities - has proposed recommendations on how to transpose European directives. In fact, the regulator has proposed three chapters regarding ECs, and two more regarding one on CEC and one on REC.

As specified by the legislative proposal, an energy community will consist of three or more natural or legal persons, for which each member will have one vote, unless otherwise stipulated in the statutes. While both have their own definitions, CEC and REC must take the legal form of an economic association, a Swedish legal entity that allows cooperative structures thus providing a governance framework. Mostly, the proposal clarifies the distinction between investing and non-investing members by outlining more restrictive rules for investing members (Frieden et al., 2020).

Regarding the purpose, as well indicated by REScoop.eu (2022), it is clearly defined: CEC would aim to generate social, economic or environmental benefits through the production, supply and consumption of electricity, aggregation, storage, provision of electric vehicle charging points, energy efficiency services or other energy services to its members; on the other hand, REC would aim to conduct renewable energy activities to provide environmental, economic or social benefits to its members. In both cases, however, it seems that providing the benefits to non-members is not allowed, greatly limiting the social innovative potential of energy communities. The main purpose then is to share electricity among the members of ECs with the prohibition on them owning electricity grids or transmitting electricity on behalf of others. For RECs there is also an effective control that is met through restrictions on participation based on geographical proximity for which eligibility is limited to residents or those who operate or are permanently linked to the area where the energy community is created. In both definitions, the energy community must be registered as an association. This is crucial to allow supervision by the network authority, which has the right to request the information necessary for supervision by mostly issuing orders to the EC to ensure the compliance.

Regarding participation in ECs in Sweden, the price for buying a share in a cooperative is €85 - €1500 representing a barrier for low-income households given the lack of incentive parts in the legislative framework. In fact, the lack of funding and support structures for ECs is often seen as one of the biggest obstacles to overcome that can lead to a slowdown in the emergence of ECs (Palm, 2021).

3.1.4. Germany

Germany is a country with a long tradition of schemes based on collective self-supply. The main legislation relevant to prosumers is the Renewable Energy Sources Act in 2017, which defined self-supply by including a definition of an energy community (Inês et al., 2020). Also in 2017, prior to the implementation of European directives, the Mieterstrom model (or Tenant Supply Act) was legally introduced, allowing electricity to be shared in the same neighbourhood or apartment building thus enabling the collective self-supply system (Paiho, Kiljander, Sarala, Siikavirta, Kilkki, Bajpai, Duchon, Pahl, Wüstrich, Lübben, Kirdan, Schindler, Numminen & Weisshaupt, 2021). The unclear definition of proximity has consequently led to decisions being made on a case-by-case basis. However, according to the law, the system - mostly photovoltaic - can have a maximum capacity of 100 kW and must be installed in a residential building. Regarding economic support, the operator of the system can sell the electricity either to the tenants of the building or to the owners of apartments in the building (Frieden et al., 2020).

Despite these regulations, Germany has not yet implemented the definitions of RECs and CECs. Specific legislation for energy communities does not yet exist and the rules that apply to cooperatives in general under the Cooperative Act are applied. In fact, the most relevant article for energy cooperatives is the one just described that regulates self-consumption, with the addition of the article regulating city energy corporations (Bürgerenergiegesellschaften) in the Renewable Energy Act of 2021. As reported by Biresselioglu et al. (2021), the latter article considers a "city energy corporation" to be any corporation:

(a) composed of at least ten voting individuals;

(b) in which at least 51% of the voting rights are held by natural persons;

(c) in which no member of the corporation holds more than 10% of the voting rights in the corporation;

d) where, in the event of a merger of several legal entities or partnerships into one company, it is sufficient that each member of the company meets the requirements in points a) to c).

However, in Germany there was no immediate need to legislatively define city energy companies because the 2017 regulation had still granted citizens the right to form cooperatives for energy production, based not on the Electricity Act but on civil law provisions such as the Cooperative Act. This German law on cooperatives however follows cooperative principles such as open and voluntary membership of citizens, democratic control by members, economic participation of members, and interest in the community. In spite of extensive legislation on energy communities the implementation process of European directives is still very incomplete in Germany considering for example the lack of definition of RECs and CECs, moving on to the lack of specification of legal entities that can establish a citizen energy company.

3.1.5. France

In France, collective self-consumption was introduced in 2017, in advance of the European directive, allowing such configuration with a power limit of 100 kW and limiting energy sharing to the same low-voltage electrical substation. There are no constraints on the positioning of the photovoltaic system, which can therefore be located either on the roof of the building it feeds or close to it. As analyzed by Battisti (2020), another bureaucratic requirement is that both production and consumption are managed by a single central legal unit. This means that the producer and the different consumers must unite in a well-defined legal entity which could configure as a bureaucratic complication. In order to optimize the correspondence between PV output and users' electricity needs, so as to maximize the system's self-consumption rate, consumers must then authorize grid operators to take measurements of their electricity load and subsequently provide these measurements to the newly formed legal entity. All this, however, is hampered by the higher charges that self-consumers have to pay (15% higher than normal consumers), thus being an additional taxation that does not comply at all with European legislation (Battisti, 2020).

After the implementation of European directives, France provided basic definitions for energy communities in 2019 in the French Energy Code (Frieden et al., 2020). The French government therefore published provisions on both CECs and RECs. The relevant definitions refer to a strong standard of autonomy that builds on existing company law in France by also elaborating in detail on the effective control and on the geographic proximity. A strong distinction between the two initiatives is the eligibility: "for RECs, there are strong restrictions on companies, whereas for the CEC definition it explicitly states that there are no restrictions to participation" (REScoop.eu, 2022). This can lead to the risk of CECs being owned by traditional energy players. In addition, French legislation does not regulate monitoring by the regulator leading to risks of misuse of the CEC and REC definitions. As far as the remaining definitions, they are considered a copy-paste of the European directives (REScoop.eu, 2022). In addition, the regulation emphasizes the prohibition of having financial profit as the main objective.

3.1.6. Greece

Greece's energy policy has historically been very conservative. The Greek experience with energy communities is limited as there are only a few examples of fully operational energy communities. The two largest and well-known energy communities are both located on an island: Sifnos and Tilos (Hannoset et al., 2019).

In the last decade, one of the most important amendments was Law 4513/2018 that introduced the concept of energy communities in Greek legislation taking into account the draft of the proposed EU RED II Directives. As indicated by Dimitrios (2020), energy communities are defined as civil cooperatives with the exclusive objective of: promoting social economy, solidarity and innovation in the energy sector to reduce energy poverty; promoting energy sustainability; promoting energy production, storage, self-consumption, distribution and supply; improving energy self-sufficiency and security of island municipalities; improving end-use energy efficiency; and promoting rational use of energy and sustainable transportation.

According to the law, eligible members of ECs can be individuals with full legal capacity, legal entities under public or private law, and local governments in the energy community region (Frieden et al., 2020). However, a member's share cannot exceed 20% of the total capital and, moreover, regarding the proximity criterion, at least 51% of the members must be related to the location of the energy community headquarters (Biresselioglu et al., 2021).

The primary purpose of ECs is as outlined by European directives, i.e., to provide environmental, economic, or social benefits to the community for its shareholders or members or for the territories in which it operates, rather than financial profits. The Greek law of 2018 highlighted two types of ECs that are not RECs and CECs as those outlined by the European directives. Thus, in Greece there are energy communities with a non-profitable character in which the profits of each financial year cannot be distributed among the members but must be kept for the fulfilment of its purposes thus revealing the social orientation of the initiative. The other type of EC is the profitable type which is carried out only exceptionally in ECs where only municipalities or regional authorities participate or in ECs developed on small islands. The surplus in this case can be distributed in part or in whole for actions of local utility, i.e., related to the adequacy and supply of raw materials, fuels and water (REScoop.eu, 2022).

Regarding supervision, energy communities are not supervised by a designated authority but should notify their creation, dissolution and modification in the list of members to the General Commercial Registry.

As described by Chronis, Paleogiannis, Kouveliotis-Lysikatos, Kotsampopoulos and Hatziargyriou (2021), in the case of renewable energy source facilities with an installed capacity of less than 500 kW (often the case of energy communities), they are mainly subject to two tariff schemes. First, there is the feed-in tariff support scheme updated in Greek Law 4602/2019 in which it is stated that all energy generated is compensated at a fixed reference price calculated according to the technology or contract. Instead, the second scheme is the so-called net metering where the generated energy is subtracted from the energy consumption and the prosumer pays the difference at the retailer price.

Thus, as far as Greek legislation is concerned, it does not differentiate RECs and CECs but only distinguishes for-profit and non-profit energy communities. However, the existing Greek definition contains both elements regulated by the RED II Directive and the IEM Directive. In the future, however, Greece may develop its energy community legislation by allowing citizens to be part of other legal bodies in addition to cooperatives (Biresselioglu et al., 2021).

3.1.7. Portugal

Portugal has a tradition of energy cooperatives that own and manage the distribution networks but operate in individual municipalities and autonomous regions, such as the Azores and Madeira (Hannoset et al., 2019).

However, Portugal introduced for the first time the concepts of collective self-consumption and renewable energy communities with the "Decreto-Lei 162/2019" transposing in advance and largely tracing the basic elements of the new European directive. As reported by Di Silvestre et al. (2021), the main inherent articles are Article 6, which opens up the possibility for a single power plant to supply more users, thus introducing unambiguously the concept of collective self-consumption. Article 19, on the other hand, describes the REC as a subject with great flexibility for the right to produce, store, consume or sell renewable energy. No definition of a CEC, however, has yet been proposed.

The Portuguese legislation does little to establish legal clarity around the REC concept and their role in the energy system since the definition is a copy-paste of the definition at the European level. From the point of view of the control the directive is more articulated since it is provided that it must reside in individuals, SMEs or local authorities that are in the immediate vicinity of the energy community, emphasizing the same principle of proximity as an eligibility requirement to participate in a REC (REScoop.eu, 2022). However, proximity is defined by the decree in a very vague way since this concept is linked to three different criteria: the link to the voltage level of the grid; geographical proximity; other criteria established by the technical decision maker, i.e., the DGEG, Portuguese Directorate General of Energy and Geology (Frieden et al., 2020).

Mostly, the Portuguese decree provides for RECs to receive remuneration for excess energy fed into the grid that reflects the market value of that electricity and that can be marketed by an aggregator or independent service company (Inês et al., 2020).
A final important note highlighted by Frieden et al. (2020) is the requirement for RECs to register on a DGEG online portal to allow the state to monitor the activities carried out by energy communities given also the possibility that the RECs themselves have to be the management entity.
As analysed by Inês and al. (2020), although in Portugal there are no legal provisions for CECs, the Portuguese decree also provides a legal basis that allows the creation of new business models, and new networks and social innovations that can develop CECs in Portugal.

3.1.8. Spain

Spain, before transposing the RED II Directive, officially introduced, through Royal Decree 244 in April 2019, the administrative, technical and economic conditions for the self-consumption of energy, which was defined as a group of consumers supplied with electricity from nearby production facilities connected to it (Di Silvestre et al., 2021). Instead, the most recent and significant legislative activity introduced the term "renewable energy community" through Decree 23/2020 of June 23, 2020, which defined the REC identically to the RED II Directive. Thus, the definition of open and voluntary participation, autonomy, effective control and the requirement of proximity is covered in Spanish legislation. For this last element, self-consumption must be at a maximum distance of 500m from the plant, while constituting a barrier for some types of RECs (Inês et al., 2020).
An important point regulated by the new Spanish legal decrees is the unlimited self-consumption for installations below 15 kW. On the other hand, for installations from 15 kW to 100 kW there is compensation in forms of savings from the electricity bill, while for energy communities there is a distribution of savings among community members (Dimitrios, 2020).
Regarding the purpose, it is as defined in the RED II directive, that is, to provide environmental, economic, or social benefits to the members or partners of the energy communities, or the local areas in which they operate, instead of financial gains.
Finally, although it is not mentioned in Royal Decree Law 23/2020, the NECP (National Energy and Climate Plan) takes into account the legal entities that can be established in local energy communities, such as those derived from associations, cooperatives, and managers of industrial areas. However, this list does not provide sufficient clarity on the legal entities that are eligible.

As just seen, the Spanish NECP also includes several measures to promote energy communities, but they are also mentioned in the Recovery, Transformation and Resilience Plan "España Puede " and in the Long Term National Strategy document "España 2050" (REScoop.eu, 2022). As we have just seen, Spain is trying to transpose the European directives as best as possible, although at the moment there is still no definition of CEC. However, the Spanish government has recognized this omission and has set a target for their introduction into legislation in 2022.

3.1.9. Ireland

There are several types of concepts in Ireland that relate to local renewable energy generation (including RECs and CECs), although - as highlighted by Frieden et al. (2020) via the Irish Central Statistical office in 2016 - a framework for collective self-consumption does not exist given that 97% of residential buildings are composed of single dwellings.

The presence of community energy initiatives is primarily due to support schemes developed by the Sustainable Energy Authority of Ireland (SEAI). In fact, this authority helped develop actions through the program called Sustainable Energy Communities (SEC), to enable citizens and communities in renewable energy projects through technical and financial support (Hannoset et al., 2019).

After the implementation of the CEP in Europe, the Renewable Electricity Support Scheme (RESS) was adopted in 2020 by the Irish government in which community-driven projects for energy generation were introduced, specifically RECs since CECs are considered a subset of RECs by the legislature. As specified by Frieden et al. (2020), this new support scheme requires that community-led projects must follow a few key points:

- Be part of a "sustainable energy community." This concept has existed in this country for several years through SECs, although they are considered broader regional initiatives and not specific, local projects as analyzed by RESS.
- Majority ownership (51%) must be a renewable energy community that has as its primary purpose environmental, economic, or social benefits to the community rather than financial benefits.
- At least 51% of all profits must be returned to RECs.
- Project size for power generation is limited to 5 MW.

In addition to these elements, REScoop.eu (2022) indicates that the RESS specifies that the REC is a legal entity in which the characteristics of openness, volunteerism and autonomy are covered. However, in contrast to other countries, in order to be a member, one must be registered as a Sustainable Energy Community at SEAI. Regarding participation in a REC, individuals, SMEs, local authorities and non-profit organizations are eligible to be part of the

community by defining different geographic boundaries for different activities, as opposed to CECs in which no limits are set in terms of geographic proximity.
In conclusion, it is necessary to understand that the Irish policy framework on SECs emerged outside of the context of the CEP given that these communities do not have any limits regarding the geographic location of participants, making this concept considerably broader than RECs and CECs (Hannoset et al., 2019).

3.1.10. Italy

The philosophy introduced by RED II for renewable energy communities as a mean of ensuring shared welfare is very similar to that found in the examples that sprung up in Italy before finding a legal definition at the EU level, since they were often cooperative aggregations to ensure energy supply to a well-defined area. After the implementation of the CEP at the European level, Italy has implemented only the REC definition with, however, some shortcomings regarding the concept of autonomy and effective control.
On February 28, 2020, Law 8 was enacted, converting into law Legislative Decree number 162 of December 30, 2019 (also known as Decreto Milleproroghe). Article 42 bis of the Decreto Milleproroghe allows the activation of collective self-consumption schemes and the establishment of renewable energy communities. The main information, pursuant to Law 8/2020, are:

- Production plants, from renewable sources, have entered into operation after March 1, 2020 and have a total power not exceeding 200 kW;
- Production facilities and withdrawal points that are part of a community are connected to the low-voltage electricity grid;
- Participants of RECs may be individuals, SMEs, territorial entities, local authorities, but preventing the participation of those who have participation in RECs as their main commercial or industrial activity;
- Sharing with the members of such schemes of the energy produced takes place through the existing electricity grid;
- General system charges apply on the energy withdrawn from the public grid, including shared energy;
- The primary purpose is to provide environmental, economic or social benefits to shareholders or community members, rather than financial profits;
- The law covers the concept of inclusivity by explicitly mentioning the need to ensure that participation is open to low-income or vulnerable households. (Zulianello et al., 2020; RSE, 2020; REScoop.eu, 2022; Pioppi et al., 2020)

While the Decreto Milleproroghe regulates the establishment of local energy communities and the association of self-consumers of energy acting collectively, the Italian Regulatory Authority for Energy, Networks and the Environment (ARERA) and the Ministry of Economic Development (MiSE) are the entities responsible for defining the measures necessary to implement the regulatory model and incentive systems. Through the regulatory model identified by ARERA, the incentive system defined by the MiSE decree and the system of tax deductions in force, it is possible to state that participants in collective self-consumption schemes and RECs will be recognized:

a) The return of certain components defined by ARERA that amount to approximately €10/MWh for collective self-consumption and €8/MWh for RECs on shared energy;
b) An incentive on shared energy equal to 100 €/MWh for collective self-consumption and 110 €/MWh for RECs;
c) A remuneration of energy fed into the grid at an hourly zonal price that averages about €50/MWh;
d) Access to a system of tax deductions for participants in the schemes;
e) Super-bonus 110%, that is a tax break, i.e. a deduction on the gross tax that will be applied on expenses incurred from 1 July 2020 to 31 December 2021 for specific interventions in the field of energy efficiency, but not giving incentive on the current self-consumed;
f) Extra super-bonus, on the other hand, allows for a 50% deduction (within the maximum limit of total expenditure of € 96,000 referred to the entire plant) by also granting the incentive described in point b) for 20 years, (Brugnara, 2021; RSE, 2020; GreenHillAdvisory, 2021)

As can be seen, the REC definition is side-by-side with the definition of collective self-consumption, while no definition has been developed for CECs.

Table 4: Transposition of REC and CEC

	REC	CEC
Austria	Yes	-
Denmark	-	Yes
Sweden	Yes	Yes
Germany	-	Not in line with EU directive
France	Yes	Yes
Greece	Only non-profit and for-profit energy communities	
Portugal	Yes	-
Spain	Yes	-
Ireland	RECs as a subset of CEC	
Italy	Yes	-

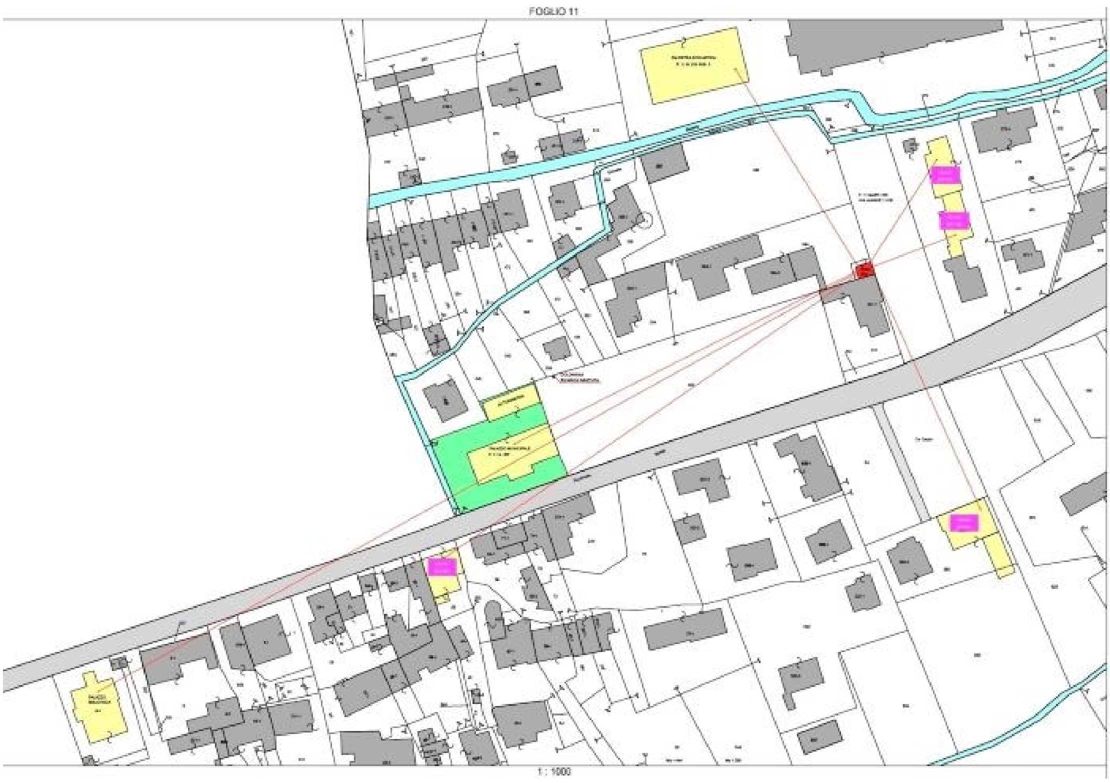
3.2. Case study: The REC of Magliano Alpi (Italy)

The first example of energy community in Italy, as defined by Article 42 bis of Decree Law No. 162/2019, is that of the municipality of Magliano Alpi with 2,300 inhabitants, in the province of Cuneo.

The path began with the adhesion of the municipality to the "Manifesto of Energy Communities" promoted by the *Energy Center* of the Politecnico di Torino in collaboration and active synergy with a pole of excellence in the world of research, such as the research groups of the Politecnico di Milano, the Universities of Bologna, Trento, Modena-Reggio Emilia and Udine (Garello, 2021). It focused on the centrality of the prosumer citizen and on the community as a capacity to aggregate at the local level, to offer services to its members and bring socio-economic benefits to the local community. In fact, in order to spread the word, the City made available the form for the expression of interest to participate in Energy City Hall (or to establish new ones in the area) both as prosumer, providing new facilities, and as consumer, consuming part of the energy of community facilities (Patrucco, 2020).

The president of the Senate Industry Committee, Gianni Girotto, attended the inauguration of this REC on Friday, March 12, 2020, but it has been operational since December. This energy community has taken the name "Renewable Energy Community Energy City Hall" and is an association registered at the “Agenzia delle Entrate” in which the City presents itself as the coordinator and prosumer of the REC (Dominelli, 2021). It has a 19.5 kW photovoltaic system installed on the roof of the City Hall that allows it to power the electrical consumption of the building and to share the energy produced and not self-consumed with the other utilities connected to the REC (Sesana, 2021). As indicated by Patrucco (2020), in addition to the municipal building, the current members of the REC are the utilities of the library, the gymnasium, and the schools, along with the four households that first gave their membership (Figure 7) thus benefiting from the energy not self-consumed by the municipality. Two recharging stations for electric vehicles have also been connected to the same system, which can be used for free by residents.

Figure 7: REC members



Source: *Patrucco* (2020)

The entities are all connected to the same secondary transformation cabin, and the GSE (Gestore dei Servizi Energetici) provides an incentive tariff defined according to the amount of energy produced and self-consumed. Consumption is monitored by smart meters (electronic devices that record energy consumption and communicate information to the supplier) positioned at the points of delivery (PoD). Collecting the data is the *Energy4com* online platform that transmits it accordingly to the GSE (Facchini, 2021).

From an economic perspective, Feletig (2021) focuses on a couple of points that the community can focus on. First, the bill can undergo a persistent relief of 20-30%. For each MWh self-produced and self-consumed there is an incentive of 110 €. Any surplus energy is instead acquired for 50 € / MWh by the GSE which is approximately three times the wholesale price of energy. It is recognized an exemption of network and system charges due to the coincidence between production and consumption with a relief qualified by ARERA of 8 € / MWh. In terms of investment for the plant and storage systems, it could benefit from tax deductions of 50% on renewable energy systems and for part of the installed capacity (up to 20 kWp) also the benefits provided by the Super-bonus 110%.

The association "Renewable Energy Community Energy City Hall" has its own statute consisting of 22 articles that refer to the headquarters and purpose, assets and social exercises, members, administrative bodies, dissolution, and general rules.

Some important points to underline are the following:

- Participation in the association may not constitute the commercial and industrial activity of the principal members;
- The assets of the association consist of:
  - From the assets, movable and immovable, owned by the association;
  - From the registration fee and eventual annual membership fees (equal to 25.00 €);
  - From eventual donations and contributions;
  - From payments freely made by the members;
- The qualification of member gives right:
  - To participate in the life of the association;
  - To participate in the election of governing bodies and to propose oneself as a candidate;
  - To be informed of the initiatives and events organized;
  - To participate financially, according to his will and availability, to the initiatives and projects carried out by the association;
- The members are distinguished in founders (those who constitute the association by signing the memorandum of association), ordinary (those who apply for membership and pay the membership fee) and honorary (those who for prestige, competence and merit are appointed unanimously by the Board of Directors);
- The quality of member is lost by death, resignation, or in case some rules of the statute are not respected;
- The dissolution of the association is deliberated by the assembly with a majority of at least three quarters of the members (Municipality of Magliano Alpi, 2020).

The creator of the initiative, since its inception, is the mayor of the municipality Marco Bailo. He explains how the initial payment for the installation of the system - as already explained often turns out to be a problem for the emergence of energy communities - was made thanks to a European funding with funds from the Regional Operational Program (POR) of the European Regional Development Fund (FESR) 2014-2020 aimed at financing projects dedicated to energy efficiency that in this specific case served to improve the energy efficiency of the municipal building. Thus, out of a total cost of €80,000, more than €56,000 was paid through non-refundable European funds, thus proving to be a negligible cost for the installation of the system by the municipality (Sesana, 2021).

As reported by Bindi (2021), the mayor indicated that the only prosumer of the REC in the municipality of Magliano Alpi is the municipality, even if the intention is to add others. In addition, a GOC (Community Operations Group) has been created in the area, i.e., the first local network of professional skills needed for project implementation (Renewable Energy Community Magliano Alpi, 2021). This group was developed to create a local supply chain of technicians, designers, installers and maintainers in order to create development and jobs in the post-pandemic phase, in addition to the fact that it allows immediate answers for citizens thanks to the short local supply chain of professionals who make the analysis of consumption, identify the most suitable companies and make a commercial proposal for the implementation of the plant (Pillitu, 2021).

After the first REC, as it is possible to see from the web page of the energy community of Magliano Alpi, two other RECs will be activated. The REC number 2 should produce energy through an additional 14 kWp photovoltaic plant in the structure of the municipal sports facility through a financing of 19,000 € provided by the Savings Bank Foundation of Cuneo. The "consumers" should be a restaurant, a solarium, a carpentry workshop, a mulin and some houses. REC number 3 instead should be developed among a group of private citizens (Bindi, 2021).

According to the mayor, one of the most positive things brought by this experience is the fact that, after a long period of closure caused by Covid-19, they have allowed to emphasize again the true sense of community from a social point of view. However, also the economic benefits are not to be underestimated since in the case of the first REC the energy produced by the photovoltaic panels of the municipality allow very low running costs of the municipal gym. As specified by Zulianello's words in the article of Sesana (2021), since energy communities are non-profit entities, they are created to respond to needs that are identified by the members themselves by deciding what to do with these resources.

Through an interview by Patrucco (2020) with the mayor Marco Bailo it emerged that the objective of the municipality of Magliano Alpi is to play an active role as Public Administration in the development of innovative models for the revitalization of the territory, instilling confidence in the citizens to involve them in the energy transition and making available to neighbouring municipalities the know-how acquired. Putting together thousands of renewable energy communities, each of which expresses a potential of a few hundred kW - explains Sergio Olivero, President of the Technical Scientific Committee REC - will reach thresholds integrated at the national level that can create players who have the ability to operate in the energy market, to trade and especially to give back to citizens that central role of representativeness (Auriemma, 2021).

Conclusions

The energy transition towards clean forms of energy and the reduction of net greenhouse gas emissions cannot be achieved solely through markets and the development of increasingly advanced technology. First of all, the energy transition implies a social transformation in which citizens play a key role. Citizens must therefore be an integral part and protagonist in this game thanks to the awareness of their role. To this end, distinctive features of innovation and social transition of energy communities are the ability to combine mutual and public interests and the possibility to make renewable energy a common good for which different stakeholders cooperate. Consequently, the social innovation potential of energy communities also lies in their ability to engage consumers regardless of their income and social status, ensuring that the benefits gained are also shared with those who cannot participate in generating them, more generally with the community. If properly designed, energy communities enable energy poverty reduction by reducing energy expenditures by breaking down barriers that prevent the most vulnerable consumers from participating in distributed generation and communities. The implementation of the *Clean Energy for all Europeans Package* by European countries has provided much greater legal certainty and clarity for all local energy communities, households, local governments, and European SMEs. The directives within it have given the possibility to all citizens to act as *prosumers* and to create energy communities in a regulated way, i.e. to exercise collectively the right to produce, store, consume, exchange and sell self-produced energy, with the aim of contributing to environmental, economic and social benefits for their community. This, however, represents only the first step - a necessary but not sufficient condition - towards the energy and social transition of energy communities. Another fundamental step lies in the need to train new professional figures involved in the processes of design and management of the built environment, updated with these new models of community. To this end, it is necessary to develop detailed technical-operational guidelines for the efficient and effective design of energy communities, both from the point of view of the citizen-*prosumer*, from that of the authorizing body, and for the competent professionals.

The EU intends to finance research and innovation policies to convert this transition into a real opportunity for economic growth. Mobilizing €117 million in public and private investment per year starting in 2021, the Clean Energy Package can generate 1% GDP growth within the next 10 years and create 900,000 new jobs, as well as enable a 43% decrease in the average carbon intensity of EU economies by 2030 compared to the current figure (European Commission, 2016). However, this opportunity for growth derived from the CEP is clouded by some of the room left by the European legislature for the transposition of certain principles. The main fear derives from the fact that the benefits set by the EU directives may be neutralized due to the generality of the terms used, which may be susceptible to excessively "broad" interpretations during transposition, thwarting in practice the objectives set upstream. The risk is that the countries least interested in making an effective energy transition in the direction of the "zero emission" objective may exploit these inaccuracies to their advantage in order to undermine the ambitious objectives set by the EU, continuing, on the one hand, to direct major public investment towards policies in favour of fossil fuels while, on the other hand, precluding their own community of citizens from moving towards the new era of the sustainable economy without this entailing an economically sustainable burden for them. In addition, the lack of specific, albeit minimal, incentives and funding to implement energy communities - considered one of the main barriers - leaves wide discretion to Member States to promote or not these initiatives, depending on the political direction of the country.

Future comprehensive regulation by Member States, however, would help address the climate crisis, socio-environmental injustice and economic inequality, shifting future urbanization towards a more environmentally sustainable and socially just path. This process has been well addressed by countries such as Sweden and Ireland, while for other countries, such as primarily Germany, followed by countries such as Portugal and Italy, it is still in the early stages of transposition or development. Moreover, the energy communities created after the advent of the new directives are still limited, even if in the last period awareness of the benefits they can offer is growing, also thanks to awareness programs at national level that are of fundamental importance for the knowledge of citizens themselves.

The regulatory body of the *Clean Energy for all Europeans Package*, however, appears to be characterized by a necessary elasticity and transience in view of a more radical regulatory reform aimed at an effective and complete integration that, although not yet outlined, would seem to be the logical epilogue. Therefore, these European directives will probably only be an incipit for a concept that will enter the energy market with greater importance in the coming decades.

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