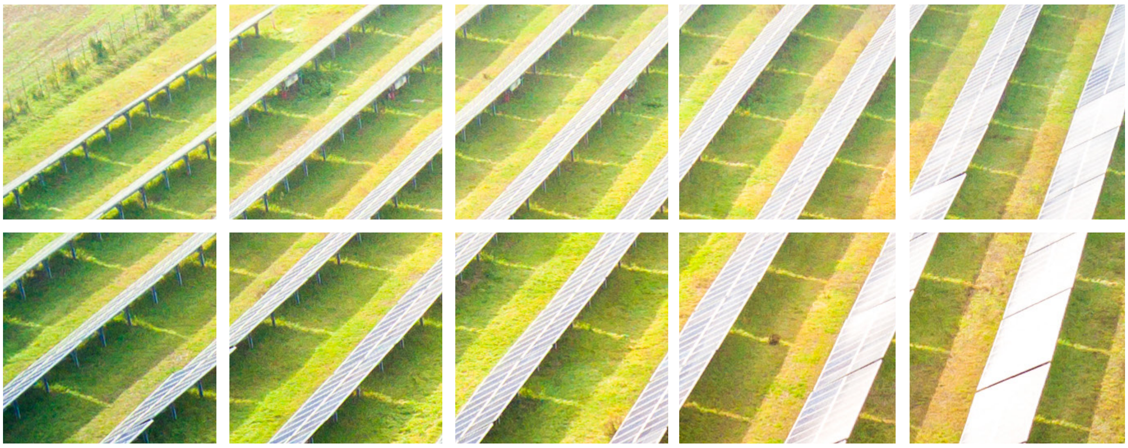
European University Institute

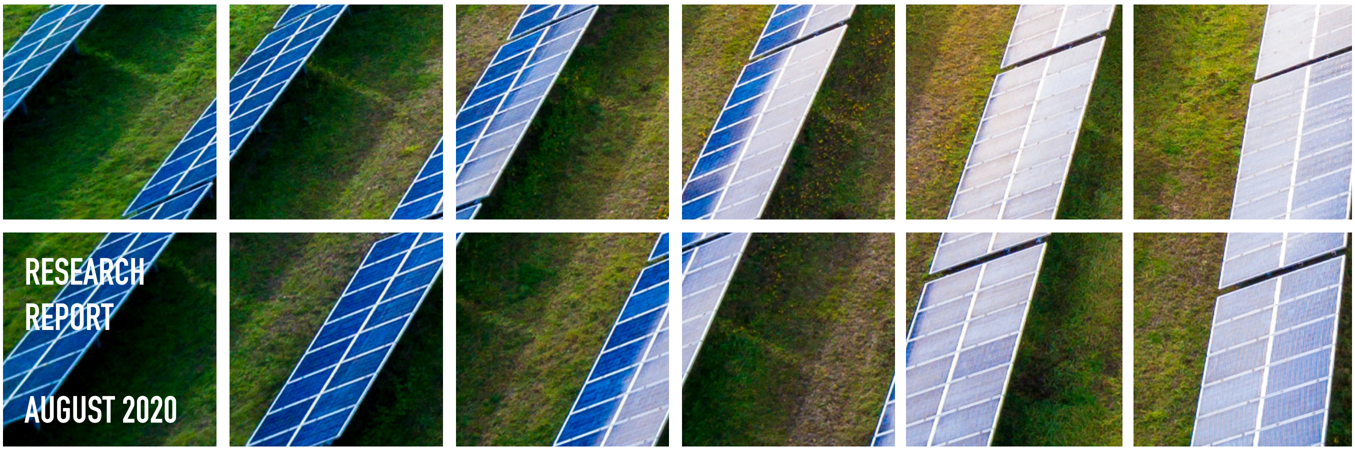
ROBERT SCHUMAN CENTRE FOR ADVANCED STUDIES

FSR ENERGY & CLIMATE
Florence School of Regulation



THE FUTURE OF RENEWABLE ENERGY COMMUNITIES IN THE EU

AN INVESTIGATION AT THE TIME OF THE CLEAN ENERGY PACKAGE



RESEARCH REPORT

AUGUST 2020

AUTHORS

STEFANO F. VERDE

NICOLÒ ROSSETTO

The Future of Renewable Energy Communities in the EU

An investigation at the time of the Clean Energy Package

Authors: Stefano F. Verde and Nicolò Rossetto

Contributing authors: Albert Ferrari and Thibaut Fonteneau

August 2020

QM-04-20-447-EN-N

ISBN: 978-92-9084-928-5

doi: 10.2870/754736

European University Institute

Badia Fiesolana

I – 50014 San Domenico di Fiesole (FI) Italy

fsr.eui.eu

eui.eu

cadmus.eui.eu

Abstract

Renewable energy communities (RES communities) are a growing and extraordinarily multifaceted phenomenon which involves a range of possible activities around renewable energy (notably, production, supply, distribution, sharing and consumption) collectively carried out by citizens, often in partnership with small and medium enterprises and local public authorities. The Clean Energy Package (CEP) is expected to represent a turning point for the development and diffusion of RES communities in Europe, as for the first time both their very existence and their potential role in the energy transition receive legal recognition at the EU level. By 2021, all Member States will have to transpose the CEP's Directives into national legislation, thus including the definition of an enabling framework that promotes RES communities. However, substantial room for manoeuvre is left to Member States in accomplishing the task. The present report analyses the phenomenon of RES communities in Europe and identifies plausible (qualitative) scenarios for their possible development over the next decade, at this very special time. It does so by carefully reviewing the socioeconomic literature on RES communities (Chapter 1), by carrying out three case studies of different types of RES communities (Chapter 2), and by analysing how the CEP provisions may be implemented by Member States and so affect the uptake of RES communities (Chapter 3).

Keywords: Community renewable energy; Renewable energy community; Renewable energy cooperative; Collective self-consumption; Clean Energy Package; Scenarios for renewable energy communities.

Table of contents

Foreword

This report is a deliverable of the research project *FRESCO – the Future of RES COmmunities*, undertaken by the *Florence School of Regulation – Energy and Climate* between September 2018 and August 2020. The project had three main objectives: providing a comprehensive analysis of the characteristics and evolution of renewable energy communities (*RES communities*) in the electricity sector in Europe; developing a conceptual framework for the role of RES communities in the European energy transition; and, related, identifying plausible scenarios for RES communities over the next decade. Reflecting these objectives and the methods adopted for the research, the report is structured into three parts: *Literature review* (chapter 1), *Case studies* (chapter 2) and *Conceptualisation and scenarios* (chapter 3).

The project has taken place at a very special time considering the introduction of novel relevant EU legislation. The Renewable Energy Directive (2018/2001/EU) and the broader Clean Energy Package more generally represent a historical turning point for RES communities, which for the first time received legal recognition at the EU level and in principle a supportive environment for their future development. The directive was adopted in December 2018 and Member States have time until June 2021 to transpose it into national legislation.

The related ongoing public debate has been intense and broad in terms of stakeholder engagement, mainly involving policymakers, energy regulators, RES communities themselves, traditional actors of the energy system and researchers. The *Florence School of Regulation* (FSR) has contributed to this debate not only through outputs of the FRESCO project (in addition to the present report, three short online articles[1], an online debate[2] and a dedicated session of the FSR Policy Advisory Council[3]), but also through other relevant initiatives, such as the participation to the Global Observatory on Peer-to-Peer, Community Self-Consumption and Transactive Energy Models[4] and the publication of a technical report on the EU Clean Energy Package[5].

Our special thanks go to *Fondation Tuck*, which has financed the project, and to the directors of *FSR Energy and Climate*, Jean-Michel Glachant and Simone Borghesi, who have supported and guided us throughout the project. We are grateful to Thomas Bauwens and Josh Roberts for providing valuable insights on various occasions, and to our fellow researchers at FSR, Tim Schittekatte, Leonardo Meeus, Isabella Alloisio, Piero Carlo Dos Reis and Athir Nouicer, for sharing their knowledge in internal

[1] The three articles taken together made the March 2020 *FSR Topic of the Month* on renewable energy communities. They are available at: https://fsr.eui.eu/community-led-renewable-energy-initiatives/; https://fsr.eui.eu/renewable-energy-cooperative-enostra/; https://fsr.eui.eu/the-advent-of-collective-self-consumption-the-french-case/.

[2] The recording of the online debate is available at: https://www.youtube.com/watch?v=tHnO_DjxjxY.

[3] https://fsr.eui.eu/event/policy-advisory-council-fsr-energy-5/

[4] The Observatory is a three-year project operating within the framework of the International Energy Agency. FSR is in charge of the Policy and Regulation Subtask and hosted the second conference of the Observatory in February 2020. More information on the Observatory is available at: https://userstcp.org/annex/peer-to-peer-energy-trading/.

[5] The report is available at: https://fsr.eui.eu/publications/?handle=1814/64524.

seminars and helping acquiring background information. Finally, we thank the participants in workshops where the project results were presented, notably our discussants at the *FSR Policy Advisory Council* (Florence, May 2019), Hélène Gassin, Thomas Bauwens and Vaiva Indilaite, and those at the *Tuck – Future of Energy Results Workshop* (Paris, October 2019), notably Andreas Ehinger, Frédéric Febvre and Jérôme Perrin.

Stefano F. Verde and Nicolò Rossetto

Executive summary

Chapter 1 – Literature review

A literature review is conducted whose purpose is to describe the multifaceted phenomenon of renewable energy communities (*RES communities*) in the electricity sector. The number of relevant studies, which often relate to the broader notion of *community renewable energy* (CRE), has steadily increased over the past decade, resulting in an abundance of knowledge and perspectives that span many diverse fields. The review focuses on four particularly relevant topics: a) the identification of RES communities (*what are they? what characterizes them?*); b) their motivations (*what motivates the action of the communities and their members?*); c) the contextual factors (*which contextual factors influence the birth and development of RES communities?*); and d) their societal impacts (*what impacts do RES communities have on society, including and beyond themselves?*). The literature is characterised by the large use of case studies, often including semi-structured interviews or surveys.

Identifying RES communities

RES communities come in many different forms, as they often carry out multiple activities, have multiple objectives, their members are driven by different motivations, they can be limited to a more or less wide geographical area, they use different technologies, have different legal forms (and hence different forms of governance), etc. As a result, interpretations can differ as to what exactly constitutes a RES community. In this regard, the element on which consensus appears to be broadest is that the members of a RES community are not only the recipients of potential benefits generated by a *CRE project*, but are also co-owners of the project and so can – and ideally would – participate in the decisions about it. By contrast, consensus is less broad over other defining elements, such as those relating to a) the geographical scope of a community (a related distinction being that between *communities of place* and *communities of interest*), b) the orientation of the community with respect to profits generation (the question being whether genuine RES communities may only be not-for-profit), and c) the possible roles of local authorities and businesses in CRE projects. The scientific literature usually conceptualises these differences without offering normative indications. By so doing, however, it provides valuable input for the development of legal definitions.

Motivations

A typical feature of RES communities is the multiplicity of their statutory objectives and, as a reflection of that, the multiplicity of their members' own motivations for founding or joining a RES community. The objectives most frequently pursued through CRE projects concern the protection of the environment and the climate, the realisation of economic gains (most often, but not exclusively, energy cost savings), energy autonomy (i.e. the control of choices regarding energy production and consumption), and the development of the local economy. The literature investigating the purposes of RES communities (or specific CRE projects) focuses on the individual motivations of community members. The emphasis is on diversity and dynamics whereby the prevalence of one motivation over others varies a) *between communities*, depending on their specific nature, b) *within communities*, given the heterogeneity of their members, and c) *over time*, depending on how the communities evolve. With regard to the last point, a relevant example is the expansion of a community's activity from electricity production alone to electricity supply. With this step, many new people typically join the community as consumers (rather than as producers) who may have different prevailing motivations compared to previous community members. In general, while the salient aspect of the motivations is their multiplicity, environmental motivations appear to be most common in the studies examined. Focusing on RES communities established in the last twenty years, *climate protection* emerges as the prevailing environmental motivation. Furthermore, some studies reveal the positive role of social psychology aspects which, for example, concern the enjoyment derived from trusted social interactions and from adhering to a common project.

Contextual factors
The contextual factors that can contribute to determining the birth and evolution of RES communities are many and diverse. They can be classified into physical-, technology-, institutional- and community factors. The literature review focuses on the last two types of factors. Some robust conclusions can be drawn based on the history of many specific CRE projects or more generally of the CRE sector in several European countries. A conclusion very often emphasised is that CRE needs a policy framework which is sufficiently supportive and stable. Adequate policy support would imply the recognition of public value also in small-sized projects or even in the specific role played by RES communities. Support policies such as feed-in tariffs for small-sized projects or tenders only for CRE projects are indeed justified on the basis of such recognition. A stable policy and regulatory framework, however, implies that the same recognition of the role of communities is not limited to a political part. In this sense, becoming mainstream is a desirable scenario for RES communities. Secondly, local authorities can play a key role in facilitating the dissemination of RES communities. However, they would need to have some experience in the energy sector: whether such experience is there may depend on the historical development of the energy system, else it would need to be acquired. Similarly, specific skills within the community are needed to start and manage a CRE project. Furthermore, a RES community is more likely to be established and thrive in the presence of trust in the wider hosting society.

Societal impacts
CRE projects impact society including and beyond the corresponding RES communities. The literature review has focused on societal impacts that concern the local economy, the energy system, the acceptance of the energy transition and the energy-related behaviour of individuals participating in CRE projects. Understanding such effects is central especially for designing appropriate supportive policies. Despite the importance of the topic, however, quite limited research appears to have been conducted to date. Most available studies involve case studies, often including interviews or surveys, but with sophisticated statistical analyses only few and far between. Based on current evidence, it can be said that CRE projects tend to have positive impacts on the local economy and jobs, but the nature and significance of these impacts depend on the specific type of community. Being part of the wider trend towards increasing decentralisation of the energy system, CRE is expected to have significant effects on the system and especially on the distribution network. Further analysis, however, is needed to determine the extent of the positive and negative effects in question. By contrast, research results more clearly back the expectation that CRE increases local acceptance of renewable energy and general support for climate action and renewable energy. Furthermore, membership in CRE projects tends to be positively correlated with more energy-efficient behaviour, increased knowledge and skills as well as to some extent to stronger social trust and capital.

Chapter 2 – Case studies

Three case studies are conducted which concern the Italian cooperative *ènostra*, collective self-consumption (CSC) in France, and an EU-funded innovation project called *WiseGRID*. *ènostra* is a representative example of the modern cooperative model of RES communities and the most significant of its kind in Italy. CSC is a new way of collectively producing and consuming electricity which could result in the emergence of many local RES communities and generate potentially significant societal benefits. In France, CSC has been the subject of intense public debate and relevant legislation has already been produced. The *WiseGRID* innovation project and, in particular, the Ghent pilot site (Belgium) on which we focus, opens a window on the future of the electricity system as imagined and put into practice by the RES cooperatives leading the project. Each case study is structured into two parts: the first describing the study subject and the second presenting interviews with two or three experts. Taken together, the various aspects captured by the case studies provide a broad picture in which salient are the data acquired regarding: a) the nature and the raison d'être of RES communities, b) their evolution, c) their expectations about the future, and d) the role of regulation for their development.

Nature and raison d'être of RES communities

A fundamental distinction highlighted by the case studies is the one between what RES communities *are* and what RES communities *do*. For example, RES cooperatives like *ènostra* are the type of RES community best equipped to combine the pursuit of mutual and societal benefits with complex, large-scale activities in the energy system, such as electricity supply. CSC is, by contrast, an emerging model for producing and consuming electricity – an activity – which may give rise to new local RES communities. Besides, for a RES community to be considered as such, as important as *what* the community does is *how* the community carries out its activities. Notably, democratic and effective participation of its members in the decisions regarding the community is normally a requisite for a community to be considered genuine. As regards the raison d'être of RES communities, the interviews with leading members of RES cooperatives (*ènostra*, *Ecopower* and *EnergieID*) reveal the recognition of community value that is both intrinsic and functional. The community itself is considered a good not only for the material benefits it offers to its members but also for the immaterial ones: feeling part of a community and feeling empowered makes people happy. The community also has functional value, it being a tool for enhancing the common good. A recurring word in the interviews, which suggests a reason why RES communities respond to someone's needs and, therefore, exist, is *empowerment*. The need addressed by RES communities through people empowerment mainly is that of citizens wishing to take direct action in the energy transition.

Evolution of RES communities

If today the EU Clean Energy Package opens potentially interesting opportunities for RES communities, it is also because especially RES cooperatives have shown that they can be active players in the electricity system and that their activities can benefit society, however difficult quantifying such benefits may be. In general, RES cooperatives exhibit a natural ability to collaborate with local authorities and other subjects with whom they share a certain view of sustainable development and society. Another element emerging from the case studies concerning RES cooperatives is the significance of the expansion of their activity from electricity production alone to electricity supply (and possibly other activities). This is a key step for its implications. The first is that cooperative members no longer cooperate only as producers, but also as consumers, being customers of the cooperative. In other words, the interests of end users are internalised. The second implication is that electricity supply involves a number of additional operations and obligations and, therefore, it requires the acquisition of new professional skills. Thirdly, with the supply activity, the growth potential of a cooperative is greatly expanded, normally exceeding the local dimension. A cooperative that makes this step will likely grow considerably in terms of members and resources available, thus becoming also less dependent on the existence of RES support schemes. A possible consequence of this growth, on the other hand, is that the intensity of the relations between the cooperative members and their effective participation in decision-making processes is greatly diluted. The risk is to weaken or even lose de facto a defining feature of genuine RES communities.

Expectations about the future

All the people interviewed in the case studies expressed a certain optimism regarding the future development of RES communities. This optimism is linked primarily to the new prospects offered by the EU Clean Energy Package but remains cautious until the relevant directives are implemented by the Member States. Related risks concern the actual possibility for RES communities to become important players in the electricity market (in the segment of residential consumers and small consumers more generally). The risks mentioned include the insufficiency of support schemes dedicated to RES communities and the advantages that traditional market players might be able to derive from those schemes by exploiting normative loopholes. Apart from the expected policy choices and regulatory treatment, the growing interest of citizens and local authorities in taking direct action in the energy transition and the fight against climate change is also a reason for optimism. The CSC model, whose future diffusion will critically depend on policy and regulatory choices, raises special hopes. It is a model that, if and when it becomes economically viable (the cost of storage technology is also a key variable in this respect), may involve many more citizens in the energy transition. Some RES cooperatives already participate in pilot CSC projects and, indeed, this is an area where we will likely see much collaboration between RES cooperatives and local RES communities in the next few years.

The role of regulation
The case study on CSC in France highlights the crucial role that policy and regulatory choices have in determining the future of this new way of producing and consuming electricity. In the face of benefits for the electricity system that are certainly plausible but difficult to estimate (in the short term: savings on the operating costs of the public network; in the long term: savings on the expansion of the network), the introduction of a special network tariff for participants in CSC operations is the question that has received most attention in the public debate. The reason for this are the possible consequences that a new special network tariff may have and which specifically concern the risk of opening the door to free-riding behaviours while potentially imposing unfair extra costs on consumers who do not participate in CSC operations. The French regulatory authority has developed an optional special network tariff for a type of CSC operation the effects of which will be assessed in five years. A related issue is the recognition of the possible additional societal benefits of the CSC model (additional to the savings achieved through a more efficient electricity system) which would include the further expansion of RES production and its greater social acceptability (ownership of local projects countering the so-called NIMBY phenomenon), but also the opportunities for economic development and greater social cohesion for local communities. In the face of these additional benefits, which also are plausible but difficult to quantify, a possible special tax treatment of CSC (mainly, reduced taxes on self-consumed energy) and the provision of dedicated support schemes are a central issue in the public debate.

Chapter 3 – Conceptualisation and scenarios

RES communities currently play a limited role in the EU energy system and their future is still largely unexplored. Their potential for development and limits to diffusion can be investigated by conceptualising their functioning and by examining how the legal and regulatory framework treats them. On the one hand, the conceptualisation exercise provides a typology of RES communities and highlights their relative strengths and weaknesses. On the other, the examination of the legal and regulatory framework reveals whether national governments have the possibility to leverage the identified strengths of RES communities and address the corresponding weaknesses to promote their expansion in the coming years.

What do RES communities do?
RES communities are essentially groups of people that, possibly in conjunction with small and medium-sized enterprises and local public authorities, together deal with renewable energy sources. Based on rules and decisions that are chosen collectively, RES communities may produce, supply, distribute, share and consume energy from RES. Two basic dimensions allow mapping the various particular cases of RES communities: the geographical scope at which they operate and the prevailing motivation that drives collective action. The first can be local or dispersed, while the second can be economic or relational. These two dimensions identify four fundamental types of RES communities that are characterised by different strengths and weaknesses. Local RES communities operate at the neighbourhood, village or district level and usually build on the thick social relations that exist among members living close to each other and that favour the implementation of collective initiatives. This strength is counterbalanced by the limited resources that can be mobilised locally and that may prevent

the achievement of an economically efficient production level. On the contrary, dispersed RES communities are active over a wider area and involve members that share some ideas or interests rather than a specific place. This broader geographical scope allows the deployment of a larger amount of resources and a more efficient production level; however, such advantage may be offset by the greater difficulty to coordinate collective action in the presence of thinner social relations among community members. Economics-driven RES communities are motivated by the possibility to achieve higher economies of scale and scope in the production, supply or consumption of renewables by acting together instead of individually. In this case, collective action reduces costs and may attract numerous members. However, the emergence of a more ‘utilitarian’ membership can change the nature of the community and transform it into something more similar to conventional market actors. On the contrary, relation-driven RES communities are motivated by the possibility to develop new relations and forms of interaction, thereby satisfying members’ preferences for specific products and a genuinely communitarian approach to energy. Yet, this key strength of relation-driven RES communities can be counterbalanced by their idiosyncratic nature and the likely higher cost of the services they provide to their members which may limit the potential for growth and scale-up.

How does the EU treat RES communities?

The legal and regulatory framework for RES communities has recently changed due to the adoption of the Clean Energy Package (CEP), which is expected to represent a turning point for the development and diffusion of RES communities in Europe, as for the first time both their very existence and their potential role in the energy transition receive legal recognition at the EU level. Within the Package, Directive 2018/2001 on the promotion of the use of energy from renewable sources (RED II) and Directive 2019/944 on common rules for the internal market for electricity (IEMD) introduce four new legal concepts. Two of them refer to groups of customers, not necessarily organised in communities, to which is recognised the right to be collectively active in the electricity markets and the right to collectively self-consume the energy locally produced from renewables. They are called, respectively, jointly acting active customers (JAACs) and jointly acting renewables self-consumers (JARSCs). The other two concepts refer to two specific types of community-based initiatives in the field of energy that are entitled to an enabling regulatory framework due to their specific characteristics in terms of membership, governance and purpose. They are called, respectively, citizens energy communities (CECs) and renewable energy communities (RECs). The two directives provide a set of rights and duties for these new categories of collective entities and specify a list of obligations that Member States must implement in order to ensure them a proportionate and non-discriminatory treatment and, under certain circumstances, a series of advantages with the aim to promote and facilitate their development. By 2021, all EU Member States will have to transpose the CEP’s directives into national legislation. However, substantial room for manoeuvre is left to them in accomplishing the task.

A variety of tools for supporting RES communities

The implementation of the CEP offers Member States various possibilities to support the uptake of RES communities during the next decade, in particular those operating at the local level. In this regard, the CEP recognises the opportunity – and the related public interest – for groups of people, enterprises and public authorities organised at the local level to invest jointly in renewable power plants, to participate in electricity markets collectively, to share the energy produced, to enter into peer-to-peer trading arrangements, etc. Member States are mandated to ensure that when performing these activities communities are not discriminated or subject to non-proportionate requirements. Moreover, local RES communities that qualify as RECs or are made by JARSCs can benefit from the enabling frameworks that Member States are obliged to adopt. In this case, the right to a remuneration for the energy injected into the grid, the right to be exempt from charges and levies on the energy that does not leave the premises of the community members, and the right to effectively access support schemes for renewables can improve the economics of collective action and ease those financial constraints that represent a frequent barrier to the diffusion of local RES communities. The CEP also enables Member State to support the development and diffusion of dispersed RES communities. However, this happens in a more indirect and partial way since the provisions for JARSCs and RECs are not applicable and those for JAACs and CECs do not specifically target communities dealing with renewable energy.

What scenarios for the next decade?

In the coming years, Member States can be more or less supportive of RES communities in general and of specific types of them in particular. This can be the result of them implementing the European provisions for JAACs, JARSCs, CECs and RECs to a different extent and making different choices on the options that the CEP leaves to national governments. Member States can also be more or less supportive by recognising legal models for RES communities in addition to those included in the CEP, by designing renewable support schemes in a way that RES communities other than RECs can have easy access to, or by promoting the emergence of networks of RES communities able to take advantage of their respective strengths and weaknesses and better support each other. During the next decade, it is likely that the relevance of national legal and regulatory choices coupled with the leeway that the CEP gives Member States will translate in a persistent heterogeneity of the national development pathways of RES communities. While in supportive countries RES communities, or at least certain types of them, will thrive, in other less supportive countries they will remain marginal. Convergence of these development pathways cannot be entirely excluded, especially between Member States that share similar conditions and adopt similar legal and regulatory frameworks; nevertheless, it will be probably gradual and become more visible towards the end of the decade because of the time needed to share experiences and learn from each other, to consolidate an accepted regulatory practice on energy communities, and to possibly agree on, develop and implement a more harmonised set of detailed rules at the EU level.

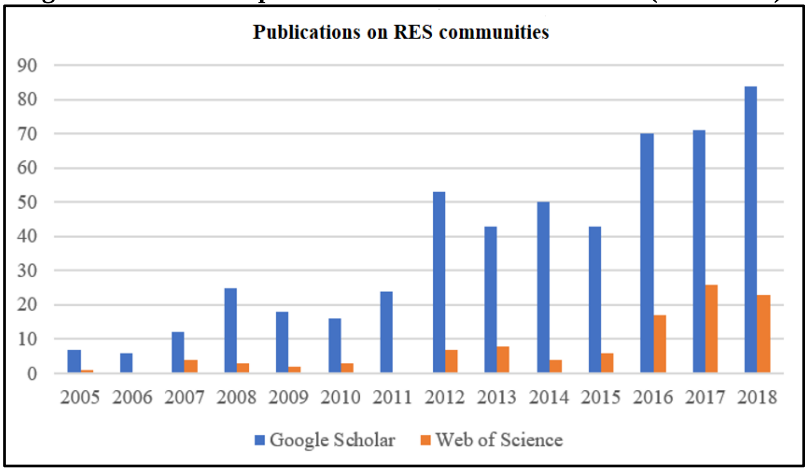
1

Literature review

1 Introduction

The appearance of the first renewable energy communities (hereafter, RES communities) as they are known today dates back to the mid-1970s, in Denmark. It was not until the 2000s, however, that their gradual diffusion in Northern Europe started to capture the attention of a wider audience. The growing popularity of RES communities then reached a peak in 2019, as the EU officially adopted a set of legislative texts known as Clean Energy Package, which among many other things legally recognises energy communities as a new actor in the European energy system. The evolution of the literature on RES communities reflects that of their actual or perceived potential relevance in Europe and the related interest in them. For illustrative purposes, Figure 1 shows the number of articles that we identified using *Google Scholar* and *Web of Science* by simply imposing the presence of *all* three words *"renewable"*, *"energy"* and *"community"* (or *"communities"*) in the title. Clearly, the volume of literature on RES communities has greatly increased over the past decade. The number of articles identified by *Web of Science* is much smaller as only scientific journals are considered, but a similar trend is visible there too and says that at least 60 relevant studies – probably more, given the restrictive terms of the bibliographic search – were published between 2016 and 2018 alone.

Figure 1 – Identified publications on RES communities (2005-2018).



RES communities are an exceptionally multifaceted socio-technical phenomenon and, for this reason, defining them is not a trivial exercise. Indeed, as we will see, their very identification is a topic in the literature. The same multiplicity of aspects concerning RES communities stimulates a variety of perspectives related to different knowledge areas. This is also reflected in the literature on RES communities, which spans the fields of economics, sociology, political sciences, geography, engineering and law, and discusses implications that may extend well beyond energy policy and regulation. To give a sense of such richness of questions and perspectives, Table 1 reports the keywords collected by van der Schoor and Scholtens (2019) in their extensive review of the literature on RES communities.

Table 1 – van der Schoor and Scholtens (2019): Typical keywords by theoretical approach.

Approach	Typical keywords
Transition studies	Energy transition, grassroots innovation, niches, regime, path dependence, energy innovation systems, sociotechnical transitions, multilevel perspective, strategic niche management, innovation
Science and technology	Socio-technical configurations, socio-technical change, constructive technology assessment, user-led innovations
Economic	Economics, markets, neoliberalism, economic development, impact, utilities, companies, ownership
Acceptance	Social acceptance, engagement, environmental awareness, public opinion, resistance, justice
Sociology	Social capital, participation, processual analysis, social resilience, behaviour change, environmental awareness, agency and capacity, organization
Governance	Governance, institutional arrangements, environmental citizenship, local authorities, local government, collaborative planning, interactive governance
Planning	Energy planning, energy strategy, public participation, energy management, energy policy, community energy planning, municipal energy plans
Spatial	Spatial planning, landscape architecture, urban planning, eco-urbanism, resilience, regional development, sustainable urban development, geography
Norms	Justice, equity, public values, public sphere, procedural and distributive justice, trust, risk, social impacts

The purpose of our literature review is to provide a picture as clear as possible on the phenomenon of RES communities by focusing on the key issues underlying their varied nature and possible development. Accordingly, the review is structured into the following four topics which were found to be particularly relevant: a) the identification of RES communities (*what are they? what characterizes them?*), b) their motivations (*what motivates the action of the communities and their members?*), c) the contextual factors (*which contextual factors influence the birth and development of RES communities?*) and, d) their societal impacts (*what impacts do they have on society, including and beyond the community?*).[1] The literature examined is characterised by the large use of case studies, very often including semi-structured interviews or surveys used for obtaining insights and primary data, respectively. This reliance on case studies and ad-hoc surveys is explained by the novelty of the phenomenon as a study subject and by a general lack of good secondary data enabling in-depth statistical analyses.[2] Furthermore, a semantic remark: often the literature uses the term *community renewable energy* (CRE) rather than renewable energy communities. The two terms are obviously very closely related but are not synonyms. Basically, CRE presupposes the existence of a RES community, but, if not explicitly specified, the term is vague concerning the exact type and role of the community. Conversely, as community is the noun in RES communities, the nature and role of the communities in question is usually clear. This may be obvious, but readers who approach the literature may be puzzled initially.

The rest of the chapter is structured as follows. Sections 2, 3, 4 and 5 respectively review the literature concerning the identification of RES communities, their motivations, contextual factors, and societal impacts. Section 6 concludes.

[1] The literature not covered in this chapter mostly includes theoretical studies that heavily rest on political theory (e.g., Szulecki, 2018; van Veelen and van der Horst, 2018) or system innovation theory (e.g., Seyfang *et al*., 2014).

[2] In this respect, things might improve in the next few years thanks to common legal definitions of Renewable Energy Communities and Citizen Energy Communities adopted at the EU level.

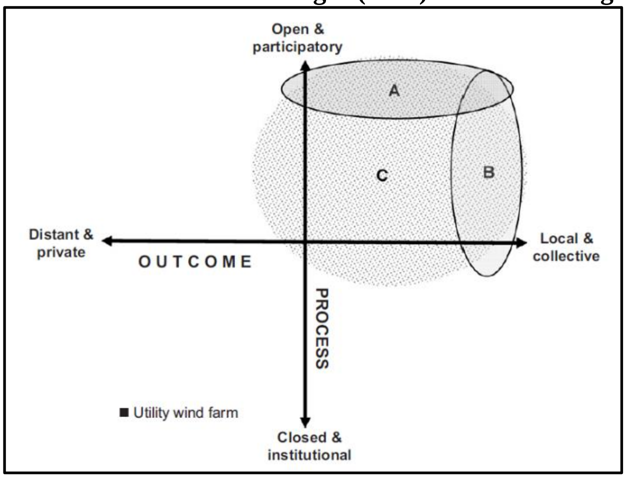
2 Identifying RES communities

In the 2000s, the increasing number in northern Europe of projects involving local communities in activities related to the production or use of renewable energy led to the coining of the term *community renewable energy* (CRE). The ambiguity of this term due to the multiple ways in which a community can be involved in an energy project and, therefore, the multiple interpretations of the attributive noun *community,* meant that projects labelled as CRE could widely differ in many important aspects concerning their activities, objectives, legal form, governance, financing, geographical scope, etc. The semantic vagueness of *CRE* prompted researchers to think about what ultimately characterises CRE projects. Such exercise is essential to identify the nature and the role of the communities involved in these projects – what we call in this report *RES communities* – which in turn is needed to eventually set legal definitions and design appropriate policy and regulatory frameworks. Several studies, some of which are reviewed below, propose theoretical frameworks and/or typologies of CRE initiatives (or projects[3]) or organisations based on many observations. A universally accepted definition of CRE does not exist and probably never will. There is a common understanding that CRE entails citizen involvement in terms of collective ownership or participation in activities related to renewable energy, but in the end only legal definitions can set clear boundaries.

2.1 Multidimensional frameworks

The seminal study by Walker and Devine-Wright (2008) is the first to consider what CRE actually means and develop a theoretical framework for addressing the question. The framework takes the visual form of a two-dimensional plane on which any type of project that concerns the production, supply, distribution or consumption of energy could be located (Figure 2). The two identified key dimensions are the outcome of the project (*who the project is for?*) and its process (*who is the project by?*). The former is concerned with how the outcomes of a project are spatially and socially distributed. The latter is concerned with who a project is developed and run by, who is involved and has influence. In the graph, the ends of the outcome dimension are "local and collective", on the right, and "distant and private", on the left. Similarly, the ends of the process dimension are "open and participatory", at the top, and "close and institutional", at the bottom.

Figure 1 – Walker and Devine-Wright (2008): Understanding of CRE.



The upper right quadrant is where CRE projects would normally be. There are, however, different interpretations of what CRE means which are represented by the shaded areas. From the interviews that the authors conducted with representatives of different (self-defined) CRE initiatives, it emerged that *"some interpretations were legally driven such that community projects were simply defined as ones led by organisations with a charitable status and without commercial interests. Some had a physical rationale so that community projects were ones that involved public buildings used by members of the community. Others stressed the importance of local people being involved in project development or*

[3] As in the literature, we use the terms *initiatives* and *projects* almost interchangeably.

having a direct financial stake in a project through cooperative share issues.” Accordingly, in the graph, the shaded area A corresponds to the interpretations focused on the processes of a CRE project, reflecting the view that its highly open and participatory character is a requisite for a CRE project to be considered such. Similarly, the shaded area B corresponds to the interpretations focused on the outcomes of a CRE project, reflecting the view that its highly local and collective character is a requisite. Finally, the shaded area C corresponds to the interpretations that recognise the specificity of CRE projects in some combination of the two characters. On the one hand, Walker and Devine-Wright’s framework suggests that identification of genuine CRE projects is less controversial if both characters are considered. On the other, it emphasises the existence of a wide “grey area” whereby a project may be qualified as CRE or not depending on subjective interpretations of the term.[4]

Walker and Devine-Wright’s theoretical framework inspired other researchers. Among these are Hicks and Ison (2018), who offer an interesting development of the original framework. This is extended in two main ways: one consists in adding key dimensions to better identify genuine CRE projects; the other concerns the introduction of a dynamic perspective, useful to analyse the evolution of CRE projects. With reference to the first extension, the two dimensions of Walker and Devine-Wright’s framework here become five and, for each of them, a spectrum of five levels is specified (with higher levels corresponding to more typical features of CRE projects). Table 2 shows the resulting 5x5 grid. Any project could be located on the grid by selecting, for each dimension, the appropriate level.

Table 2 – Hicks and Ison (2018): Dimensions and levels for evaluating community orientation of CRE projects.

	Level				
Dimension	1	2	3	4	5
Range of actors involved	Only non-local organisations, business and government	Mix of all actor types, more non-local than local	Mix of all actor types, more local than non-local	Local individuals, organisations, government and business	Only local individuals
Level of community engagement	Starts late, occurs rarely and via very limited means	Occurs only at key times, using limited methods	Occurs via various means but only during key times of project	Starts early but is sporadic, uses less methods	Starts early and occurs often, using a broad range of methods
Distribution of voting power	One actor has all votes	Actors’ votes correlate to level of shareholding	Limit on shareholding to ensure no single controlling interest	Some actors get more, less or no votes	One vote per actor
Scale of the technology	Scaled to maximise economic efficiencies	Scaled to local demand	Scaled to gain economic efficiencies, with some consideration of appropriateness for local context	Balanced between achieving economies of scale and appropriateness for local community	Scaled in relation to local energy demand and local agreement
Distribution of financial benefit	Non-local investors, with surplus leaving local and possibly national economies	Partly local investors, partly non-local investors	Local investors, with local economic flow-on effects	Partly to community, partly as dividends to local investors	Community fund to be used for communal benefit

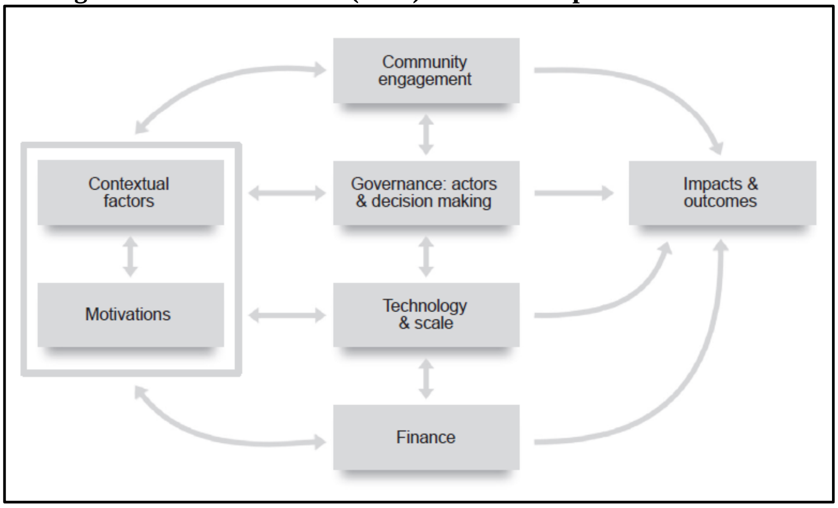
Here, too, the framework has a graphic representation. The authors draw a pentagram whose rays connecting the centre to the vertices correspond to the spectra of the five dimensions. Important, as in Walker and Devine-Wright (2008), a “grey area” remains: in some cases, the qualification of a project as a CRE project or not continues to depend on subjective evaluation. The larger number of dimensions, however, precisely serves to reduce such area of indeterminacy.

Hicks and Ison’s second extension of the original framework is the inclusion of a dynamic perspective. The emphasis is on two fundamental categories of elements explaining the birth and indeed the evolving structure of any CRE project, namely the contextual factors (physical, institutional,

[4] In Creamer *et al.* (2019), Walker and Devine-Wright’s framework is discussed directly with the authors.

technology-, and community-related) and the motivations of the individuals participating in the project. The bidirectional interactions between these two groups of elements (context and motivations) and four others that correspond to key dimensions of the framework presented above, determine the results of a project and its own evolution (Figure 3).

Figure 3 – Hicks and Ison (2018): CRE development framework.



In light of the varied experience of CRE in Europe, the emphasis on different contextual factors and motivations of the participants is absolutely appropriate and useful for any evolutionary analysis of CRE. In this connection, Seyfang *et al.* (2013) is an often-cited study which, also based on a large number of observations (from the UK), identifies five key factors for successful outcomes of CRE initiatives. Specifically, the authors identify the following five categories of factors:

- *Group*: having key committed individuals to drive a project forward; an effective organising group capable of maintaining momentum and overcoming setbacks;
- *Project*: having sufficient time, information, skills, money and material resources to carry out the project; financial viability (where relevant);
- *Community*: the project being designed to meet the community's needs; engaging with and developing trust with the community;
- *Network*: forming supportive partnerships and information-sharing networks; sharing information with other groups; and
- *Policy*: a supportive national policy context.

The theoretical frameworks developed to analyse the evolution of CRE initiatives logically follow those conceived to identify their nature. In this section, we have presented examples of the two together so as to stress that to some extent the very nature of CRE projects may evolve over time.

2.2 Further perspectives

Further studies have contributed to the characterisation of CRE, though without necessarily producing explicit theoretical frameworks and powerful graphical representations.[5] Among these, Hielscher *et al.* (2013) identify two main distinctive features of CRE projects which differentiate them from more typically government- or business-led initiatives. First, CRE projects are multifaceted, this reflecting the fact that they often involve multiple activities (say, electricity generation and energy conservation) and they address technology and related behavioural aspects together. Second, they empower citizens and communities to directly address sustainable energy issues in close connection with their local environment.

[5] In addition to those reviewed in this section, other relevant studies include Grunewald *et al.* (2014), Gui and MacGill (2018), Hoicka and MacArthur (2018).

The local dimension of a project, already introduced with the illustration of Walker and Devine-Wright's (2008) framework, is central and one over disagreement is likely to arise when it comes to defining CRE. On the one hand, there is the acceptation of community as a *community of place*, hence with people living in the same geographical area (whose delimitation is an additional question); on the other, is the acceptation of community as a *community of interest*, which clearly does not imply that collective action is carried out by people located in the same geographical area. Using this fundamental distinction, Moroni *et al.* (2019) propose a taxonomy for RES communities. The taxonomy is perhaps too simple to be useful in many situations, but it has the merit to emphasise that the geographical scope of a community does not necessarily have to be limited to a certain area and that the activities of a community can extend beyond the energy realm. The taxonomy rests on the double distinction between *place-based* and *non-place-based* communities, on the one hand, and between *single-purpose* (only energy-related) and *multi-purpose* (including and beyond energy-related purposes) communities, on the other. The four resulting categories provide a broad classification of RES communities (Table 3).

Table 3 – Moroni et al. (2019): Types of energy-related communities.

	Non-place-based	**Place-based**
Single-purpose	Non-place-based communities set up for the sole purpose of producing, managing or purchasing energy in accordance with shared rules	Place-based communities set up for the sole purpose of producing, managing or purchasing energy in accordance with shared rules
Multi-purpose	Non-place-based communities set up for the purpose of sharing production, management or purchasing of various goods and services including energy	Place-based communities set up for the purposes of sharing production, management or purchasing of various goods and services including energy

Another study that offers a potentially useful classification is by OFGEM (2016), the UK energy regulator. The study identifies archetypal business models for production and supply of energy services addressing the needs of local groups of consumers. The identified business models are the following (though the authors recognise that some schemes may cut across them): local consumer services; local generation; local supply; micro-grid; and virtual private networks. The focus, however, is on *local* rather than on *community*. Accordingly, while most or all of these models may be implemented by a local community, the ways to satisfy consumption of local communities are the underlying criterion, not citizen ownership or active participation. For our purposes, this recalls the distinction between outcome and process in Walker and Devine-Wright (2008).

2.3 Legal forms

Classifications of RES communities according to the different legal forms that they can have may be particularly effective in showing the range of their possible configurations. Starting from the assumption that a necessary feature of CRE initiatives is citizen involvement in terms of ownership or participation, Roberts *et al.* (2014) offer a detailed illustration of the legal forms in which *de facto* RES communities (i.e., irrespective of specific relevant legal definition that may exist in certain countries[6]) present themselves in Europe. As national legal systems differ to some extent from one another, the following archetypal legal forms are identified: limited partnerships (typically with limited liability company as general partner); cooperatives; trusts and foundations; non-profit customer-owned enterprises; housing associations; and other socially-oriented enterprises.[7] In addition, the authors present real-world examples of ways in which local authorities can have a leading role in CRE projects. The illustrated arrangements concern public utility companies, public-public partnerships, public-private partnerships, as well as mandatory involvement of local communities in RES projects. For each of these possible legal forms or arrangements, we would argue, the actual degree of citizen involvement in terms of ownership or participation would need to be verified in the specific cases. Cooperatives, however, do stand out for lending a natural legal form for CRE projects, as they normally combine shared ownership,

[6] This is also our use of the term RES community in this report.
[7] Walker (2011) provides a similar classification.

democratic participation in decision-making and, most often in the case of *modern* RES cooperatives, social responsibility.[8]

Modern RES cooperatives are so called to distinguish them from the energy cooperatives that, in parts of Europe and North America, were established in the early twentieth century or even earlier, typically in remote areas. The origin of modern RES cooperatives is usually traced back to the wind cooperatives established in the 1970s, first in Denmark and then elsewhere. They tend to be characterised by a strong orientation towards general interest goals, beyond traditional mutual interest, and a membership of multiple stakeholders (Huybrechts and Mertens, 2014; Yildiz *et al*., 205; Lowitzsch and Hanke, 2019).[9] In countries where cooperativism is better rooted in society, RES cooperatives have established themselves as the most common form of RES communities (especially if photovoltaics is the chosen technology, which is less capital intensive than other alternatives) as well as an increasingly important actor in the wider landscape of social enterprises (Borzaga *et al*., 2020). In general, RES cooperatives tend to be small and local, with only few examples of bigger ones having several thousand members, typically engaged in electricity supply (in this case, cooperative membership including customers). To give a sense of the orders of magnitude regarding their relevance in European electricity markets, according to Wierling *et al.* (2018), in Germany, 9% of total RES generation capacity installed by 2012 was owned by cooperatives; for Belgium and Scandinavian countries, Huybrechts and Mertens (2014) report estimates of cooperatives' share of total RES generation between 2005 and 2010 of 6% and 15%, respectively. In southern and eastern Europe, however, the same shares would not exceed 1-2%.

3 Motivations

The objectives pursued by a community – a group of people that share something – through the development of a RES project would normally be reflected in the motivations of its members for establishing or joining the community.[10] The analysis of related project and individual motivations, together with the contextual factors that influence them, is useful for understanding the nature of CRE projects, their past evolution, as well as for making hypotheses over their possible future. Several empirical studies investigate the motivations of participants in CRE projects. The first aspect to stress is the multiplicity of motivations both at the community level (project motivations) and at the individual level (individual motivations), consistent with the characterisation of CRE projects as pursuing multiple objectives and as often seeing the participation of different stakeholders. Accordingly, research questions are typically framed in terms of *prevailing* or dominant motivations. Three main types of motivations are most commonly observed: environmental, economic, and social motivations. In general, environmental motivations appear to be the most frequent across different types of projects and contexts. In the 1970s and 1980s, environmental motivations often were related to concerns about the diffusion of nuclear power. By contrast, since the 1990s, climate change concerns have become increasingly prominent. As Bauwens (2019) notes, economic motivations are more closely dependent on the type of CRE project. Some CRE projects offer the participants a return on their investment, which for someone also could be a reason to join and contribute to a project.[11] Moreover, in the case of RES cooperatives that supply electricity to their members, these might benefit from paying lower prices than those offered by other retailers. Further, often CRE initiatives include programs or services enabling the members of the community to reduce their own energy consumption, thus realising some savings. As regards social motivations, Bauwens (2019) explains them with notions from social psychology:

[8] In limited partnerships, which are most common in community wind projects, voting rights are allocated according to the amount of capital invested (Bauwens, 2016).
[9] The orientation also towards general interest goals is usually explicit in the cooperative statute and it is reflected in the principles established by the International Cooperative Alliance to which most modern RES cooperatives adhere (http://ica.coop/en/whats-co-op/co-operative-identity-values-principles).
[10] It would also be spelled out in the statute of the organisation, if there is one. However, statutes are usually succinct, may not be explicit as to the ordering of multiple objectives, and are rarely changed.
[11] However, someone who was *exclusively* interested in the economic return would normally find better investment alternatives (in a strict economic sense).

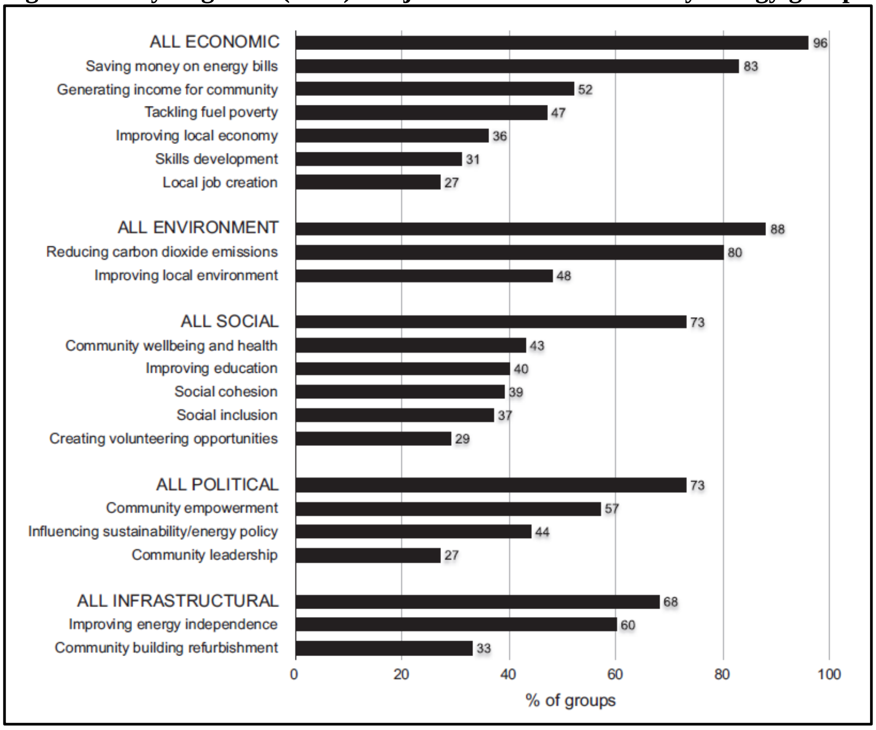
relational goods, social identity (with the group) and peer effects (in the adoption of innovations). From a different materialist perspective, other authors emphasise the political motivations driving CRE (among others, Becker and Kunze, 2014).

In the literature that investigates project and individual motivations, as for much of the literature on CRE, works that are based on a more or less large number of case studies prevail numerically. Primary data is typically acquired through semi-structured interviews and surveys with experts and participants in CRE projects. Depending on the data thus gathered, simple descriptive analyses or more sophisticated statistical analyses are conducted. Hipotheses may be formulated and then tested against the data. Accordingly, below we first review studies that do not go beyond insightful descriptive analyses and, to follow, studies that also identify statistical correlations. A third final section is dedicated to studies that, while considering essentially the same types of motivations, investigate people's willingness to participate in CRE projects. Thus, in this case, survey respondents are people who are *not* currently participating in a CRE project. Information about people' willingness to participate in CRE projects is useful especially to think about the potential of CRE in the future.

3.1 Descriptive analyses

Based on the responses of 190 participants in CRE projects in the UK, Seyfang *et al.* (2013) identify 18 types of stated project objectives. The objectives are classified as follows: economic, social, environmental, political, and infrastructural. On average, respondents indicated no less than 8 objectives per project. As it turns out, the most commonly cited single objective was saving money on energy bills, reported by 83% of projects. Overall, economic objectives were the most prominent (held by 96% of groups), followed by environmental (88%), social (73%), political (73%) and infrastructural (68%) goals (Figure 4).

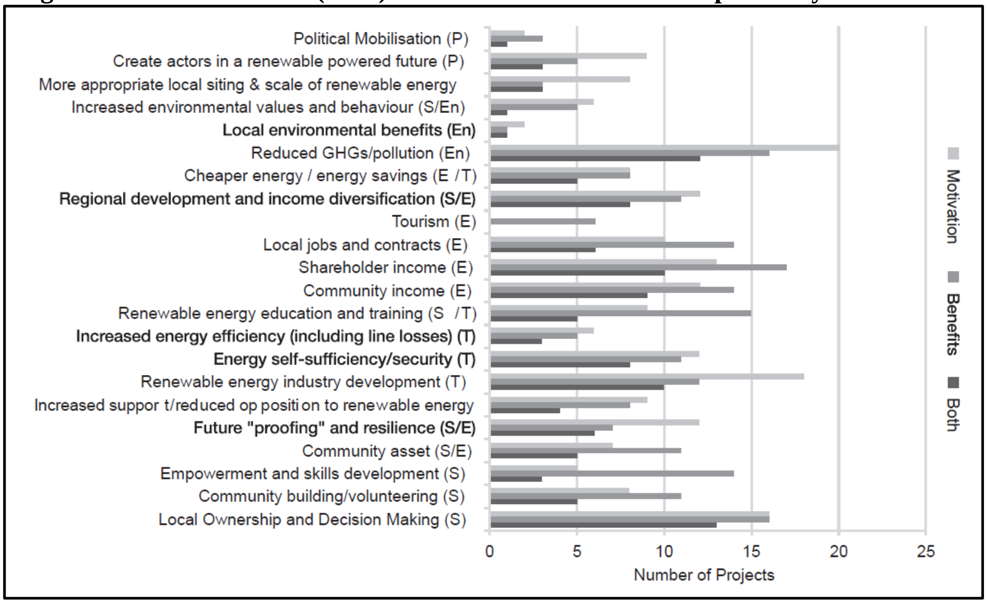
Figure 4 – Seyfang *et al*. (2013): Objectives of UK community energy groups.



However, two considerations are in order. First, the number of possible specific economic objectives is larger than that of specific environmental objectives, which is understandable given the many ways in which different CRE projects may offer economic benefits. Yet, it is not clear whether this fact (that more numerous specific economic objectives exist) is taken into account in the overall results presented. If it is not, then the results would be biased. Second, it is not clear whether CRE projects only involving energy conservation are more represented among the respondents than those only involving energy generation. If it was the case, though energy conservation clearly has a positive impact on the environment, it is also logical that realising cost savings would rank high.

Based on interviews with leaders of 25 CRE projects in Europe, North America and Australia (covering the period 2010-2014), Hicks and Ison (2018) record as many as 22 project motivations. These are grouped by the authors in five broader categories, namely economic, social, environmental, technological, and political motivations – thus a classification that is almost identical to that of Seyfang *et al.* (2013). Some specific motivations appear under two broader groups of motivations, which means that there are some overlaps between the second. Examples of such intersections include: "increased environmental values and behaviour", which is classified under both environmental and social motivations; "future proofing and resilience", which is considered both an economic and social motivation; and "increased support /reduce opposition to renewable energy", which is classified as both political and social. Interestingly, the interviewees were also asked about the project outcomes, which then the authors compare with the project motivations (Figure 5). Often project motivations and (self-stated) project outcomes (benefits) coincide, but not always: not all motivations are delivered as benefits and not all identified benefits were originally motivations.

Figure 5 – Hicks and Ison (2018): Motivations and benefits reported by case studies.



Note: E = Economic; En = Environmental; P = Political; S = Social ; T = Technological .

As can be seen, the most common motivation is the reduction of GHG emissions or, more generally, of polluting emissions (environmental); the second is renewable energy industry development (technological); the third is "local ownership and decision making" (social). It should be recalled that, as in Seyfang *et al*. (2013), these results refer to a variety of CRE projects, even from different continents in this case.

Radtke (2014) is one of the first studies in the CRE literature to explore the relationships between participants' demographics, their motivations and modes of participation. The study uses survey data originated by the answers of 2826 participants in 84 CRE projects, located in Germany. Simple statistics are used to characterise the observed CRE participants. These tend to be well-educated, knowledgeable, enjoy a good income, and operate with a strong organisational commitment and dedication to the beneficial effects of energy initiatives. Besides, the data clearly show that participants are not exclusively profit-oriented. In fact, 93% of the respondents indicate that their involvement is primarily for ecological reasons, while 56% indicate that their primary motivation is realising economic gains. With reference to their specific project, CRE participants were also asked about their participation in discourse and discussion, their views on organisational democracy, their sense of community, and their views on social effects. Based on the answers, the author derives the following three modes of participation: a) *cultural and social participation*: in the context of events, where participation and governance is collaborative and social; b) *political and organisational participation*: where codetermination is the rule, voting and incorporation of ideas and issues makes for participation in decision-making; and c) *financial and economic participation*: in the form of financial shares, where the participatory mode is monetary.

Dóci and Vasileiadou (2015) examine the motivations of participants in four local CRE projects, two in Germany and two in the Netherlands. The data are derived from 41 semi-structured interviews and are then analysed through the lens of the goal-frame framework. Borrowed from psychology, the gist of this framework is that people perceive situations differently and that this also has to do with the goals that people want to achieve. Three goal frames are considered: a) the *hedonic goal*, "to feel better, feel comfortable"; b) the *gain goal*, "to guard and improve one's resources"; and c) the *normative goal*, "to act appropriately", meeting one's own norms or those expected by the community. The goal frames are interdependent, which means that variations in relevant conditions can change the dominant goal frame. The authors establish a correspondence between stated motivations for participating in CRE projects and the goal frames. For example, protecting the environment, supporting the development of RES technologies and protecting the rights of future generations, all map into the normative goal frame. The results show that mainly gain considerations, such as decreasing energy costs, and normative considerations, such as addressing climate change, played a role in the decision to participate in a CRE project. In the background, however, hedonic motivations were also present, such as having fun and integrating in a community.

3.2 Correlation analyses

Though applied to Japan, while our focus is on Europe, Maruyama *et al.* (2007) deserves special mention as it appears to be the first study to examine with a statistical method the relative importance of different personal motivations for participating in CRE projects. The empirical analysis uses data from surveys conducted with both investors and people who only showed interest in investing but never did ("non-investors"), in three different collective funds for wind generation projects (one national and two local, in different regions). Using factor analysis, three categories of motivations (the factors) are identified based on the respondents' answers: a) *environmental movement factor* (specific motives including: "personal choice in type of energy", "want to stop global warming", "a society not reliant upon nuclear energy is good", "to show support for the citizen NPO (non-profit organisation) movement", "wanting to make a socially responsible investment", etc.); b) *commitment factor* ("being able to inscribe name on windmill", "want to have own windmill", "agree with the idea of a citizen-financed windmill", etc.); and c) *economic factor* ("not a donation", "expecting a dividend", etc.). Multivariate ANOVA is used to establish statistical differences in the three types of motivations between investors and non-investors and by fund. The bottom line is that all agents, namely investors in the different funds as well as the respective non-investors, share interests such as economic interests and a sense of social commitment, participation and contribution. The relative importance of these interests, however, significantly differs across funds (projects) and between investors and non-investors as expected.

Fleiβ *et al.* (2017) presents some clear similarities with Maruyama *et al.* (2007). The authors use data from surveys with participants and non-participants in two Austrian CRE initiatives, both of which involve investment in photovoltaic installations but under different business models and in different parts of Austria. Using factor analysis, five categories of motivations (factors) for participating in the initiatives are identified: a) *social capital* ("strengthening inclusive decision-making in the region", "strengthening social cohesion in the region", "approval and appreciation of others"); b) *preservation* ("preservation of the townscape", "preservation of green spaces"); c) *environmental protection* ("supporting regional environmental initiatives", "contribution to environmental protection", "reduction of greenhouse gas emissions"); d) *energy autonomy* ("independence from energy supply companies", "self-generation of electricity from photovoltaics", "fostering the diffusion of photovoltaic in the region".); e) *financial aspects* ("attractive interest rates", "no binding period for invested capital", "security of investment"). Separate logit regressions are then estimated for participation in the two CRE projects. The results point to the key role of economic motives, which for both projects are identified as the main driver of participation. Most effects referring to the other factors are not statistically significant. Two considerations are in order, however. First, both initiatives are profit-oriented, so results would probably differ for more grassroot CRE initiatives. Second, in the logit regressions, a possible problem of multicollinearity does not seem to have been addressed (if so affecting the statistical significance of estimated coefficients).

Holstenkamp and Kahla (2016) collect survey data on investment motives of participants in German CRE initiatives. Using the answers of about 340 respondents, the authors compute and compare descriptive statistics for scores (from 1 “no relevance” to 5 “highly relevant”) on seven investment motives: *return*; *energy supply*; *generation of regional added value*; *nature conservation*; *advancing the energy transition*; *participating in the production of electricity or heat*; and *being a member of the community*. To explore the role of contextual factors, the authors compute correlations between investment levels and several relevant variables. Overall, the results show that environmental concerns dominate, while social and political goals are the second most frequent. Moreover, many respondents place less emphasis on financial return, but still this motive plays a role. Notably, significant differences are found with respect to the following dimensions: *governance* – participants in limited partnerships tend to place higher value on the return motive than those of bottom-up cooperatives; *technology* – return on investment plays a higher role for wind generation projects; *ecosystem and social setting* – there seems to be a North-South divide with higher emphasis placed on the return motive by community investors in the North; *economic and political setting* – data suggest that higher feed-in tariffs during the period 2009–2011 triggered a shift in the predominating type of investor or in the preferences of the same type of investor; *function within the company* – a significant difference between ordinary members’ and mangers’ assessment of the return motive (higher for the former); *investment level* – positive relationship between the level of investment and the relevance of the return motive.

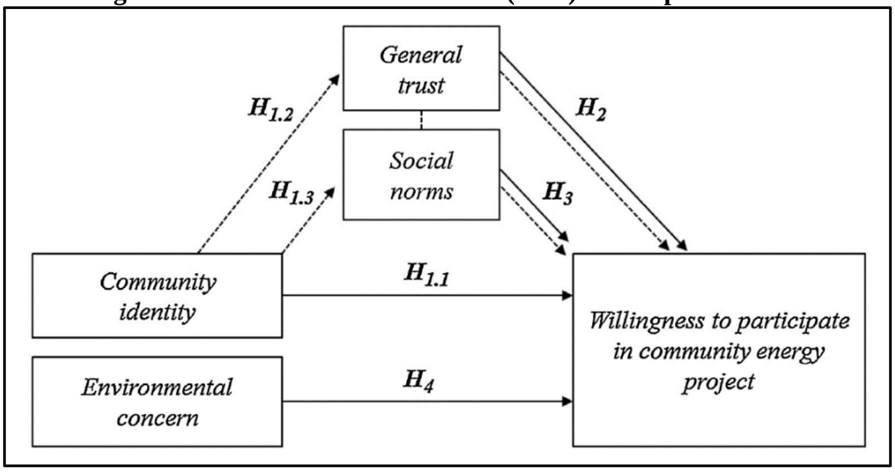
Bauwens (2016) investigates the motivations of the members of two Belgian RES cooperatives in the decision to join the respective organisations. The two cooperatives, *Ecopower* and *BeauVent*, differ in some relevant respects. Notably, the former carries out both production and supply of RES electricity, whereas the latter only production; also, *Ecopower* was established in 1992, whereas *BeauVent* only in 2005. Importantly, as until 2003 the activity of *Ecopower* was limited to production, *Ecopower* in its early days presents similarities with *BeauVent* today. The data were collected through surveys, to which over 4000 cooperative members responded. The author uses correlation analysis and statistical tests to analyse members’ motivations and characteristics, and compare different member categories within and between the two cooperatives. As in Holstenkamp and Kahla (2016), five-scales scores (from 1 “not at all” to 5 “completely”) are used to measure the subjective relevance of different motives. The members of *Ecopower* are grouped in three cohorts corresponding to the first “idealistic” phase of the cooperative (1992-1999), the “energy production” phase (2000-2002) and the “supply” phase (2003-). The main finding – which again proves the relevance of contextual factors – is that the members of a cooperative are not a homogeneous group. Specifically, material incentives attached to electricity supply turned out to be more important for the third cohort of *Ecopower* members than for the two previous generations. On the other hand, the two first cohorts as well as *BeauVent* members are more pro-environmentally oriented and identify more strongly with their organisations. Further, the second generation of *Ecopower* members has a higher degree of interpersonal trust when compared to the most recent generation.

Drawing on the same dataset used in Bauwens (2016), Bauwens (2019) analyses the economic, social, environmental and institutional factors explaining the size of investments in *Ecopower* and *BeauVent* by the respective members – investment size being a measure of financial engagement. This time the author uses multivariate regression analysis (possible thanks to variation in the outcome of interest), the dependent variable being the number of purchased shares expressed in six discrete levels (1 “1 to 9” shares, 2 “10 to 19”, 3 “20 to 29”, 4 “30 to 39”, 5 “40 to 49” and 6 “50 or more”). The explanatory variables (complemented by control variables), represent the importance assigned by cooperative members to different motivation factors, which largely coincide with those in Bauwens (2016). To appreciate differences between different organisational contexts, ordered probit models for investment size are estimated separately on three subsamples corresponding to older *Ecopower* members (who joined the cooperative between 1991 and 2002), more recent *Ecopower* members (joined after 2002) and *BeauVent* members. The results show that the return on investment is the most important determinant for members of larger cooperatives (which may be likened to communities of interest), while environmental, social and other non-economic drivers tend to dominate financial motives for members of smaller cooperatives (communities of place). Moreover, the presence of other cooperative members in close social networks plays a particularly important role in the latter kind of cooperatives, highlighting the strength of social interactions as a driver for investments.

3.3 Willingness to participate in CRE projects[12]

Kalkbrenner and Roosen (2016) empirically analyse whether and how community identity, social norms, trust and environmental concerns (these are the explanatory variables) affect citizens' willingness to participate in CRE projects (the dependent variable). The data used are from a survey with German citizens who are in charge of energy-related and financial decisions in their households. Multivariate regression analysis is used, with all variables expressed as scores according to specific Likert-type scales. Based on the answers of almost 1000 respondents, the authors test hypotheses concerning direct and indirect effects as pictured in Figure 6.

Figure 6 – Kalkbrenner and Roosen (2016): Conceptual model.



The results provide support for direct effects of trust, social norms, and environmental concerns (*H2, H3 and H4*) but not for a direct effect of community identity (*H1.1*). Community identity does play a role, but only through changes in trust and social norms (*H1.2* and *H1.3*). Other interesting findings include the following: a) the general attitude toward community energy is positive; b) willingness to volunteer is higher than willingness to invest money; and c) higher income, ownership of a renewable energy system and living in a suburban or rural (rather than urban) community, all are positively related with the willingness to participate.

In a study that presents similarities with Kalkbrenner and Roosen (2016), both in the research questions addressed and in the methods used, Koirala *et al*. (2018) analyse the influence of demographic, socio-economic, socio-institutional and environmental factors on people's willingness to participate in CRE initiatives. The authors collected data through a survey among Dutch citizens (who would be officially eligible to participate in a CRE project), to which almost 600 people responded. Factor analysis is used to identify individual motivations influencing the willingness to participate. The willingness to participate, measured on a five-point Likert scale (from 1 "Not very willing" to 5 "Very willing"), is then regressed on the motivations identified, measured by the respective factor scores, and on other relevant variables including socio-demographics and awareness about local energy initiatives. In order of magnitude, statistically significant effects turn out to be the following: community trust, community resistance (the effect being negative), energy independence, environmental concerns, energy-related education, education, and awareness about local energy initiatives. Interestingly,

[12] Rogers *et al.* (2008) is one of the first studies examining public perceptions of CRE projects. By presenting descriptive statistics of data collected through interviews and a survey, the authors investigate the attitudes of a very small rural community in England toward a proposed CRE project. Given the very limited size of the sample (38 observations) and the simplicity of the methodology, we do not summarise the study's findings. However, the questions addressed are relevant and indeed recur in the more recent literature.

economic incentives are not significant. Over 50% of the respondents declared to be willing to participate in a CRE project and over 30% were undecided. This would suggest that there is a large potential for expansion of CRE initiatives and, considering the regression results, increasing community trust (sense of community and trust in community) and reducing community resistance (limited familiarity with CRE and lack of time) would be the most effective avenues to realise it.

4 Contextual factors

The contextual factors that can play a role in the emergence and evolution of CRE projects are many and diverse. Hicks and Ison (2018) propose a classification that distinguishes between physical-, technology-, institutional- and community factors. Specifically, *physical factors* relate to, e.g., the topography, the availability of renewable energy sources, and the existing energy infrastructure. *Technology factors* relate to, e.g., the cost of different RES technologies, the maturity and modularity of the technology, the energy needs and the demand profile of the community. *Institutional factors* relate to, e.g., the structure of the energy market, the regulatory environment, the laws governing legal structures, renewable energy policies (especially dedicated support schemes), the culture within existing energy and other relevant institutions. *Community factors* relate to, e.g., the local history and culture, to relationships or social capital, to skills and knowledge available, to social perceptions of and appetite for certain technologies. To understand the evolution of a specific CRE project or more generally that of the CRE sector in, say, a country or region, all these factors would need to be considered. We note, however, that both physical and technology factors are to a large extent exogenous. That is, they represent conditions on which CRE leaders and even policymakers have little control, if any. By contrast, institutional and community factors – however broad these categories are – are variables on which CRE stakeholders are usually more able to exert some influence, or even control in the case of policymakers. This distinction seems relevant to us especially if one tries to imagine the possible future development of CRE – as we do in Chapter 3. Also, CRE being a social phenomenon in the first place, institutional and community factors per se are particularly relevant.

The same contextual factors recur in a rather extensive literature that analyses the current state and the historical evolution of the CRE sector, or a segment of it, in various European countries. Some of these studies offer comparative analyses of a small number of countries (e.g., Ruggiero *et al*., 2019, comparing countries of the Baltic Sea region; Kooij *et al*., 2018, on Denmark, Sweden and the Netherlands; Mignon and Rüdinger, 2016, on Germany, Sweden and France; Bauwens *et al*., 2016, on Denmark, Germany, UK and Belgium; Oteman *et al*., 2014, on Denmark, Germany and UK; Toke, 2002, on Denmark and UK). Others only deal with one country (e.g., Candelise and Ruggieri, 2020, on Italy; Magnusson and Palm, 2019, on Sweden; Heras-Saizarbitoria *et al*., on Spain; Capellán-Pérez *et al*., 2018, on Spain; Van Veelen, 2017, on Scotland; Oteman *et al*., 2017 on the Netherlands; Berka, 2017, on the UK; Magnani and Osti, on Italy; Boon and Dieperink, 2014, on the Netherlands; Haggett *et al*., 2013, on Scotland). Especially in the second case, the description of the contexts can be very detailed, often informed by case studies on specific CRE projects and data collected through interviews with CRE stakeholders.

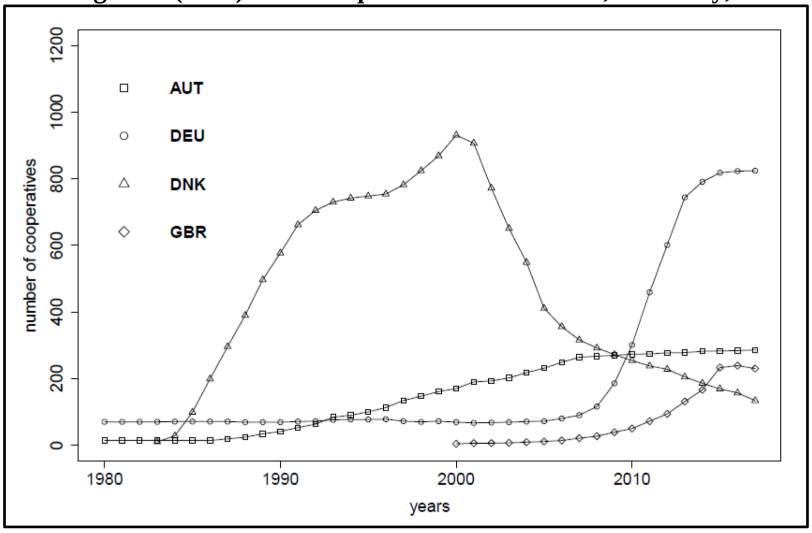
In each country, the CRE sector has its own history, more or less long and more or less successful, strongly influenced by specific contextual factors. Reviewing the significance of all these factors in many different countries is outside the scope of this report.[13] However, wishing to provide concrete examples that show the relevance of at least some of these contextual factors, we describe some evidence emphasised by the literature. To do this, we focus on three countries where CRE has a longer history: Denmark, Germany and UK. Other European countries where the concept of CRE has been present in society for several years, and a significant number of CRE projects is already there, include Sweden, the Netherlands, Austria and Belgium. Conversely, CRE does not have a long history in southern Europe and even less so in eastern Europe, where for a long time the word community has somehow been reminiscent of the socialist past.

[13] For a detailed and up-to-date account of the state of the CRE sector in several European countries, as well as some non-European ones, see Lowitzsch (2019).

4.1 Examples from the history of CRE in Denmark, Germany and UK

Denmark has been a pioneer in wind energy and today remains a world leader. Denmark is also the country where the first modern CRE projects were realised and, importantly, contributed in a fundamental way to the development of the wind industry. The first experiences of CRE projects date back to the mid-1970s, after the first oil crisis pushed Danish society to consider the nuclear option (never subsequently undertaken). The search for alternatives to nuclear power and the wealth of wind in the country stimulated experiments for the commercialization of wind energy, to which, especially in the beginning, an entrepreneurial civil society gave a fundamental contribution. An extraordinary diffusion of local wind energy cooperatives followed in the subsequent two decades. It has been estimated that, by the late 1990s, over 2000 turbines belonged to these cooperatives and small local owners (Oteman *et al*., 2014). The success of wind cooperatives can be explained, on the one hand, with the development of the national wind industry, which became an industrial policy objective pursued with effective forms of economic support, notably investment grants, tax exemptions and (later) feed-in tariffs (Bauwens *et al*., 2016);[14] on the other, with the involvement of local communities. Historically, Danish local authorities are actors in the energy sector, which is markedly decentralised. In a highly supportive national political context, local authorities and communities collaborated closely for the realisation of wind farms, typically small in size, located in rural areas and owned by farmers, households, local companies or investors.

Figure 7 – Wierling *et al*. (2018): RES cooperatives in Denmark, Germany, Austria and UK.



In the early 2000s, the liberalisation of the electricity market and the measures introduced by a new government less supportive of green technologies dealt a serious blow to the model of local energy cooperatives and the renewable energy sector more generally. Funding for renewable energy was slashed and the feed-in tariff scheme was replaced by renewable portfolio standards. As a result, almost no new wind turbines were installed between 2003 and 2007 (Kooij *et al*., 2018) and, as Figure 7 shows, the number of wind cooperatives collapsed in that period. Subsequently, the number of wind turbines started to grow again, a feed-in tariff scheme was reintroduced in 2009, but ownership continued to move away from local entities to large project developers and investors. At the same time, the advantages of projects owned by the local population were made salient by a growing number of NIMBY-type protests against new wind projects. In response to them, the government adopted a law that established a fund for local community development including financial support to onshore turbines, and provided that in a commercial build of new onshore turbines, at least 20% of shares must be offered to the local community. According to Kooij *et al.* (2018), in 2017, a total of 4910 wind turbines (with an installed capacity of 5229 MW) existed in Denmark. Of these, about 20% were estimated to be locally owned by citizen cooperatives, farmers and local landowners.

[14] Today, green energy technologies make up about 7% of total Danish export (Kooij *et al*., 2018).

Germany is a world leader in renewable energy. The range of used RES technologies is wide, but wind and solar have a prominent role. The specific contribution of citizens and communities through cooperatives and limited partnerships is also important. Oteman *et al*. (2014) describe the German RES policy system as moderately decentralized. While the federal level sets policy targets and goals, the states decide on the implementation of the projects through, e.g., the allocation of wind zoning plans and subsidy schemes, which however often are delegated to municipalities. Germany has a long tradition of energy cooperatives and local public utilities, though most of the second have been privatized or indeed are now owned through local cooperatives. Today wind cooperatives are fewer than solar cooperatives but have a longer history, which started in the early 1990s thanks to the first feed-in tariff scheme, and are larger in terms of generation capacity. While declining over the years, due to increasing professionalization and commercialization in the sector, the share of wind capacity owned by citizens and local communities remains significant: about 20%, according to Bauwens *et al*. (2016). By contrast, solar cooperatives, which often involve collaborations between citizens and local governments, are a more recent phenomenon. Its origin coincides with the economic crisis of 2008-2009 and the ensuing search for new economic models. Solar cooperatives grew very rapidly: from only four in 2007, to 200 three years later, according to Oteman *et al*. (2014). In Figure 7, the curve corresponding to Germany, which steeply increases starting in 2008 and gets flat after 2014, closely reflects the evolution of solar cooperatives. That year, the reform of the Renewable Energy Act replaced the feed-in tariff scheme with a market premium scheme, which penalised small-sized plants as being typically less competitive. The next major change in support measures was in 2016, with the shift to a tendering scheme. However, preferential rules have been applying for "citizen energy companies" and energy cooperatives in onshore wind and photovoltaic auctions (Yildiz *et al*., 2019).

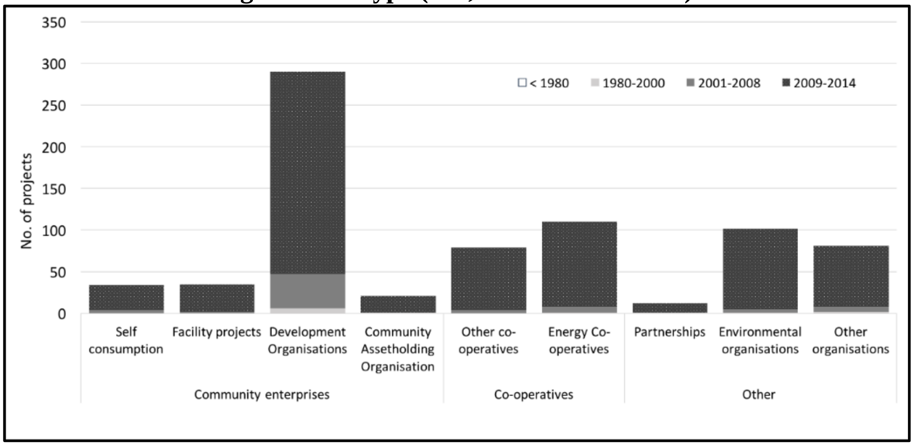
Crucially, the development of the RES sector takes place in the context of a long-term political strategy called *Energiewende*, which literally means energy transition. The *Energiewende* concept dates back to the 1980s, when the German anti-nuclear movement was strong. Having evolved over time, it then became a government program in 2010, a few months before the Fukushima nuclear accident. The transition envisaged by the *Energiewende* is to a low-carbon, nuclear-free energy system. The strategy has gained broad public support (although not without exceptions[15]), which is also explained by the active participation of citizens and communities. Active involvement of the population is not accidental, but is actually a central component of the strategy (Morris and Jungjohann, 2016). Overall, the long horizon of the *Energiewende* and the broad consensus that it enjoys in the German society have determined a highly stable policy and regulatory framework for the RES sector. The more specific CRE sector both contributed to it and benefited from it.

After Denmark and Germany, the UK is one of the first countries in Europe where the concept of CRE started to take hold. After over two decades, however, its penetration in the British electrical system remains relatively limited. As Berka (2017) illustrates in a detailed historical account of the evolution of CRE in the UK, in the early 1990s the electricity market, following extensive privatizations and its liberalization, was dominated by large international groups and without a significant role of local public utilities: not an ideal starting point for CRE. Apart from some experiences of community enterprises, mostly concentrated in Scotland, the first opportunities for CRE projects began to appear at the turn of the millennium with the introduction of RES support schemes. The main of these, however, was a market-based mechanism that did not allow small-scale projects to benefit from it. The Renewables Obligation scheme (what others call a renewable portfolio standard) was initially exclusive to projects larger than 5MW. Then, in 2004, it was extended to allow smaller plants (>50kW), though without technology-related differentiations (this would change later, in 2009). Still, CRE projects were normally not competitive. During these years, community enterprises in rural areas continued to be the primary niches for community-led renewable energy development. It is also during these years that the Scottish government started to clearly distinguish itself from the UK one in actively supporting CRE as a means to achieving broader objectives around rural development and community empowerment.[16]

[15] See, for example, Reusswig *et al.* (2016).

[16] For more details on CRE in Scotland, see, e.g., Haggett *et al.* (2013) and Van Veelen (2017).

Figure 8 – Berka (2017): Development of installed community energy capacity over time and by organisation type (UK, Scotland included).



For CRE in the UK, 2010 represents a turning point as it is the year a feed-in tariff scheme for renewable energy was introduced. The scheme, together with tax incentives and public loans, proved very effective in stimulating RES investment, including CRE more specifically. In five years, between 2009 and 2014, the total amount of installed community-owned energy capacity almost quadrupled, from 28MW to 105MW (Berka, 2017). Mainly thanks to the feed-in tariff, reduced investment risk meant that more diversified financial resources became available, urban RES cooperatives made their appearance as well as new shared ownership arrangements. The importance attributed to energy communities is also testified by an ambitious Community Energy Strategy that the government published in 2014 (DECC, 2014). This phase of substantial growth of CRE, however, came to an end in 2015 when a new (conservative) government deeply reformed RES support reducing the applicability of the feed-in tariff and preferring other instruments (renewables obligations and contracts for difference) suited to large-scale projects. CRE continues to be supported in Scotland, but its future in the UK remains uncertain.

4.2 Recurring institutional factors

It emerges from the literature that, in several countries, some specific contextual factors have played a very important role (both positively and negatively) in the evolution of CRE. We recall three that fall into the category of institutional factors and which seem particularly relevant to us today, as EU countries are working on the implementation of the Clean Energy Package. First, CRE needs a policy framework that is sufficiently supportive. Since typically (almost by definition) CRE projects are smaller in terms of generation capacity than purely commercial projects, the former cannot compete with the latter if economic efficiency of production is the only level of competition. For this reason, auction-based support schemes are normally inaccessible for CRE projects. In addition, very often, especially in the beginning, CRE projects encounter funding difficulties. Therefore, forms of support that make it possible to reduce the riskiness of investments are very useful for gathering sufficient resources. For both reasons, feed-in tariffs have proven to be the most effective type of support scheme for CRE projects. Second, local authorities, if they see development opportunities in CRE projects, play a key role in facilitating their dissemination. Collaboration by local authorities with initiators of CRE projects can be of different types and more or less close in nature, but in any case it presupposes that those authorities have sufficient knowledge regarding the energy sector. In many countries, however, local authorities are no longer directly involved in the sector (often as a result of privatisation processes) or have never been so. This can be an obstacle to ambitious development of CRE. Third, as long as recognition of the public value of CRE remains confined to part of the political spectrum, the future of CRE remains uncertain because changes of government can be reflected in reforms of the energy policy framework which, as experience shows, can be very penalizing for CRE. Clearly, we are talking about something – the significance of the role of CRE – that is the result of a continuous and complex process which involves political and economic views, interests of incumbents and innovators in the energy sector, and dynamics within society.

5 Societal impacts

The development of CRE has implications for traditional energy markets, it is expected to have effects on the sectorial and local economies, as well as on the levels of support for renewable energy and citizens' environmental awareness in general. The assessment of these societal impacts of CRE (i.e., affecting society and economy including and beyond the members of a RES community) is central for defining the appropriate regulatory framework and policy support that fits best its development while at the same time reducing related costs and risks (Berka *et al*., 2017). Until now, the literature has mostly examined the general assumptions that CRE fosters local economic development, strengthens the acceptance of renewable energy, and increases people's environmental awareness. However, as concluded by Berka and Creamer (2018) – which is, to our knowledge, the most exhaustive review on the societal impacts of CRE to date –, the existing evidence on CRE's impacts is "*relatively weak and demonstrates considerable variability across case studies*"; in addition, it "*may be biased towards positive impacts*". Moreover, most research is based on case studies, which often include interviews, surveys or different theoretical frameworks. Interesting correlations can be found, but conclusions are usually drawn based on correlations rather than causal effects.

Depending on the stakeholders, there are "*different understandings of what a benefit is and who the beneficiaries should be*" (Rudolph *et al.*, 2018). The type of community is also an element that will make the impacts differ. Notably, communities of place usually have stronger local economic impacts than communities of interest, which tend to be more widespread or less value driven. Moreover, the statute and type of legal entity chosen both can determine the degree of acceptability of RES projects, by defining the internal participative governance, and can have an impact on the local economy by mandating the use of profits for financing specific common goods. In this regard, RES cooperatives tend to be more successful than private-citizen partnerships. In general, policies that prioritise higher levels of local ownership are associated with stronger positive impacts on local economic development (Lantz and Tegen, 2009).

5.1 Impacts on the local economy and the energy system

One way CRE projects tend to differ from those by traditional players is their higher upfront costs: as grassroot, sometimes non-professional organisations, they can face limited trust from other market players and, above all, their projects can be perceived as being economically riskier. CRE projects often rely on external service providers for technical, economic, legal and financial expertise which they lack internally. Moreover, while their participative governance strengthens internal support for strategic decisions, it usually comes at the expense of lengthier decision-making processes than in traditional and non-participative private entities. This, in turn, also can lead to higher risks as compared to those of traditional players and, therefore, to more costly project development phases. On the other hand, if members accept lower hurdle rates (i.e. minimum returns) for their investment, and if they encounter less opposition through more often successful planning processes, this can significantly reduce the overall cost of the projects (Berka *et al*., 2017).

A good understanding of the different direct costs and their variability based on local ownership is crucial when reviewing the impacts of CRE. While CRE projects have higher direct costs, these may be compensated by their positive impacts, albeit indirect and harder to quantify, on the surrounding communities, on the environment and on the members themselves. Using a computable general equilibrium model calibrated to a specially constructed social accounting matrix for North East Scotland, Phimister and Roberts (2012) show that without any local ownership, the wind energy sector may have a positive effect on GDP in rural areas, but not on household incomes. CRE projects are often associated with an increase in local jobs and economic development. While traditional incumbents are likely to rely on inhouse expertise for renewable energy projects, CRE initiatives are more prone to make use of local suppliers and technicians for expertise that they are lacking internally. For example, for wind energy projects in the US, a study has found that the construction-period impacts are as much as 3.1 times higher for community wind, and operations-period impacts are as much as 1.8 times higher in terms of jobs created and economic benefits as compared to privately-owned plants (Lantz and Tegen, 2009). The local benefits manifest themselves in the form of return on investments for members, jobs creation, and redistribution of revenues. Although research has proven direct effects on household income and welfare, especially in rural areas, these revenues generated locally are not always sufficient for a wider positive spill-over in the rest of the economy, as consumption of goods leaks out most of the benefits (Phimister and Roberts, 2012). Sometimes, especially when the mission of a CRE project goes beyond RES development and financial gain, the revenues are used to finance public goods, including education and social care, housing and culture, or may be used to finance energy savings investments and services (Berka and Creamer, 2018; Musall and Kruik, 2011).

The development of CRE also affects the energy system. In a review of the impacts of CRE on the energy system, McKenna (2018) presents CRE as a manifestation of an increasingly decentralised system. Notably, the distribution grid is not only "*the end of the pipe*" but also dispatches local energy production, thus becoming the core component of local energy supply (smart grids, collective self-consumption). In that context, some research argues that participants in CRE may aim for their energy autonomy, typically defined as generating enough energy to meet the demand of the members on an annual basis (Schumacher *et al*., 2019, McKenna, 2018). However, there is sometimes confusion between the will to be supplied with green energy and the presumed will to be independent from the grid, which research should clarify. McKenna argues that this trend towards autonomy could have far-reaching consequences for how energy markets are structured. As CRE initiatives become more numerous, this development would also impact the financing of the public grid, which traditionally has relied on contributions based on the amount of energy taken from the grid by network users.

Overall, considering the political weight carried by CRE, which is challenging the current competitive paradigm of the energy sector, research should arguably act as a myth buster and examine more thoroughly some of the possibly overly positive and negative impacts of CRE. Notably, while many positive impacts need to be confirmed, some questions raised by the alleged tendency towards energy autonomy should also be better understood, in particular how they contradict and relate with values of solidarity and inclusion that often drive CRE. CRE development is expected to impact grid financing, energy flows and market structures and, not least, final costs for consumers and taxpayers. However, research could explore how and under what conditions CRE could play a positive role for demand response, market participation, tackling fuel poverty and providing decentralised flexibility to the grid.

5.2 Impacts on social acceptance of the energy transition

There is a key expectation that CRE fosters local social acceptance of renewable energy. The literature has indeed primarily focused on this type of impact, aiming to understand how CRE could help overcome resistance to renewable energy projects at the local level. Surveys often find positive correlations between the development of CRE and support for local renewable energy (Musall and Kuik, 2011, Fast, 2013, Schumacher *et al*., 2019), a trend that is particularly significant for communities of place (as opposed to communities of interest) (Bauwens and Devine-Wright, 2018). As noted by Fast (2013), in his review of social acceptance from a geographical perspective, scientific articles usually start "with an opening paragraph that will mention and dismiss this formerly pervasive" NIMBY concept (Not-In-My-Back-Yard is the trend of people opposing a planned project for being too close to their home, but potentially accepting it if located elsewhere). NIMBY is considered by the more recent research as too simplistic – binary, in the sense of support and opposition – and too judgmental over the motivations of oppositions. Most studies today analyse the correlation between acceptance of renewable energy and CRE using the concepts of "community acceptance", "socio-political acceptance" or "market acceptance", usually confirming the assumption that CRE supports renewable energy development. Following Schumacher *et al.* (2019), the socio-political acceptance refers to the institutional acceptance of renewable energy technologies by key stakeholders and public opinion. The community acceptance refers to the acceptance of renewable energy plants by local stakeholders directly affected, whereas the market acceptance is intended as the acceptance of certain technologies in the market and their diffusion within the consumers community.

Table 4 – Schumacher *et al.* (2019): Examples of stakeholder roles by social acceptance dimension.

	Acceptance dimension		
Stakeholder	**Socio-political**	**Community**	**Market**
Public	Citizen, general public	Resident	Consumer, prosumer, investor
Government	Regulator, policy actor, legislative authority	Local authority	Regulator, policy actor, taxing and subsidizing authorities
Companies	Industry association, lobbying group, focal company	Focal company, investor, operator, supplier	Producer, distributor, investor, network operator, intra-firm adopter
Other	NGOs, media	Local interest groups, local clubs, local media	Consumer interest groups

Most of the literature under consideration is focused on wind projects, which raises questions as to whether wind energy is intrinsically more contentious than biomass or solar based energy or only more often developed at a large corporate scale – notes Fast (2013). Schumacher *et al*. (2019) administered a survey on public acceptance for a set of technologies in three sub-regions of the Upper Rhine region, deriving dataset that comprises 495 German, 501 French, and 493 Swiss inhabitants. The authors find that public acceptance is highly dependent on the type of technology (e.g., opposition is greater for biomass and wind than for large solar, and only minimal for smaller solar plants). Moreover, it is found that personal experience in renewable energy, such as already living in the proximity of a plant or (co-)ownership of a local plant, are associated with increased social acceptance. Distance-decay frames also help to understand local acceptance (Fast, 2013), though sometimes people living closest to an installation are in fact the most supportive (Musall and Kuik, 2011). More broadly, CRE impacts vary according to the geographical scope considered in the analysis. The way people relate to their territory also plays a role in how much they support or oppose a project. Some studies find differences in acceptance between established locals, who tend to be more supportive, and newcomers, who fear renewable energy projects may disrupt their imagined idyllic landscape (Fast, 2013). Conversely, Johansen and Emborg (2018) find that second house owners tend to be more positive toward such projects than residents.

Interestingly, comparing the opinion of 320 residents of Zschadraß (Germany), where a CRE wind initiative existed, and the neighboring town Nossen, where a traditional corporation built a wind farm, Musall and Kuik (2011) find that the CRE project in Zschadraß led to a higher level of acceptance not only towards the installed wind farm but also towards wind energy in general. Indeed, it has been confirmed by other studies that CRE tends to make citizens more supportive of public policies and trends in favour of renewable energy and climate action (Bauwens and Devine-Wright, 2018, Schumacher *et al*., 2019). Generally, this socio-political type of acceptance of renewable energy tends to be higher than local (community) acceptance.

Nevertheless, the positive relationship between CRE and acceptance for the energy transition does not guarantee that opposition to renewable energy projects completely and easily disappears. Johansen and Emborg (2018) explore the perception of the Danish wind co-ownership scheme (WCS) whereby 20% of overall ownership shares of (certain) wind projects must be offered to local citizens. The authors conducted a survey on almost 2000 respondents during the Danish near-shore bid for tender, in 2015, where a WCS was considered. They found that investors in co-ownership schemes had in general specific demographic features, more financial liquidity and were already supportive of wind energy prior to that. On the other hand, opponents to wind energy in principle refrained from engaging in such schemes. Moreover, the authors found that economic benefits, potentially gained via the wind energy community scheme in Denmark, did not compensate for the "*quality of life feared lost due to the wind farms*" and are sometimes seen as bribery by local opponents. It would thus appear that the possibility to actually change the perceptions of opponents towards renewable energy is limited.

5.3 Impacts on energy-related behaviours

Membership in a RES community can impact individuals' behaviours as energy active consumers and as citizens. Bauwens and Eyre (2017) conducted a survey on 3988 members of the Belgian cooperative *Ecopower*, comparing them to a group with similar sociodemographic characteristics drawn from the national population, to understand the specificities of the members in terms of energy use. Using probit regression analysis, the authors find electricity consumption to be positively correlated with membership in the cooperative. Crucially, the difference is most likely explained by self-selection, whereby people who consume more energy have a stronger reason to join a RES cooperative, rather than a causal effect of joining the cooperative (to establish this, specific methods for causal analysis would have been needed). Accordingly, it is concluded that results suggest high use consumers have greater incentives to join a community-based organization which provides assistance and advice on the adoption of green technologies and energy efficiency measures. More specifically on energy savings, Hoppe *et al*. (2019) investigated the predictive value of RES cooperatives on their intention to save energy, engagement in energy-saving actions, and self-reported energy conservation. The analysis involves multivariate logistic regressions on data from surveys with the members of two cooperatives: *Ecopower* (Belgium; N = 1000) and *Enercoop* (France; N = 8290). In the results of their survey for *Enercoop* and *Ecopower*, respectively 38.7% and 64.7% of respondents indicated saving more energy since joining the cooperative, whereas 18% and 37% of respondents attributed their energy savings to services and advice provided by their cooperatives. Also, performing a t-test between members of *Enercoop* and supporters of *Enercoop* who are not members but receive its newsletter, Hoppe *et al.* (2019) find that the former engage more proactively in energy saving behaviours compared to the latter.

Some interesting results are found by Roth *et al*. (2018) regarding energy flexibility. Based on a survey with 2143 respondents in Germany and using propensity score matching techniques, the stated willingness of (co-)owners of renewable energy installations to adjust their demand is compared with that of non-owners. The authors identify a statistically significant effect on the willingness to operate demand-side flexibility matching electricity demand to production. In particular, consumers participating in collective self-consumption schemes or similar CRE projects, in which they can choose between consuming and selling their production, were found to be more open to provide flexibility.

Other studies show further factors that influence energy behaviour. For example, with reference to a RES cooperative, the length of membership and the presence of peers as fellow members are positively related to energy savings (Hoppe *et al.*, 2018). Beyond the individual level, CRE members have also a higher level of interpersonal trust and network, which is usually both a precondition and an outcome of the membership (Bauwens and Eyre, 2017; Berka and Creamer, 2018). This sense of community can be correlated to energy savings, meaning that CRE may create a positive social environment for their members to mutually motivate each other to reduce their energy consumption (Hoppe *et al*., 2018).

According to Berka and Creamer (2018), there is considerable evidence that active participation in CRE projects can also facilitate the development of knowledge and skills across a range of areas (e.g. energy technologies, project management, communication, business development, finance and law). These skills, however, are mainly acquired by project leaders.

While there is some evidence that local energy projects empower communities to collectively change their social, economic and technical contexts, this certainly needs further investigation (Berka and Creamer, 2018). In general, a better understanding of the impact of the membership on individual behaviour is needed. Future research would ideally assess causal effects of CRE membership on changes in people's habits, opinions and energy-related behaviours.

6 Conclusions

The goal of this literature review was to gain a sound understanding of the phenomenon of RES communities. Accordingly, the review has been structured into four topics deemed particularly important: the identification of RES communities as entities with certain characteristics, the motivations that lead citizens to found a RES community or to take part in one that already exists, the contextual factors contributing to determine the birth and development of a RES community and, finally, the impacts of RES communities on society.

Establishing what RES communities are is not a trivial exercise because they come in many forms: they often carry out multiple activities, have multiple objectives, their members are subjects with different interests, they can be limited to a more or less wide geographical area, they use different technologies, have different legal forms and therefore different forms of governance, etc. The relevance of this question becomes very concrete when legal definitions need to be established. A key element on which consensus appears to be broadest is that the members of a RES community are not only the recipients of potential benefits generated by a CRE project, but are also co-owners of the project and so can – and ideally would – participate in the decisions about it. By contrast, consensus is less broad over other defining elements, such as those relating to a) the geographical scope of a community (a related distinction being that between *communities of place* and *communities of interest*), b) the orientation of the community with respect to profits generation (the question being whether genuine RES communities may only be not-for-profit), and c) the possible roles of local authorities and businesses in CRE projects. The scientific literature usually recognises these differences without offering normative indications. By so doing, however, it provides valuable input for the development of legal definitions, which have to set precise limits. For example, Van Veelen (2017) points out the differences in the definitions of RES communities adopted by the Scottish and UK governments. Namely, the former only consider energy generation by not-for-profit local groups as community energy, whereas the latter also includes projects focused on energy demand and distribution, as well as communities of interest in their definition.

A typical feature of RES communities is the multiplicity of their statutory objectives and, as a reflection of that, the multiplicity of their members' own motivations for founding or joining a RES community. The objectives most frequently pursued through CRE projects concern the protection of the environment and the climate, the realisation of economic gains for the members (most often, but not exclusively, energy cost savings), energy autonomy (i.e. the control of choices regarding energy production and consumption), and the development of the local economy. The literature investigating the purposes of RES communities (or specific CRE projects) focuses on the individual motivations of community members. The emphasis is on diversity and dynamics whereby the prevalence of one motivation over others varies a) *between communities*, depending on their specific nature, b) *within communities*, given the heterogeneity of their members, and c) *over time*, depending on how communities evolve. With regard to the last point, a relevant example is the expansion of a community's activity from electricity production alone to electricity supply. With this step, many new people join the community as consumers (rather than as producers) who may have different prevailing motivations compared to previous community members. In general, while the salient aspect of the motivations is their multiplicity, environmental motivations appear to be most common in the studies examined. Focusing on RES communities established in the last twenty years, *climate protection* emerges as the prevailing environmental motivation. Furthermore, some studies reveal the positive role of social psychology aspects which, for example, concern the enjoyment derived from trusted social interactions and from adhering to a common project.

The contextual factors that can contribute to determining the birth and evolution of RES communities are many and diverse. They can be classified into physical-, technology-, institutional- and community factors. The literature review focuses on the last two types of factors. Some robust conclusions can be drawn based on the history of many specific CRE projects or of the CRE sector in several European countries. A conclusion very often emphasised is that CRE needs a policy framework which is sufficiently supportive and stable. Adequate policy support would imply the recognition of public value also in small-sized projects or even in the specific role played by RES communities. Support policies such as feed-in tariffs for small-sized projects or tenders only for CRE projects are indeed justified on the basis of such recognition. A stable policy and regulatory framework, however, implies that the same recognition of the role of communities is not limited to a part of the political spectrum. In this sense, becoming mainstream is a desirable scenario for RES communities. Secondly, local authorities can play a key role in facilitating the dissemination of RES communities. However, they would need to have some experience in the energy sector: whether such experience is there may depend on the historical development of the energy system, else it would need to be acquired. Similarly, specific skills within the community are needed to start and manage a CRE project. Furthermore, a RES community is more likely to be established and thrive in the presence of trust in the wider hosting society.

CRE projects impact society including and beyond the corresponding RES communities. The literature review has focused on societal impacts that concern the local economy, the energy system, the acceptance of the energy transition and the energy-related behaviour of individuals participating in CRE projects. Understanding such effects is central especially for designing appropriate supportive policies. Despite the importance of the topic, however, quite limited research appears to have been conducted to date. Most available studies involve case studies, often including interviews or surveys, but with sophisticated statistical analyses only few and far between. Based on current evidence, it can be said that CRE projects tend to have positive impacts on the local economy and jobs, but the nature and significance of these impacts depend on the specific type of community. Being part of the wider trend towards increasing decentralisation of the energy system, CRE is expected to have significant effects on the system and especially on electricity distribution networks. Further analysis, however, is needed to determine the extent of the positive and negative effects in question. By contrast, research results more clearly back the expectation that CRE increases local acceptance of renewable energy and general support for climate action and renewable energy. Furthermore, membership in CRE projects tends to be positively correlated with more energy-efficient behaviour, increased knowledge and skills as well as to some extent to stronger social trust and capital. Arguably, the main limitations of this body of literature are in the scarcity of causal econometric analyses (correlation is not causation) and too little attention devoted to potentially undesirable effects. Most likely, research on societal impacts of CRE will be of growing interest in the future.

References

Bauwens, T. (2016), *Explaining the diversity of motivations behind community renewable energy*, Energy Policy, 93, 278-290.

Bauwens, T. (2019), *Analyzing the determinants of the size of investments by community renewable energy members: findings and policy implications for Flanders*, Energy Policy, 129, 841-852.

Bauwens, T. and P. Devine-Wright (2018), *Positive energies? An empirical study of community energy participation and attitudes to renewable energy,* Energy Policy, 118, 612–625.

Bauwens, T. and N. Eyre (2017), *Exploring the links between community-based governance and sustainable energy use: Quantitative evidence from Flanders*, Ecological Economics, 137, 163–172.

Bauwens, T., Gotchev, B. and L. Holstenkamp (2016), *What drives the development of community energy in Europe? The case of wind power cooperatives*, Energy Research and Social Science, 13, 136-147.

Becker, S. and C. Kunze (2014), *Transcending community energy: collective and politically motivated projects in renewable energy (CPE) across Europe*, People, Place and Policy, 8(3), 180-191.

Berka, A. (2017), *Community renewable energy in the UK: a short history*, in: Holstenkamp, L. and J. Radtke (eds.), *Handbuch Energiewende und Partizipation*, Springer VS, Wiesbaden.

Berka, A. and E. Creamer (2018), *Taking stock of the local impacts of community owned renewable energy: A review and research agenda*, Renewable and Sustainable Energy Reviews, 82(3), 3400-3419.

Berka, A., Harnmeijer, J., Roberts, D., Phimister, E. and J. Msika (2017), *A comparative analysis of the costs of onshore wind energy: Is there a case for community-specific policy support?,* Energy Policy, 106, 394–403.

Boon, F.P. and C. Dieperink (2014), *Local civil society based renewable energy organisations in the Netherlands: exploring the factors that stimulate their emergence and development*, Energy Policy, 69, 297-307.

Borzaga, C., Galera, G., Franchini, B., Chiomento, S., Nogales, R., and C. Carini (2020), *Social enterprises and their ecosystems in Europe – Comparative synthesis report*, Publications Office of the European Union, Luxembourg.

Candelise, C. and G. Ruggieri (2020), *Status and evolution of the community energy sector in Italy*, Energies, 13, 1888.

Capellán-Pérez, I., Campos-Celador, A. and J. Terés-Zubiaga (2018), *Renewable energy cooperatives as an instrument towards the energy transition in Spain*, Energy Policy, 123, 215-229.

Creamer, E., Aiken, G.T., van Veelen, B., Walker, G. and P. Devine-Wright (2019), *Community renewable energy: what does it do? Walker and Devine-Wright (2008) ten years later,* Energy Research and Social Science, 57, 101223.

DECC (2014), *Community Energy Strategy: Full report*, Department of Energy and Climate Change.

Devine-Wright, P. (2019), *Community versus local energy in a context of climate emergency*, Nature Energy, 4, 894-896.

Dóci, G. and E. Vasileiadou (2015), *“Let’s do it ourselves” Individual motivations for investing in renewables at community level*, Renewable and Sustainable Energy Reviews, 49, 41-50.

Fast, S. (2013), *Social Acceptance of Renewable Energy: Trends, Concepts, and Geographies,* Geography Compass, 7/12, 853–866.

Fleiβ, E., Hatzl, S., Seebauer, S. and A. Posch (2017), *Money, not morale: the impact of desires and beliefs on private investment in photovoltaic citizen participation initiatives*, Journal of Cleaner Production, 141, 920-927.

Grunewald, P., Hamilton, J., Mayne, R. and K. Beaudry (2014), *How community energy initiatives generate and distribute value*, BEHAVE Energy Conference, 3rd-4th September 2014, Oxford.

Gui, E.M. and I. MacGill (2018), *Typology of future clean energy communities: an exploratory structure, opportunities, and challenges*, Energy Research and Social Science, 35, 94-107.

Haggett, C., Creamer, E., Harnmeijer, J., Parsons, M. and E. Bomberg (2013), *Community energy in Scotland: the social factors for success*, University of Edinburgh.

Heras-Saizarbitoria, I., Sáez, L., Allur, E. and J. Morandeira (2018), *The emergence of renewable energy cooperatives in Spain: A review*, Renewable and Sustainable Energy Reviews, 94, 1036-1043.

Hicks, J. and N. Ison (2018), *An exploration of the boundaries of ‘community’ in community renewable energy projects: Navigating between motivations and context*, Energy Policy, 113, 523-534.

Hielscher, S., Seyfang, G., Smith, A., (2013), *Grassroots innovations for sustainable energy: exploring niche development processes among community energy initiatives*, In: Cohen, M., Brown, H., and P. Vergragt (eds.), *Innovations in sustainable consumption: new economics, socio-technical transitions, and social practices*, Edward Elgar.

Holstenkamp, L. and F. Kahla (2016), *What are community energy companies trying to accomplish? An empirical investigation of investment motives in the German case*, Energy Policy, 97, 112-122.

Hoicka, C.E. and J.L. MacArthur (2018), *From tip to toes: Mapping community energy models in Canada and New Zealand*, Energy Policy, 121, 162-174.

Hoppe T., Coenen, F. and M. Bekendam (2019), *Renewable Energy Cooperatives as a Stimulating Factor in Household Energy Savings,* Energies, 12, 1188.

Huybrechts, B. and S. Mertens (2014), *The relevance of the cooperative model in the field of renewable energy*, Annals of Public and Cooperative Economics, 85(2), 193-212.

Johansen, K. and J. Emborg (2018), *Wind farm acceptance for sale? Evidence from the Danish wind farm co-ownership scheme*, Energy Policy, 117, 413-422.

Kalkbrenner, B. and J. Roosen (2016), *Citizens’ willingness to participate in local renewable energy projects: the role of community and trust in Germany*, Energy Research and Social Science, 13, 60-70.

Koirala, B.P., Araghi, Y., Kroesen, M., Ghorbani, A., Hakvoort, R.A. and P.M. Herder (2018), *Trust, awareness, and independence: insights from a socio-psychological factor analysis of citizen knowledge and participation in community energy systems*, Energy Research and Social Science, 38, 33-40.

Kooij, H.J., Oteman, M., Veenman, S., Sperling, K., Magnusson, D., Palm, J. and F. Hvelplund (2018), *Between grassroots and treetops: Community power and institutional dependence in the renewable* *energy sector in Denmark, Sweden and the Netherlands*, Energy Research and Social Science, 37, 52-64.

Lantz, E. and S. Tegen (2009), *Economic Development Impacts of Community Wind Projects: A Review and Empirical Evaluation*, Conference Paper (Pre print), WINDPOWER 2009 Conference and Exhibition Chicago, Illinois, National Renewable Energy Laboratory, NREL/CP-500-45555.

Lowitzsch, J. (ed.) (2019), *Energy transition: financing consumer co-ownership in renewables*, Palgrave Macmillan, Cham.

Lowitzsch, J. and F. Hanke (2019), *Renewable energy cooperatives*, in: Lowitzsch, J. (ed.), *Energy transition: financing consumer co-ownership in renewables*, Palgrave Macmillan, Cham.

Magnani, N. and G. Osti (2016), *Does civil society matter? Challenges and strategies of grassroots initiatives in Italy's energy transition*, Energy Research and Social Science, 13, 148-157.

Magnusson, D. and J. Palm (2019), *Come together - The development of Swedish energy communities*, Sustainability, 11, 1056.

Maruyama, Y., Nishikido, M., and T. Iida (2007), *The rise of community wind power in Japan: enhanced acceptance through social innovation*, Energy Policy, 35, 2761-2769.

McKenna, R. (2018), *The double-edged sword of decentralized energy autonomy*, Energy Policy, 113, 747–750.

Mignon, I. and A. Rüdinger (2016), *The impact of systemic factors on the development of cooperative projects within renewable electricity production - An international comparison*, Renewable and Sustainable Energy Reviews, 65, 478-488.

Moroni, S., Alberti, V., Antoniucci, V. and A. Bisello (2019), *Energy communities in the transition to a low-carbon future: A taxonomical approach and some policy dilemmas*, Journal of Environmental Management, 236, 45-53.

Morris, C. and A. Jungjohann (2016), *Energy democracy - Germany's Energiewende to renewables*, Palgrave Macmillan, Basingstoke.

Musall, F. and O. Kuik (2011), *Local acceptance of renewable energy—A case study from southeast Germany*, Energy Policy, 39, 3252–3260.

OFGEM (2016), *Local energy in a transforming energy system*, OFGEM Future Insights Series, Office of Gas and Electricity Markets (UK), London.

Oteman, M., Wiering, M. and J.K. Helderman (2014), *The institutional space of community initiatives for renewable energy: a comparative case study of the Netherlands, Germany and Denmark*, Energy, Sustainability and Society, 4(11).

Oteman, M., Kooij, H.J. and M.A. Wiering (2017), *Pioneering renewable energy in an economic energy policy system: the history and development of Dutch grassroots initiatives*, Sustainability, 9, 550.

Phimister, E. and D. Roberts (2012), *The Role of Ownership in Determining the Rural Economic Benefits of On-shore Wind Farms*, Journal of Agricultural Economics, 63(2), 331–360.

Radtke, J. (2014), *A closer look inside collaborative action: civic engagement and participation in community energy initiatives*, People, Place and Policy, 8(3), 235-248.

Reusswig, F., Braun, F., Heger, I., Ludewig, T., Eichenauer, E., and W. Lass (2016), *Against the wind: local opposition to the German Energiewende*, Utilities Policy, 41, 214-227.

Roberts, J., Bodman, F. and R. Rybski (2014), *Community power: model legal frameworks for citizen-owned renewable energy,* ClientEarth, London.

Rogers, J.C., Simmons, E.A., Convery, I. and A. Weatherall (2008), *Public perceptions of opportunities for community-based renewable energy projects*, Energy Policy, 36(11), 4217-4226.

Romero-Rubio, C. and J.R. de Andrés Dìaz (2015), *Sustainable energy communities: a study contrasting Spain and Germany*, Energy Policy, 85, 397-409.

Roth, L., Lowitzsch, J., Yildiz, Ö. and A. Hashani (2018), *Does (Co-)ownership in renewables matter for an electricity consumer's demand flexibility? Empirical evidence from Germany*, Energy Research and Social Science, 46, 169–182.

Rudolph, D., Haggett, C. and M. Aitken (2018), *Community benefits from offshore renewables: The relationship between different understandings of impact, community, and benefit*, Environment and Planning C: Politics and Space, 36(1), 92–117.

Ruggiero, S., Isakovic, A., Busch, H., Auvinen, K. and F. Faller (2019), *Developing a joint perspective on community energy: best practices and challenges in the Baltic Sea region*, Co2mmunity Working Paper 2.3, Lund University.

Schumacher, K., Krones, F., McKenna, R. and F. Schultmann (2019), *Public acceptance of renewable energies and energy autonomy: A comparative study in the French, German and Swiss Upper Rhine region*, Energy Policy, 126, 315–332.

Seyfang, G., Park, J.J., and A. Smith (2013), *A thousand flowers blooming? An examination of community energy in the UK*, Energy Policy, 61, 977-989.

Seyfang, G., Hielscher, S., Hargreaves, T., Martiskainen, M. and A. Smith (2014), *A grassroots sustainable energy niche? Reflections on community energy in the UK*, Environmental Innovation and Societal Transitions, 13, 21-44.

Szulecki, K. (2018), *Conceptualizing energy democracy*, Environmental Politics, 27(1), 21-41.

Toke, D. (2002), *Wind power in UK and Denmark: can rational choice help explain different outcomes?*, Environmental Politics, 11(4), 83-100.

van der Schoor, C. and L.J.R. Scholtens (2019), *Scientific approaches of community energy – A literature review*, Centre for Energy Economics Research, CEER Policy Papers 6, University of Groningen, The Netherlands.

van Veelen, B. (2017), *Making sense of the Scottish community energy sector - An organising typology*, Scottish Geographical Journal, 133(1), 1-20.

van Veelen, B. and D. van der Horst (2018), *What is energy democracy? Connecting social science energy research and political theory*, Energy Research and Social Science, 46, 19-28.

Walker, G. (2011), *The role for "community" in carbon governance*, WIRESs Climate Change, 2(5), 777-782.

Walker, G. and P. Devine-Wright (2008), *Community renewable energy: what should it mean?*, Energy Policy, 36, 497-500.

Wierling, A., Schwanitz, V.J., Zeiß, J.P., Bout, C., Candelise, C., Gilcrease, W. and J.S. Gregg (2018), *Statistical evidence on the role of energy cooperatives for the energy transition in European countries*, Sustainability, 10, 3339.

Yildiz, Ö, Gotchev, B., Holstenkamp, L., Müller, J.R., Radtke, J. and L. Welle (2019), *Consumer (co-) ownership in renewables in Germany*, In: Lowitzsch, J. (ed.), *Energy transition: financing consumer co-ownership in renewables*, Palgrave Macmillan, Cham

Yildiz, Ö., Rommel, J., Debor, S., Holstenkamp, L., Mey, F., Müller, J.R., Radtke, J. and J. Rognli (2015), *Renewable energy cooperatives as gatekeepers or facilitators? Recent developments in Germany and a multidisciplinary research agenda*, Energy Research and Social Science, 6, 59-73.

2

Case studies

1 Introduction

This chapter presents three case studies on RES communities in Europe. Case studies are a popular and useful form of investigation for RES communities. These being a varied and evolving phenomenon, "approaching the magnifying glass", which is what case studies do, can help a great deal to better understand it. The selection of our three case studies presented in this chapter was informed by three main criteria, namely, the cases needed to cover: a) different types of RES communities; b) different maturity levels of the communities or of their activities; and c) different national contexts. Accordingly, the case studies conducted concern, in this order, the Italian cooperative *ènostra*, collective self-consumption in France, and an EU-funded innovation project called *WiseGRID*.

ènostra is a representative example of the modern cooperative model of RES communities (Huybrechts and Mertens, 2014) and the most significant of its kind in Italy.[1] The main innovative element of modern RES cooperatives (in Europe, traditional electric cooperatives have a history that begins as early as the end of the 19th century) is in the objectives that they pursue. These involve attaining benefits not only for their members through the provision of energy services or investment opportunities, but also for the wider society with public goods such as reduced GHG emissions, energy education, increased social capital, etc.[2] Collective self-consumption (CSC) is a new way of collectively producing and consuming electricity which, if properly accommodated in the electricity system and supported, could result in the emergence of many local RES communities and generate potentially significant societal benefits. The French context is a suitable and interesting one in which to observe the emergence of the CSC model, as in France CSC has been the subject of intense public debate and relevant legislation has already been produced. Finally, the *WiseGRID* innovation project and, in particular the Ghent pilot site (Belgium) on which we focus, opens a window on the future of the electricity system as imagined and put into practice by the RES cooperatives that lead the project.

The three case studies are similar with respect to the methodology used. Specifically, each of them has two parts: the first describing the study subject (using information that is almost entirely publicly available) and the second presenting interviews with two or three experts on various issues related to the same topic. The interviews are important in our investigation, as they allow us to gather useful insights and thereby to get a more complete picture than it would be possible otherwise. The questions posed in the interviews partly reflect the themes of the literature on RES communities reviewed in Chapter 1 and, at the same time, are thought to acquire useful data for the conceptualization of RES communities and the related possible future scenarios elaborated in Chapter 3.

The rest of the chapter is structured as follows. Sections 2, 3 and 4 present the case studies on *ènostra*, CSC in France and the *WiseGRID* project, respectively. Section 5 concludes.

---

[1] Other studies that have considered *ènostra* as a case study are Magnani and Osti (2016) and Candelise and Ruggieri (2020).

[2] On modern cooperatives, see Chapter 1, Section 2.3.

2 Case I: *ènostra* - Italy's main RES cooperative

2.1 Illustration of *ènostra*

ènostra is the first national not-for-profit and democratic supplier of electricity from renewable energy sources (hereafter, RES electricity) in Italy.[3] Firmly grounded on ethical values, the cooperative aims at contributing to a just energy transition by producing and selling RES electricity as well as by providing energy efficiency services – these are its core activities. *ènostra* was founded in 2014, but its actual origin dates back to 2008 when *Retenergie*, a small RES cooperative based in Piedmont, in the northwest of Italy, started producing electricity. *Retenergie* participated in the foundation of *ènostra* and, a few years later, the two cooperatives were merged. The resulting cooperative, for which the name *ènostra* was kept, is both a producer and consumer cooperative. Accordingly, *ènostra* today represents and promotes the role, the strength and the rights of RES producers, self-consumers and active customers. At the time of writing (January 2020), *ènostra* counts about 6000 members and, in terms of energy volumes, it sold 13.5 GWh in 2019 (+56% compared to 2018). The cooperative capital is about €1.9m and social lending, also by its members, is about €1.2m. Although *ènostra*'s number of members and contracts has constantly increased, electricity is still supplied at a loss. The break-even is close to be reached as it is estimated at around 6500 supply contracts. Expectations are that the cooperative will grow substantially in the next few years.

Table 1 – *ènostra*: number of members, contracts and volumes of sold electricity (2015-2019).

	2015	2016	2017	2018	2019
Members	324	819	1662	4372*	≈ 5900
Supply contracts	-	890	1963	3271	≈ 4900
Energy sold (MWh)	-	1271	4270	8642	13542

* After the merger with *Retenergie*.

Further details about *ènostra*'s history, its purpose and business model, its governance and its members, are given below.

2.1.1 History

Antecedents: Retenergie

Created in 2008, by 13 founding members, the aim of the cooperative *Retenergie* was, as stated in its statute, to *"contribute to a new economy based on the principles of environmental sustainability, sobriety and solidarity"* by promoting production and supply of RES electricity as well as energy efficiency services. In its first five years, *Retenergie* installed seven rooftop photovoltaic systems and, in 2015, it acquired two additional photovoltaic plants. It was a national initiative organised in territorial nodes in order to facilitate the development of local projects. About 70% of the total investment in the power plants was financed through contributions by the cooperative members and other citizens, the remaining 30% being covered by a loan from *Banca Etica*. Said contributions could take two forms: people could buy equity of the cooperative capital (€500 was the minimum share) or they could finance the cooperative through social lending. After the termination of the feed-in-tariff scheme (*Conto Energia*) for new photovoltaic plants, in 2013, *Retenergie* managed to expand its activity by realising, in 2015, a wind power project, specifically a 60 kW turbine in Sardinia, and the energy retrofit of a building in Vicenza (a former public nursery school, now used by a local social cooperative).

Establishment and milestones

The Intelligent Energy Europe (IEE) project *RESCoop 20-20-20* (2012-2015) was developed with the aim of replicating the success stories of RES cooperatives in countries where those did not yet exist. In

[3] www.enostra.it

2012, *Avanzi*, a company promoting social innovation and the main Italian project partner, organised a workshop with all the actors involved in community energy experiences in Italy (not only cooperatives). That event was the beginning of the development of a RES cooperative supplying electricity, which was a missing actor in the Italian landscape. *ènostra* was then founded in 2014 and promoted by *Avanzi*, *Retenergie* and *EnergoClub*, an association promoting grassroot initiatives for the energy transition, as a deliverable of *RESCoop 20-20-20*. The following year, *ènostra* joined *REScoop.eu*[4], the European federation of RES cooperatives, and in March 2016 it started delivering, at the national level, RES electricity to households and SMEs, with special tariffs offered to not-for-profit organisations. The merger with *Retenergie*, thanks to which *ènostra* can sell to its members electricity generated by its own plants, was completed in late 2018.

2.1.2 Purpose and business model

Purpose

As a cooperative, *ènostra* has a general mutualistic purpose to provide goods and services in the most favourable way to its members. Its mission, however, is broader than that: *ènostra* aims at contributing to developing a sustainable, democratic, participated, cooperative and resilient energy model based solely on renewable sources. All of this clearly is in the interest of the wider society, including and beyond the cooperative members. The pursuit of such goal involves multiple activities carried out by the cooperative:

- production of RES electricity;
- trading of RES electricity;
- provision of energy efficiency services;
- capacity building (technical trainings);
- energy education and organisation of awareness-raising campaigns;
- participation in research projects.

Business model

Since the merger with *Retenergie*, the energy community of *ènostra* has stood on three pillars: production, supply and energy efficiency services. *ènostra*'s own production of RES electricity currently covers around 15% of its members' consumption and it is financed mainly by its members' investments. At the time of writing, the projects at the most advanced stage of development are a wind turbine (500 kW) and a photovoltaic plant (840 kW), both located in Puglia (southern Italy). For the medium term, it is an objective of *ènostra* to develop a 1 to 2 MW wind turbine project in order to further increase the share of self-production. This is an ambitious plan considering the size of the cooperative, so it needs time to be completed. In addition, the cooperative is planning to develop ten smaller photovoltaic plants, of about 250 kW each, within two years. These new plants will produce electricity that will be partially consumed on site, while the rest will be sold by the cooperative to its members all over the country. Projects of the latter type have three main advantages:

- they are relatively simple to develop, as normally they do not involve complex authorization processes;
- they can provide electricity at network parity, which means they do not need subsidies;
- given their relatively small size, they can be at least partially financed by local actors interested in the positive effects induced by the project, thus helping the growth of the cooperative.

The electricity supplied by *ènostra* to its members is only partially self-produced. The part that is not self-produced is sourced in two ways. First, electricity is sourced via bilateral agreements with selected generators. To ensure that this electricity is sustainable and ethical, *ènostra* has developed a tool (with the supervision and validation of a scientific committee) assessing the suitability of the power

[4] www.rescoop.eu

plants. A matrix of sustainability criteria is applied to photovoltaic, wind and hydro plants to be selected as well as to the company profile of the owners. For example, excluded from consideration are photovoltaic systems subtracting land for agricultural use as well as any plant whose owner is involved in fossil fuel power production or has economic interests in fossil fuels (thus encouraging a divestment approach). Moreover, the matrix is geared in favour of collective and socially accepted plants. Second, electricity is purchased on the wholesale market with Guarantees of Origin, so that 100% of the electricity sold by the cooperative is renewable. For *ènostra*, one of the main issues in these first years of activity is that about 80% of the electricity it sells to its members comes from the market. This means that the above-said sustainability matrix only applies to 20% of the electricity sold (corresponding to energy from *ènostra*'s own plants and the other few selected ones). The objective is to close the gap by 2021.

The third pillar of the community is the provision of energy efficiency services. Any member of the cooperative can ask for technical assistance with a view to improving the energy efficiency of their own household or business. Energy audit, renewal of thermal plants, thermal insulation and installation of photovoltaic systems, are some examples of the services provided by *ènostra* through its network of technicians. When a cooperative member asks for assistance, the coordinator of the network identifies the technician or company that will deliver the service, depending on the geographic location and availability. Each technician or company of the network is also a member of the cooperative and is in direct contact with the coordinator and the other members of the network. Every year a training is organised which is also useful as a team building activity. The technicians regularly use a dedicated mailing list to share experiences and ask for advice ("Is that product working properly?", "What would you do in this situation?", "How should I interpret the law?", etc.).

An additional important activity of the cooperative is its participation in EU-funded research and innovation projects. *ènostra* itself was established as a deliverable of an IEE project and has participated in other relevant ones such as *RESCoop PLUS* and *ASSET*. Moreover, *ènostra* has been shareholder in a company developing kite generators and, importantly, it is currently developing the first on-field test experience of local energy community (a collective self-consumption operation) in Italy (Padua).

2.1.3 Governance and members

Governance

The cooperative is currently led by a board of seven members (they were five before) elected at the 2019 general assembly. The president, the vice president and a third member of the board are founding members of *ènostra*. The other four new members were selected in consideration of their professional experiences, covering different areas of interest for the strategic development of the cooperative. Specifically, they are a lawyer with long experience in the energy sector, a fund manager in the renewable sector, the technical manager of an energy service company, and a journalist and communication manager.

Today, a challenge for the cooperative is to keep striking the right balance between effective participation of its members to the decision-making process, on the one hand, and the efficient role of the board, which needs to take its own responsibilities, on the other. In the annual general assembly, of course all cooperative members can participate and vote (in person or online) on the most relevant matters concerning the cooperative. Besides, steps have been taken to foster participation from a community that is increasing in size. Notably, in Spring 2019, a survey was administered to all cooperative members to collect the information needed to develop a plan for participation. The type of information sought related to questions like: Are the members interested in participating to the decision making process? Which instruments are favoured by the members? Which issues should be investigated with the participation process? What are members willing to do for the cooperative? etc. One thousand people responded to the survey and exactly half of them expressed no interest in the participation making process. A plan for participation was then developed on the basis of the answers provided by the 500 people (about 10% of the total number of members, back then) interested in greater participation. The plan consists of two national meetings on complex issues (e.g., values and instruments, development strategy) and two to three web-based surveys on specific issues.

Members

In the Italian electricity market, *ènostra* appears to have a comparative advantage in being perceived as a trustworthy and transparent supplier. The service "stop to frauds" – a collection of experiences and related suggestions on how to deal with possible illegal or manipulative practices by electricity suppliers – and the advisory services offered to incoming members are two examples of the dialogue with the community which also marks a difference with traditional energy providers. Increasingly, the cooperative is building strong networks with similar organisations and a variety of local and national media partners sharing a common vision. Thanks to their experiences and the synergies developed with them, *ènostra* is planning big steps forward to the benefit of its community. The cooperative already provides consultancy energy efficiency services, which range from energy certification, to the design and implementation of technical interventions (on the heating system, insulation and renewable integration), to the documentation needed to obtain fiscal incentives. In addition, new projects currently in their initial phase concern the offer of a special rate for the recharge of electric vehicles and participation in a collective self-consumption operation.

2.2. Interviews with the leaders

This section reports the content of the interviews with Sara Capuzzo and Gianluca Ruggieri, respectively president and vice-president of *ènostra*. The interviews were carried out separately, but asking them the same questions. As the interviewees turned out not to express conflicting views, but rather complementary ones, it was decided to consolidate their answers into a single text.[5]

Who are the founders of *ènostra* and what were their motivations for creating the cooperative?

ènostra is a product of *REScoop 20-20-20*[6], a European project which also led to the creation of other organisations such as *REScoop.eu*, the European federation of RES cooperatives, and *Coopérnico*[7], a RES cooperative in Portugal. *ènostra* was founded in 2014, following a workshop that brought together about 40 people active in the area of community renewable energy in northern Italy. The founders of *ènostra* are four legal entities: *Avanzi*[8], a company promoting social innovation; *EnergoClub*[9], a non-profit association promoting grassroot initiatives for the energy transition; *Retenergie*, a RES production cooperative; and *ForGreen*[10], a RES production company, which however left within a year or so as being interested in pursuing a more business-oriented activity. Most of the initiators were between 35 and 50 years old. They tended to be highly educated, with degrees in engineering, social and natural sciences, and with a strong personal interest in topics related to society, the environment and ethics. Only one of the first five board members was a woman, but otherwise gender balance has always been good among the wider staff.

The challenge for us was creating something that did not yet exist in Italy: a cooperative selling electricity. The goal was – still is – to contribute to reducing the environmental impact of electricity production and consumption in Italy by increasing the share of renewables in the national energy mix. While mainly animated by environmental and other value-based motivations, we also wanted to establish an economically sustainable activity (though not-for-profit), not a charity or association. It did not take us long to realise, also observing analogous experiences in Europe, that we needed to expand our activity from only selling RES electricity to also producing it. Indeed, we realised that you can only hope to make an impact on the energy system if you contribute to production. This is the rationale for the subsequent merger with *Retenergie*, which had been producing (but not selling to end-users) RES electricity since 2008.

[5] The interviews took place in April 2019.
[6] https://ec.europa.eu/energy/intelligent/projects/en/projects/rescoop-20-20-20
[7] www.coopernico.org
[8] www.avanzi.org
[9] www.energoclub.org
[10] www.forgreen.it

What are the socio-demographics of *ènostra*'s members and their motivations for joining the cooperative? Has there been an evolution over the years? Have many members left the cooperative?

There are four main categories of members and related motivations: 1) people from ethical purchasing groups, thus primarily motivated by ethical consumerism; 2) environmental activists; 3) people interested in social innovation; and 4) people interested in technological innovation in renewables and energy efficiency. Over the years, however, a growing number of people have joined the cooperative not only for idealistic reasons, but also with the hope to derive some economic gains. While *ènostra*'s electricity prices are not particularly competitive in that they are aligned to those of the Italian default tariff for residential customers (*Maggior tutela*), the additional services offered to our members may be more clearly attractive. Also, last year, we observed that many people new to the cooperative contributed to our crowdfunding for a new windmill in southern Italy. So far, very few people have left *ènostra*, not more than a few dozens in total, and usually for personal reasons rather than dissatisfaction with the cooperative.

Our members are prevailingly middle-aged, concentrated in the area of Milan and in northern Italy more generally. We have no information on their economic status, but we sense that there is not a prevalence of high-income or low-income households. The same applies for their education level. By contrast, there seems to be a prevalence of members with leftist worldviews, as reflected in their strong sensitivity to issues relating to social justice, human rights, etc., but this has never translated in any official position or statement by the cooperative on specific political questions.

What contextual factors favoured the birth of *ènostra*? Has the development of the cooperative been influenced by any exogenous factor?

ènostra was created at a difficult time for the renewables sector in Italy, just after the termination of the main feed-in-tariff scheme for photovoltaic generation. Paradoxically, however, the lack of policy support was a trigger for the birth of *ènostra*. Without feed-in tariffs, we had to be more ambitious than we could have afforded to be otherwise. This means that it would only make economic sense to attempt starting a cooperative with, say, 5000 members rather than 30 or 50. Indeed, in Italy, most small collective RES producers comparable to *Retenergie* barely survived those years. Subsequently, regulatory uncertainty, regarding, e.g., the exact rules for accessing public support and various authorisation processes, has been the main exogenous factor having a negative impact on the cooperative. If you are in the renewables sector in Italy, you need to be able to cope with regulatory uncertainty and adapt to contingencies.

What are the main costs and benefits of joining the cooperative?

Costs of membership are minimal. The cost of becoming a member of *ènostra* is €50, which is the value of two of its shares (returned if and when the person leaves the cooperative). Electricity supply contracts with *ènostra* are activated together with the membership of the cooperative. As already said, *ènostra*'s electricity prices are aligned to those of the Italian default tariff for residential customers. Concerning the benefits, firstly, it is our ambition to offer in the future lower electricity prices to our members as a function of the growth of the cooperative, once standing economic losses are fully recovered. Secondly, our members can avail of economically convenient consulting services for their own investments in energy efficiency or photovoltaic generation (note that the cooperative has a margin on these services, which means energy efficiency improvements are in its own interest). Some discounts tied to specific commercial partnerships are offered too. Importantly, *ènostra* gives all citizens the opportunity to directly participate in the energy transition. Finally, the cooperative carries out activities that also bring benefits to the broader community. For example, it has started delivering training courses for social operators targeting energy poverty as well as awareness raising campaigns on climate change.

What are the costs and benefits of *ènostra* for society?

The value of *ènostra* for society is high. We promote a model that safeguards the final consumer, increases renewable energy, facilitates active consumption and self-consumption, and helps those who have difficulty paying their electricity bills. We are of course a very small actor in the Italian system, as we make up less than 0.01% of total electricity sales. However, we manage to exert a positive influence on bigger actors, pushing them to revise their business models. Importantly, we are able to engage with associations or other organisations that oppose new RES projects in their proximity and to agree with them on alternative solutions. We thus contribute accelerating the energy transition through increased social acceptance of RES projects with reduced undesirable effects on the local environment. We can do this thanks to our credibility and the patience of our investors, as it does make a difference whether you need to ensure a 2-4% return on investment or a 10% return.[11] We also contribute to accelerating the transition through our consulting services and hopefully, as soon as the relevant regulation is fully defined, by facilitating the birth of local renewable energy communities.

What are the main challenges that you have faced so far?
Many and diverse challenges have been encountered over the years. Starting from scratch was not easy. The learning curve was very steep at the beginning, as none of us had ever sold electricity before or had professional experience in many of the related activities, such as issuing bills or taking out social loans. As an electricity supplier, we must comply with many legal and bureaucratic obligations (despite the exemptions accorded to small suppliers). Much volunteering work and generosity were needed to get the whole thing started. Financially, the cooperative was initially endowed with a capital of €6000 from the founding organisations and some additional funds from *REScoop 20-20-20*. And it was not until 2016, with the sale of electricity, that we started to have revenues – we expect to finally break even in 2020. Coordination of all the activities carried out by the cooperative has proved challenging too, especially during phases of sustained growth in the number of members.

How does *ènostra* compare with similar organisations in Europe? Has anything been missing for matching the success of, say, *Ecopower* or *SOM Energia*?
Though it is only a few years older than *ènostra*, *SOM Energia*[12] has been for us a model to follow, a guiding light. Today, the Catalan cooperative has as many as 65000 members. Initially they relied entirely on volunteering work and have been exceptionally good at making the cooperative grow and managing it well through the transition. *SOM Energia* was created in response to a sudden stop to incentives for renewable energy in Spain and in close connection with the Catalan political context. Indeed, their politicization both characterises the cooperative and is a factor of its success.[13] By contrast, *ènostra* did not have a particularly favourable political context nor has it ever had a specific political orientation.

That of *Ecopower*[14] is also a very successful story. We do not know as much about the genesis of *Ecopower*, but a strong cooperative culture in Belgium, stronger than in Italy, especially these days, was of help. Compared to other similar cooperatives, a peculiar characteristic of *ènostra* is its broad ethical approach (extending beyond the concern for the environment), whereby, for example, we do not consider producing or selling electricity from photovoltaic plants on agricultural land or from windmills not welcome by local communities.

Over the next five to ten years, what types of RES community models are likely to thrive and how do you see *ènostra* developing?
High expectations are on local renewable energy communities, notably those taking the form of collective self-consumption operations. In principle, if it can be demonstrated that collective self-consumption operations reduce transmission costs, then they should be entitled to reduced network tariffs. Under this condition (again, to be proved), there is a massive potential for largely autonomous areas producing, storing and distributing electricity, with a new role for DSOs. While being a national actor, *ènostra* will act as an enabler of energy citizens and local communities in renewable production and collective self-consumption initiatives. However, we observe major actors pushing in the direction of different models.

As concerns *ènostra*'s prospects, our hope is to grow very strongly in the volumes of sold and self-generated electricity, but also in the services offered and visibility. Today, about 20% of the

[11] References to the economic patience of investors in community research projects are somewhat frequent in the literature (see, e.g., Boon and Dieperink, 2014).
[12] www.somenergia.coop
[13] The case of *Som Energia* is described in Pellicer-Sifres *et al.* (2018) and Capellán-Pérez *et al*. (2018).
[14] Information on *Ecopower* is provided in Section 4.1.1 below.

electricity we sell is either produced by us or by our selected partners (the rest being bought on the wholesale market with a guarantee of origin). We would like to increase this 20% share up to 100% by 2021. Also, we would like *ènostra* to become a second-level cooperative, meaning one that facilitates other cooperatives and RES communities coming to life and thriving. In expectation of this expansion of our activities, *ènostra*'s executive board has been enlarged (from five to seven members), bringing in new competences and experimenting a more efficient way of working while preserving our values and identity.

Exogenous factors that may have positive or negative consequences for the fulfilment of our ambitions include, firstly, the transposition of the Clean Energy Package into national legislation and, secondly, the phase-out of the Italian default tariff for residential customers, as many customers will have to choose a new supplier and might then decide to join *ènostra*.

Do you see any risk for RES communities in the transposition of the Clean Energy Package into national legislation?

The Clean Energy Package potentially offers major opportunities for RES communities and the wider energy system, but there are risks as well. Notably, there is a risk that too many constraints are imposed, starting from the legal definition of a RES community (something that has to be finalised by the Member States), which would have the effect of hindering related investments. On the other hand, too lax a definition would be problematic too. We saw it two years ago, in Germany, how such flaw could seriously penalise RES communities. On that occasion, there was a call for tenders for installing new wind capacity in which community projects would be prioritised. 45 out of 46 of the winning bids were community projects according to the rules of the tender. As it turned out, however, the vast majority of those projects were in fact not led by genuine communities. Clearly, this should not happen again.

3. Case II: collective self-consumption in France

3.1 Illustration of collective self-consumption and the French context

Self-consumption is the act of consuming on the spot all or part of the energy produced. It can be limited to a single site of production and consumption, in which case it is referred to as individual self-consumption, or – in its collective variant – it can involve a plurality of consumers located in the same building, on the same street or even in the same neighbourhood, depending on the scale allowed. While individual self-consumption is a well-established model, collective self-consumption (CSC) is a more recent concept. In the past few years, it has attracted much attention because of its potential societal benefits, which mainly would be attained by its improving the efficiency of the electricity system (more specifically, this is an energy system benefit) while also mobilising investments in renewable energy.

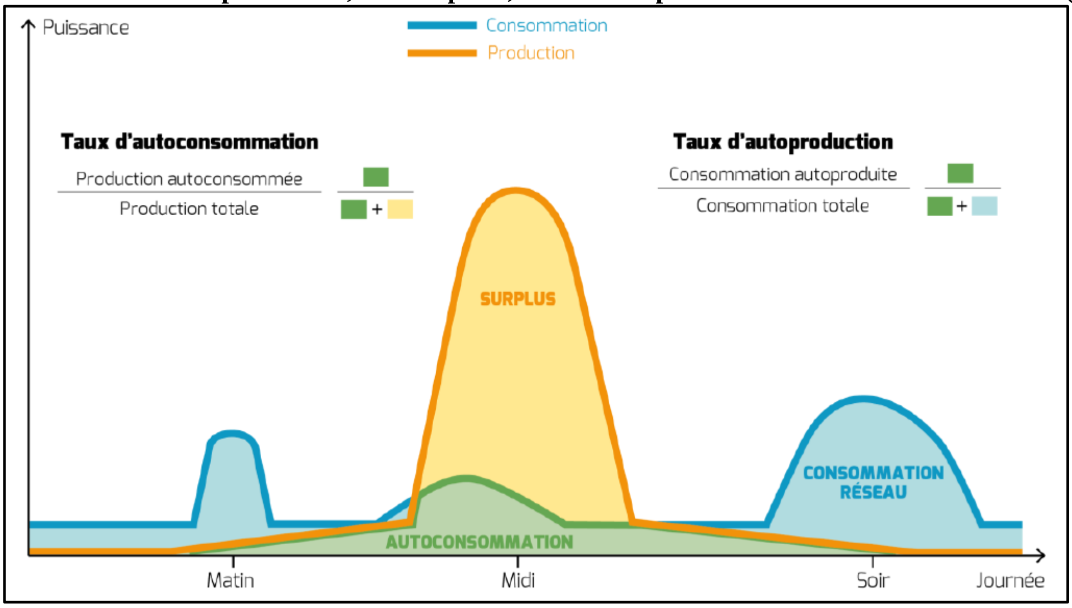
Until recently not even allowed in most European countries, CSC has been introduced at the EU level by the Clean Energy Package through the definitions of *jointly acting renewable self-consumers*, in the Renewable Energy Directive, and *jointly acting active customers*, in the Electricity Market Directive. It is now up to the Member States to specify the terms of CSC in their jurisdictions (Campos *et al*., 2020; Frieden *et al*., 2019). In France, however, a lively public debate on CSC already started a few years ago, the regulatory framework is now well developed and, after a slow start, many CSC projects are under way.

The CSC model has implications for the activities of almost all actors of the electricity system: consumers, producers, DSOs, suppliers, aggregators. From the policymaker perspective, accommodating the CSC model in the electricity system raises challenges. For example, relevant questions concern: a) setting the maximum scope allowed of CSC operations; b) defining cost-reflective network tariffs (i.e. reflecting the impact of CSC on the operation and development of the public electricity network) in conformity with existing tariffication principles); c) choosing appropriate ways for promoting the CSC model; and d) preserving existing consumers' rights (CEER, 2019). Indeed, the development of CSC strongly depends on policy and regulatory choices. Other factors, of course, may also play a role. These can be as disparate as the cost of batteries (storage), the future evolution of electricity prices, and citizens' willingness to take direct action in sustainable energy models.

3.1.1 Economic model

In general, the economic model of CSC, just as that of individual self-consumption, is based on maximising the self-consumption rate, that is, the share of energy produced that is also locally consumed. The fundamental difference between the models of individual self-consumption and CSC is that in the second, self-consumers as a group, by virtue of their plurality and diversity in terms of consumption profiles, can attain higher self-consumption rates. This would be the mere result of adding together different load curves, but then – by so doing – CSC itself could encourage further synchronisation of cumulative consumption and production flows within the operation. For these reasons, CSC is a particularly interesting option for settings that involve consumers with different consumption patterns. One of many possible examples would be residential buildings and school buildings.

Figure 3.1 – Patterns of production, consumption, self-consumption for residential self-consumers (PV).



Source: *CRE* (2017).

Apart from the possibility offered by CSC to increase self-consumption rates (in the way explained), the key variables for the economic convenience of the CSC model are the following:

a) the cost of producing electricity, which in the case of renewable energy is essentially an investment cost;
b) the sale price of surplus electricity (and possible related subsidies);
c) the tariffs and taxes applied to self-consumed electricity; and
d) the price of purchased electricity (taxes and tariffs included).

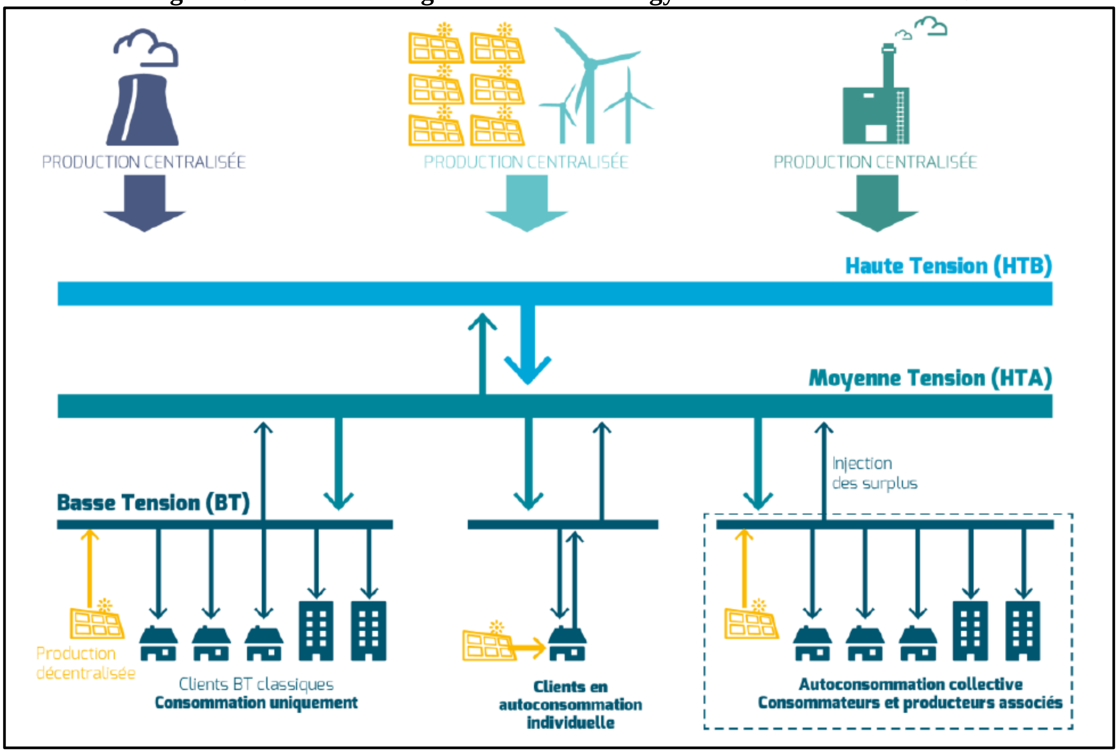
The last two variables are particularly relevant in that, together with the rate of self-consumption, they determine the economic savings achieved. Importantly, in a CSC operation, self-consumed energy may transit through the public network (it certainly does in the French case) and, if so, it is normally expected to contribute to its financing. On the other hand, there are valid arguments for which tariffs and taxes applied to self-consumed energy should be lower than standard rates (see Section 3.1.2). Indeed, tariffs and taxes on self-consumed energy are often critical for the economic convenience of a CSC operation. Not surprisingly, then, what they should be is a question typically at the core of the public debate.

Last but not least, in a CSC operation, the volume of self-consumed energy ascribed to each self-consumer depends on the time frame set by regulation and on the agreed formula for allocating electricity production among all participants. In France, for example, the time frame corresponds to 30-minute intervals. Given the time frame, the formula chosen for allocating production may be static or dynamic, the latter usually requiring precise knowledge of consumption patterns and large amounts of data, as it would vary on the basis of minutes, hours, days and seasons. At the other end of the spectrum, the simplest option is to allocate production among participants in fixed parts based on consumption or investment in the installation.

3.1.2 Implications for the electricity system

From the perspective of the electricity system, the diffusion of CSC operations integrated in the public network has implications that in part are simply those of increased distributed generation; namely, increasing energy volumes flowing from the low voltage network to higher voltage branches. In addition, the CSC model encourages the shift of consumption loads over time so as to maximize self-consumption rates. This means that the transport of energy in the network would be reduced, thus increasing the efficiency of the system via lower energy losses. Also, in the long term, this could mean limiting the development of the network (in particular at the transmission level), thus generating potentially important savings.[15] Despite the relevance of the issue, however, studies that provide quantitative estimates of such savings are still only few. Furthermore, compared to individual self-consumption, larger plants serving multiple self-consumers entail lower unit generation costs and hence scale economies. These are the benefits that the CSC model is supposed to bring to the electricity system.

Figure 3.2 - Distributed generation and energy flows across the network.



Source: *CRE* (2017).

The impact of CSC on the use and development of the network is directly relevant to regulation because network tariffs are supposed to reflect said benefits. Network tariffs are an important component of electricity costs and, as we have seen (Section 3.1.1), taxes and tariffs applied to self-consumed energy are key determinants of the economic convenience of the CSC model. There is therefore a need to determine appropriate network tariffs – a task typically entrusted to national regulatory authorities (CEER, 2020).[16] Closely related to this question are two others which also have implications for the electricity system and, more generally, for society. The first is that, in the face of

[15] The bigger the impact of CSC on the maximum required capacity of the network, the bigger the savings.

[16] For details concerning the setting of cost-reflective distribution network tariffs, see Schittekatte and Meeus (2020).

reduced network tariffs on self-consumed energy, the recovery of fixed network costs may result in increased tariffs for other network users, depending on whether and how the whole system of network tariffs is reformed. The concern is that excessive extra costs could be borne by consumers not participating in CSC operations. This would be problematic for equity reasons, as people for whom electricity costs are already heavier (in relative income terms) would likely be in that group (Schittekatte *et al*., 2018). The second question, not independent of the previous one, is what forms of support to offer for the development of CSC and how to finance them.

3.1.3 The French context

Legal definition

In France, the legal and regulatory framework for CSC is relatively recent and comprehensive, yet it has already been amended multiple times. Mandated by the Energy Transition for Green Growth Act, the framework for CSC was first drafted by Order n° 2016-1019 and then amended by Law n° 2017-227 and more recently by Law n° 2019-1147 "on Energy and Climate". A CSC operation is currently defined as

"the supply of electricity between one or more producers and one or more final consumers bound together within a legal entity whereby input and output metering points are located within the same building or multi-apartment block. A collective self-consumption operation can be described as extended when the supply of electricity is made between one or more producers and one or more final consumers bound together within a legal entity whose input and output metering points are located on the low voltage network and abide to criteria, including geographical proximity".

Thus, the law provides for two categories of CSC operations. One matches the definition of "jointly acting renewables self-consumers" introduced by the Renewable Energy Directive (RED II): a CSC operation is a local supply of energy within the perimeter of a building or a multi-apartment block. The other allows for a more flexible CSC configuration that it is not bound by the network's ramification. In this "extended" category, the CSC operation must be connected to the low voltage network of a unique DSO and abide to a set of criteria, including geographical proximity. These criteria have then been translated in the following constraints: a maximum perimeter corresponding to a circle with a maximum 2 Km diameter connecting the two furthest participants (producer or consumer) and a maximum generation capacity of 3 MW (0.5 MW for islands).

Actors involved

By French law, there must be a legal entity that gathers together the participants (consumers and producers) in a CSC operation. This is a requirement in France, but in other countries, like Germany, an agreement between the participants in a CSC operation is sufficient. The legal entity could be of any kind: it could be, say, a private company, a cooperative or a registered association. With the new provisions included in Law n°2019-1147, social housing organisations also can arrange CSC schemes for the tenants and play the role of the legal entity (tenants being free to opt-out of the CSC scheme anytime). The primary role of the legal entity is to notify the DSO of the apportionment of self-produced electricity among the consumers (see Section 3.1.1). Each participant in a CSC operation must be equipped with a smart meter (most commonly *Linky*[17]) to monitor their electricity flows, and any storage facility is treated equally: as a consumption point when charging and as a production point when discharging.

In a CSC operation, beyond the legal entity just described and the individual participants in the operation, the other actors involved are the DSO, the energy suppliers and the aggregators. In a CSC operation, the DSO manages the network, which in France must be public, and is in charge of data collection. It collects data for each production site and each consumption point, as well as the general balance to define self-produced, self-consumed, dispatched and consumed electricity. The DSO thus

[17] *Linky* is a smart meter deployed by the DSO *Enedis* which will allow for closer consumption data monitoring and remote control. By 2021, over 35 million *Linky* meters will be installed.

plays a key role connecting producers and consumers through the public network. As any final consumer, each self-consumer can choose any supplier (as mandated by EU legislation) to satisfy their excess consumption, just as each producer can choose any aggregator to sell their excess production (or dispatch it into the network for free, if generation capacity is below 3 kWp).[18] For their part, suppliers are responsible for collecting all revenues from taxes and tariffs on both self-produced electricity and the extra electricity that they provide. Finally, aggregators are the entities that buy excess electricity from self-consumers, that is, the electricity that is not consumed locally. Suppliers themselves could also act as aggregators.

Public debate

In France, the electricity system is progressively moving away from the traditional model, based on large nuclear and fossil fuel power plants, to a more decentralised renewables-based one. CSC is part of this trend. The transformation of the electricity system, however, puts into question some of its historical defining features, such as the tariff equalisation principle, the scale economies offered by big national operators and the one-direction electricity flow with a stable permanent use of the public network. In recent years, the early development of CSC has raised a number of technical and related political questions that have become the object of public debate. Often this debate has been characterised by the contrast between two views. On the one hand, the view that recognises in the CSC model an opportunity for strengthening local communities and fostering the energy transition while helping consumers reduce their energy bills. On the other, the view that sees CSC advocates and participants as free-riders, eager to disconnect from the public network and create closed communities.

Behind these conflicting views there is the question of network tariffs, that is, whether and what special tariff regime should be granted to CSC operations. The question is relevant because, on the one hand, network tariffs are one of the key variables for the economic convenience of the CSC model, on the other, the same tariffs are used to recover the cost of the network: depending on how network tariffs are reformed and the network costs recovered, extra costs might fall on users who do not participate in CSC operations, thus raising an equity problem (Shittekatte, 2020).[19] The national regulatory authority was then tasked to define an optional network tariff for (both individual and) collective self-consumers. The result has been a special tariff with the following characteristics: a) a lower volumetric charge on self-consumed energy, b) a higher volumetric charge on the energy provided by the supplier (i.e., electricity consumed in excess of self-production), and c) a higher fixed charge (for the extra data-related work carried out by the DSO). So far, however, nobody (or at least almost nobody) seems to have opted for this special rate.

Another debated issue concerns the allowed geographical scope of CSC operations. Initially, the legislation limited the extension of a CSC operation to the part of the public network downstream of a low voltage transformer public substation. This physical constraint has been the subject of discussion because it limits the possibility of optimizing a CSC operation in the sense of maximizing the self-consumption rate. Subsequently, the physical constraint of the network was overcome by allowing a maximum distance of 2 Km between the most distant participants as well as a maximum generation capacity of 3 MW. This more flexible criterion, which allows for further possible configurations, opens up new opportunities for CSC operations. In general, for the policymaker, the challenge in delimiting the scope of CSC is to strike a balance between allowing CSC operations over larger areas, so as to include as many and diverse participants as possible, and minimising their impact on the operation of the electricity system.[20]

[18] Other countries have chosen different approaches. In Germany, for example, rather than being fully monitored by the DSO, the part of the network used in a CSC operation is leased to a collective group and one supplier takes over the supply for all consumers.

[19] Open editorials have been published stressing the concern that CSC and energy communities may worsen energy poverty (Derdevet and Mazzucchi, 2019).

[20] CSC operations benefit from a specific treatment, with fewer rights and obligations than suppliers, but the more they increase in size, the more their impact needs to be taken into account in designing network tariffs and local supply rules.

Finally, until CSC reaches grid parity[21], its model will not be economically viable without some form of dedicated support. Broadly speaking, two main alternatives for support exist. On the one hand, implicit support would be offered through tax breaks or potentially through reduced network tariffs (not fully cost-reflective) on self-consumed electricity; on the other, direct support would be offered through ad-hoc instruments such as feed-in tariffs or premia, competitive tenders or investment grants. Indirect support is simple to provide, but difficult to assess, plus it could lead to distortions in the efficient use of resources if not well designed and monitored. Direct support, by contrast, allows a more harmonious development through targets and specific support schemes.[22] Many stakeholders have called for indirect support, simple to put in place and without any direct (and hence salient) cost to society – what still would leave non-CSC participants or all taxpayers (in the case of tax exemptions) sharing the collective cost. Conversely, forms of direct support seem to be preferred by the Ministry of Energy. At present, electricity production and dispatch in CSC operations are not automatically eligible for feed-in or premium tariffs, but specific self-consumption settings, including multiple consumers in the same building, cadastral plot or activity site can compete in support tenders targeted at self-consumption operations between 100 kW and 1 MW. Their intrinsic limitations, however, lower their chances of winning against individual self-consumption operations, which in general benefit from more incentives and a simpler framework. The winners of the tenders are granted a feed-in premium on the electricity produced, with a bonus for self-consumed electricity.

3.2 Interviews with experts

This section reports the content of the interviews with three experts, Eugénie Bardin (*Enercoop*[23]), Marc Gratton (*ENEDIS*[24]) and Basile Nicolsky (*Commission de Régulation de l'Énergie, CRE*[25]), who have closely followed the CSC debate in France. Consistent with the different roles of the respective organisations (RES cooperative, DSO and national regulatory authority) in CSC setups, their views offer a variety of perspectives on the issue.[26] In the Appendix to this chapter, the description of one of the first CSC pilot projects in France (*Partagélec*) provides concrete supporting evidence for many of the issues discussed in the interviews.

Is CSC an effective and efficient option for accelerating the energy transition? If yes, how should it be promoted?

Eugénie Bardin (EB): CSC is an effective option for accelerating the energy transition. CSC projects can be particularly effective in empowering citizens and local actors (notably SMEs and local authorities) through ownership of electricity production capacity and social ties. Yet, CSC in France remains niche because it is not economically convenient. Financial incentives need to be strengthened. Key is the remuneration of excess electricity injected into the network, which should be valued as much as self-consumed electricity. This would probably ensure that CSC operations remain integrated in the public network while also promoting CSC with third-party investment – a configuration incentivising both self-consumption and production beyond own consumption needs. As regards taxes and tariffs, we are certainly in favour of exemptions on local excise taxes, and also consider a) exemptions on the CSPE, which is the levy financing RES support schemes (among other things), and b) a revision of the CSC-specific TURPE (the new optional network tariff for CSC operations), notably, a reduction of the rate paid on withdrawn energy. Under no circumstances, however, should such measures result in a burden on consumers not participating in CSC operations.

Marc Gratton (MG): Under the current rules, CSC projects are usually not economically viable. Thus, as it stands, CSC does not seem cost-effective. CSC project developers are concerned about tax and

[21] A technology for electricity generation reaches grid parity when its levelized cost of electricity (the average net present cost of generation) is equal to or less than the full price of electricity from the network.
[22] This is also the view of European energy regulators, as expressed in CEER (2019).
[23] www.enercoop.fr
[24] www.enedis.fr
[25] www.cre.fr
[26] The interviews took place in July 2019, with few days in between.

tariff treatment, but a critical variable is also the perimeter of CSC operations. It does not represent a form of direct support, but it is a determinant of the maximum self-consumption rate that can be achieved, all the more important as getting a revenue from the sale of excess electricity is difficult. The *Loi Pacte* allowed experimenting on the maximum CSC perimeter, which is now a circle with a 1 Km radius (note that under previous rules, all consumers participating in a CSC operation had to be behind the same low voltage transformation station).

Basile Nicolsky (BN): CSC can be a cost-effective option inasmuch as it results in reduced expansion of the network and, therefore, reduced costs. The energy transition requires major investments in the network, so in theory this aspect of CSC is important. However, its actual significance must be demonstrated. At CRE we think that a network tariff specific to CSC should only reflect the network costs or benefits that can be related to CSC (e.g., the fact of consuming electricity when it is locally produced), but it should not be confused with support mechanisms. Of course, the government may want to promote CSC given its own policy objectives. In that case, we favour forms of direct policy support, such as tenders or feed-in tariffs, rather than indirect support, such as tax exemptions or special network charges, as the former are more controllable and minimise potential windfall effects. Tenders guarantee that financial support is allocated efficiently, whereas all producers benefit from tax exemptions regardless of their own profitability. Also, direct support can be signed for a fixed duration, whereas special fiscal treatment is not guaranteed to cover a project's whole life.

Do you have any concern about the diffusion of CSC?
EB: A risk is that CSC develops in the form of islands. Conversely, the development of CSC should stay integrated in the public network and conform to existing tariffication principles, including geographical equalisation. Network tariffs applied to self-consumers can be different from those applied to standard consumers, but the difference cannot be disproportionate. The argument of CSC detractors whereby differentiated network tariffs would result in excessively high electricity costs for consumers not participating in CSC operations is a false argument. Energy poverty depends on other factors that should be tackled, such as home insulation. In fact, as we have had the opportunity to observe, CSC can play a role in changing consumer behaviour, making people more attentive to how much electricity they consume.

MG: From the DSO perspective, no particular problems are foreseen. It will be the task of *ENEDIS* to make sure participants in CSC operations consume electricity from the network without any problem, meeting their expectations, and that all the consumer data are well protected.

BN: CSC raises different equity questions. Firstly, we need to make sure that consumers have the right to join or leave a CSC operation, so that they are able to protect themselves from the evolution of electricity prices and the partition of energy as determined by the administrator of the operation. Secondly, there is the question of setting fair network tariffs, not placing unjustifiable burdens on consumers that do not participate in a CSC operation.

Which actors in the electricity system will be most affected by CSC?
EB: DSOs have shown strong responsiveness to the topic, probably because historically the French electricity system is very much centralised. More interestingly, perhaps, also thanks to pilot projects in which *Enercoop* participates, we can clearly see CSC causing changes in the activity of energy suppliers. The role of suppliers in CSC operations is central, one that requires new types of interaction with other actors.

MG: DSOs are of course directly affected, as they need to make sure that things work as smoothly as possible. It is a technical and organisational challenge – *ENEDIS* might need a couple of years to fully meet such expectations. Suppliers are also affected. For example, as in a CSC operation each consumer keeps the right to choose her own supplier, suppliers need to know the difference between production and consumption levels. And aggregators will be affected too, for just as any other actor who is in charge of keeping the production-consumption balance, they need information on how the energy load is spread over time.

BN: DSOs are the first to be affected, as they need to put in place all the necessary contractual, billing and IT infrastructure. Then, consumers taking part to such operations will likely become more reactive in terms of demand response. In turn, this greater engagement of consumers will have implications for the activities of aggregators and suppliers, who are the main counterparts to consumers. Suppliers will be affected because of their balancing responsibility, while aggregators will have the opportunity to show the value of their activity.

How do you expect the diffusion of storage and blockchain to affect the development of CSC?
EB: The diffusion of storage can have a huge impact on the development of CSC, as it means excess electricity can be stored instead of being injected into the network. However, this should not be the objective of CSC development. In a sense, storage can be dangerous if it leads to isolated CSC operations. But I have no real expectations about such risk, that is, I wouldn't be able to somehow quantify it.

MG: Storage of course will help increase self-consumption rates – so, good for the profitability of CSC operations. However, it is to be regarded as complementary to CSC, as people will still need the network to ensure security and quality of power. Blockchain might play a role, but it is still not clear how exactly it could benefit CSC operations. *ENEDIS* is working with *Sunchain*[27] to understand under what conditions blockchain may change things, but there is no real evidence as yet. The role of blockchain will become clearer as CSC projects get bigger, with more participants involved. In such cases, you might need something like blockchain to secure the growing amount of transactions and facilitate scale economies.

BN: Storage can be the propeller for the added value of CSC by reducing peak demand and, thereby, network and generation costs. Blockchain could be used today to help share electricity among CSC participants. In the future, it might even offer an alternative to the traditional supplier scheme, allowing consumers to bypass suppliers. But this will of course depend also on the legal framework.

Today, in France, a key rule is the 1 Km radius delimiting the CSC perimeter. Is this parameter tight, lax or reasonable?
EB: The 1 Km radius seems reasonable. However, as already said, support for CSC remains insufficient.

MG: As DSO we are neutral about these rules. If tomorrow the CSC perimeter is changed, our task is to make things work. However, when it comes to network tariffs, it seems logical that they meet the general principles of tariffication and reflect the reality of the network – but this is in the regulator's hands. A CSC-specific network tariff was recently set, but it might be revised later on as currently there is no sufficient evidence on the impacts of CSC projects on the network. In any case, we need to wait and observe the many CSC projects that have just started or are about to start.

BN: Let me first specify that the 1 Km rule is accompanied by a 3 MW limit for the total power of a CSC operation. Also, it was not the regulator that set these parameters, but the ministry: CRE only has to formulate a non-binding assent. These criteria define an experimental framework until 2023 when it will be reviewed. Under previous rules, the entirety of a CSC operation had to be behind the same low-voltage transformation station. This arrangement was quite constraining, as two consumers could be on the same street but not behind the same transformation station. The new experimental rules allow more CSC operations to be developed and to find profitability. We at CRE do not have a position on what the radius or power limitation should be, as long as the development of CSC operations stays under control. CSC allows consumers to trade locally-produced electricity without being subject to retailing rules, which are there to protect consumers. If there were no geographical limits, it would effectively constitute retailing at large scale. The power limitation guarantees that the scale of CSC operations is not excessively large.

[27] www.sunchain.fr

CRE was tasked with setting a CSC-specific network tariff. With the previous definition of CSC (requiring participants to be behind the same transformation station), this was possible because the DSO could allocate its costs between the low and medium voltage branches of the network. Given the demand and production curves of CSC participants, it was then feasible to allocate those costs between energy flows produced locally, which only transit through low-voltage networks, and residual consumption coming from the higher voltage network. With the new definition of CSC, it is not possible to distinguish energy flows in the same way. This is why the optional rate should be available only to those CSC operations that meet the previous definition.

Several CSC pilots are under way in France. So far, what is the experience accumulated telling us?
EB: It is difficult to say with precision how many CSC pilot projects are under way in France, but certainly many more than a dozen, and the number is increasing quickly. In general, the experience so far has been positive. I am particularly familiar with that of *Partagélec*[28], in Penestin (Brittany), in which *Enercoop* is directly involved. There, in the capacity of aggregator, *Enercoop* buys excess electricity at a price higher than the prevailing market price, supporting the project in this way. Based on our experience, the development phase of these projects tends to be the most critical in terms of risks.

MG: The primary concern of CSC promoters is the financial viability of the projects. Especially small promoters, however, often complain about bureaucratic processes whereby, for example, they need to create a specific entity only to get the project started. For some, this is not trivial and takes time. The majority of current CSC projects were sponsored or launched by local authorities, which usually are better equipped to tackle these criticalities. But private projects exist too, and they will probably be much more numerous in the future. Real estate and social housing operators – major players interested in CSC – are already tailoring big projects, attracted by the possibilities offered by the 1-Km radius perimeter.

BN: We at CRE have not yet accumulated much practical experience. We observe, however, that no one so far has chosen the optional CSC-specific network tariff. I think that people have had difficulty understanding the differentiation between the rate applied to locally-produced energy flows, which is slightly lower than the base rate (as only the low-voltage network is involved), and the rate for flows that systematically come from higher voltage levels, which is slightly higher.

4 Case III: The *WiseGRID* project

4.1 Illustration of the *WiseGRID* Ghent pilot
WiseGRID is an innovation project funded by the EU under the Horizon 2020 programme.[29] It started in late 2016 and is due to end in April 2020. The project, which has a €17.6 million budget, is carried out by an international consortium of 21 partners. These include cooperatives active in the electricity sector, DSOs, technology and energy providers, legal advisors and research institutes based in Belgium, France, Italy, Germany, Greece, Spain, Romania and the UK. Coordinator is *ETRA I+D*, a Spanish company providing technologies for the areas of mobility, lighting, energy, security and communications. *WiseGRID*'s goal is to provide a set of solutions and technologies for increasing the smartness, stability and security of an open and consumer-centric European energy network. The project is one of several EU-funded projects for the future energy system with which information is shared but also some physical infrastructure (e.g., *NOBEL GRID*[30], *Elsa*[31], *Buurzame Stroom*[32]).

[28] The project is described in the Annex of this chapter.
[29] www.wisegrid.eu
[30] www.nobelgrid.eu
[31] www.elsa-h2020.eu
[32] www.buurzamestroom.energent.be

The project is conceptually organised in seven work areas, called Use Cases (UC), which correspond to different operational situations and needs of the future network and its users. They are as follows:

- UC1: Integration of distributed RES;
- UC2: Automation of decentralised network control;
- UC3: Integration of electric mobility with vehicle-to-network technology;
- UC4: Integration of battery storage at substation and prosumer levels;
- UC5: Integration of cogeneration in public buildings or collective housing;
- UC6: Technical and economic feasibility of aggregated management of distributed RES;
- UC7: Empowerment of citizens in the energy market and reduction of energy poverty.

WiseGRID will produce nine new tools, most of which are ICT tools, whose application will be central or auxiliary in the seven work areas above. Each tool does not serve all of the seven areas, but at least three of them and typically more than three. Crucially, the tools are applied in different real-world contexts so as to test their actual utility, net of contingencies related to local physical infrastructures, regulatory frameworks, social conditions, etc. The project comprises four large-scale pilot (or demonstration) sites across Europe, specifically, in Ghent (Belgium), Terni (Italy), Crevillent (Spain) and Kythnos (Greece).

In the Ghent pilot site, six *WiseGRID* tools are tested, some of which are of special interest to us as they are directly relevant to activities carried out by RES communities. With reference to all the tools tested in Ghent, they serve (to different degrees) five of the project's work areas: all except UC2 and UC5.

4.1.1 Site and actors

Site: location, citizens and infrastructure

Within the city of Ghent, the pilot site is more specifically situated in the Sint-Amandsberg district. This is a neighbourhood with a dense and rather heterogenous population, which includes students, young households, families with migration background, elderly people and vulnerable social groups with limited income. About 100 dwellings have taken part in the project as consumers of energy services (including mobility) or prosumers. Participation in the project was offered to all inhabitants and homeowners of Sint-Amandsberg. To carry out the project, participating households and businesses have been equipped with some ad-hoc infrastructure, which includes digital meters, roof photovoltaic plants (about 750 kW in total) and 5 household battery sets (6 kWh). Most photovoltaic plants had been installed as part of a community project called *Buurzame Stroom*, which partly overlapped with *WiseGrid* and with which collaboration and synergies have been strong. In the *Buurzame Stroom* project, special attention had been devoted to involving families and companies wishing to invest in photovoltaic systems but not having suitable roofs or the necessary financial resources.

Actors: project developers

The Ghent pilot is implemented by *Ecopower*, which also acts as the coordinator, and three other partners, namely *EnerGent*, *EnergieID* and *Partago*.

Ecopower[33] is a RES cooperative, one of the largest (currently with almost 60000 members) and best-known in Europe (Bauwens *et al*., 2019). Founded in 1992, it has three main goals: investing in RES projects, supplying RES electricity to its members (since 2006), and promoting rational use of energy. In the demonstration site, *Ecopower* participates as both a supplier and aggregator. Table 2 reports some recent data about the size of the cooperative.

[33] www.ecopower.be

Table 2 – *Ecopower*: figures about its size.

	2016	2019
Members	50393	59321
Customers	41586	49143
RES electricity generation	56 GWh	94.5 GWh
Private equity (capital)	€49.8 m	€55.7 m
Balance total (assets)	€83.9 m	€74.8 m
Turnover	€37.1 m	€36.4 m
Employees (full-time)	33	40

Source: www.wisegrid.eu and *Ecopower* (personal communication).

EnerGent[34] is a local cooperative investing in RES projects, in the realisation of energy savings and the provision of energy services. Being leader of the *Buurzame Stroom* project, it owns many photovoltaic generation systems used in *WiseGRID*'s Ghent pilot site. *EnergieID*[35] is a social-profit cooperative whose mission is to develop IT tools for rational energy use and sustainable living. Its main product is an energy management platform through which households, businesses and other organisations can follow, compare and analyse their energy consumption. *EnergieID* participates in the pilot as technical advisor to *Ecopower*. Finally, *Partago*[36] is a local cooperative that shares 100% electric cars (currently, it has a fleet of about 65 vehicles and X charging stations). Its main role in the project is to test the tool for integrated management of electric vehicles with the electricity network.

4.1.2 Tools

The following six *WiseGRID* tools are tested in the Ghent demonstration site:

- *WiseCORP* is a corporate application for businesses, industries, ESCOs and public facilities. The application can help these entities reduce their electricity bills and increase self-consumption through the collection of real-time data from all their energy devices and systems and by means of demand response and load optimisation schemes. The application can be used directly by the energy manager of the facility or organisation. In Ghent, *WiseCORP* is provided to the facility managers of SMEs (consumers or prosumers) participating in the project.

- *WiseHOME* is basically an adapted version of the *WiseCORP* application, tailored to individual domestic consumers and prosumers. The functionalities offered by the tool include real time monitoring of consumption and production, participation in demand response programs, alerts, tips and price information for reducing bills, and remote control of the smart devices and distributed energy systems deployed at home (e.g., photovoltaic panels, storage systems, charging points for electric vehicles, power-to-heat solutions). In Ghent, *WiseHOME* is provided to domestic consumers and prosumers participating in the project.

- *WiseCOOP* is an application for energy retailers, aggregators, local communities and cooperatives of consumers and prosumers to help domestic and small businesses, consumers and prosumers achieve better energy deals while relieving them from administrative procedures and search costs. By means of aggregation and cooperation between citizens, better services and prices can be offered to final consumers and prosumers. In Ghent, *WiseCOOP* is used to assist both owners and not-owners of photovoltaic installations participating in the project. Demand response and maximisation of self-consumption are encouraged.

[34] www.energent.be
[35] www.energieid.be
[36] www.partago.be

- *WG RESCO* (Renewable Energy Service Company, *RESCO*) enables the provision of RES electricity to consumers (whether households or businesses). The consumers serviced may well not own the generation equipment, which is normally owned, serviced and operated by the RESCO itself. The fee charged to the consumer includes any required capital replacement cost and all operating, maintenance and repair costs plus a profit for the operating organisation. In the Ghent pilot, *EnerGent* uses *WG RESCO* to monitor production and forecast production from photovoltaic installations.

- *WiseEVP* is a platform designed for electric car-sharing companies and fleet managers, who can use it to optimise the activities related to charging and discharging of the electric vehicles. The platform can be used to plan and control the charging/discharging schedule of the vehicle fleet, thus enabling reduced energy bills. In the Ghent pilot, *Partago* uses *WiseEVP* to efficiently manage the charging/discharging of its fleet based on demand for vehicle use and the availability of RES production.

- *WG StaaS/VPP* (*Storage as a Service/Virtual Power Plants*) makes operational a service by which consumers/prosumers can offer to the market their unused storage capacity. Similarly, it also allows them to aggregate their spare energy generation capacity and offer it to the market in the form of a virtual power plant (VPP). In the Ghent pilot, *Ecopower* uses *WG StaaS/VPP* to aggregate available RES capacity and storage from participating consumers, prosumers, SMEs, etc. and offer it on the market.

4.1.3 Results

At the time of writing, the results of *WiseGRID* are not yet publicly available. They should be released later in 2020 after the end of the project. However, we had the opportunity to follow the project final conference during which some information of interest for our purposes was offered.[37] In particular, with regard to the Ghent pilot site, a presentation was dedicated to the experience with the *WiseCOOP* tool. This is an application for the use of aggregators of consumers and prosumers, be they energy retailers, local communities or – as the name suggests – cooperatives more specifically. The tool is conceived to help consumers and prosumers work together in order to achieve better energy prices and smarter use of available local RES production

In Ghent, *WiseCOOP* was tested by *Ecopower* as supplier/aggregator (*EnergieID* providing technical assistance) with a community of about 100 consumers and prosumers (all households except one enterprise). The tool allowed *Ecopower* to view granular consumption and production data of the community members and, thereby, to simulate dynamic pricing in real world conditions. In a strict technical sense, the tool passed the test, the main difficulties encountered being occasional connectivity problems at homes which interrupted the data transmission. Dynamic pricing simulations highlighted opportunities for energy and economic optimisation, even though consumers and prosumers did not actually face dynamic prices: their load shifting was encouraged but without real economic incentives, for which appropriate smart meters is a requirement.[38] In the project final conference, two main remarks were made in relation to the experience with *WiseCOOP* and dynamic pricing specifically. First, not all users will be equally able to reap the benefits offered by dynamic pricing and, in this connection, home automation will be key for maximal results. Second, it was shown that electricity wholesale prices went negative at some point, and so also simulated dynamic retail prices, which means a prosumer would have to pay for injecting electricity in the public network. This led to the comment that, as an alternative, one should be given the possibility to share the energy produced within the community (assuming that, for the user, this would be more convenient, or preferable for non-economic reasons, to buying electricity from the market).

[37] The video recording of the final conference is available online (project website and *Youtube*).

[38] In Belgium, the deployment of smart meters is still limited. Among other possible factor, this explains why dynamic pricing has not yet taken hold for residential and small consumers generally.

In general, the conference confirmed that the project was mainly of a technical nature. That is, its focus was on the technical functioning of the devices developed rather than on the effects of their use on energy user behaviour and ensuing energy outcomes.[39] It is therefore plausible that future projects in the same area will instead focus on such effects. As with *WiseCOOP*, the other tools discussed in the conference appeared to have successfully passed the test of their application in different real world contexts. In fact, technically most of them seemed almost ready for commercialization. In some cases, however, relevant regulation may not yet be ready for exploiting their use. For *WiseCOOP*, said current unavailability of dynamic pricing is a good example. Another one that was mentioned with reference to the Belgian context, and which would be relevant for *WiseHome*, is the current impossibility for individual prosumers to directly participate in the flexibility market. In this sense, the project shows instances of energy regulation lagging behind technology. Overall, *WiseGRID* is a very important project for RES communities because it technically demonstrates the many things that citizens and communities can do as actors in the energy system. The project started when at the level of EU legislation there was still nothing concerning RES communities and ends with the EU Clean Energy Package already in place; that is, after energy communities have received full legal recognition. *WiseGRID* was therefore a pioneering project and, today, with a much more complete legal and regulatory context in place (despite some gaps as those mentioned above), it is easy to imagine follow-ups.

4.2 Interviews with the project developers

This section reports the content of the interviews with Ine Swennen, from *Ecopower*, and Vincent Dierickx, from *EnergieID*. For the respective cooperatives, they are the persons in charge of the *WiseGRID* Ghent pilot site.[40] Dierickx is also a founder and board member of *EnergieID*. The interviews are about the two cooperatives, their specific roles in *WiseGRID* and *WiseGRID* itself. However, as the project was still under way at the time of the interview, it was not possible to enquire about its final results.

4.2.1 *Ecopower*

What explains the birth of *Ecopower* and its (successful) growth?

We started early: *Ecopower* was founded in 1991. In the beginning it was a group of volunteers with a shared interest in renewable energy. Starting from one wind turbine and progressively increasing our generation capacity thereafter, for several years we only produced electricity. Then, in 2003, following the liberalisation of the Belgian electricity market, we started selling electricity to our members, who are households and SMEs. Of course, as a supplier we could offer more services and, therefore, be of interest to more people. Compared to other suppliers, our prices are generally competitive (and, in this connection, we currently offer a flat tariff that is particularly advantageous to small consumers). Also, we receive lots of positive feedback about our customer service. But these are not the main reasons why we have grown. More than anything, I think, more and more people over the years have become aware of climate change and the need to act. This trend plays in our favour because we give citizens the opportunity to directly participate in the energy transition.

How has *Ecopower* been affected by the increased number of its members?

Well, firstly, if you have more customers – and hence more members – to supply, then you need to develop more RES projects to cover their consumption. Also, you need more employees for customer service, so we hired people for that. Of course, when you have more employees, then you need more structure in the organisation. If you are a company with 10 or 20 employees, then it is easy for everyone to talk with each other; but if you are 40, it is a lot more difficult, so for instance you need to plan meetings longer in advance – the standard things that a growing organisation encounters. Nevertheless,

[39] Analyses of behavioural change related to two of the project tools, namely *WiseHOME* and one for fast EV charging (not tested in Ghent), will be made publicly available through the project website in a few months.
[40] The interviews took place in July 2019, with few days in between.

the organisation of *Ecopower* has remained pretty horizontal: there are not many layers in the organisation.

Concerning our members, of course we have always had an annual general assembly, which is a requirement for a cooperative. The one-person one-vote rule applies, so there are no majority shareholders at *Ecopower* (you can buy up to 20 shares, but your vote still counts as one). Apart from the general assembly, starting six or seven years ago, we have organised informational meetings with our members in every province of Flanders, which are additional opportunities of exchange and participation. In these meetings, we typically provide information about hot topics in the energy market. For example, a couple of years ago, nuclear was in the public debate, so we discussed it; we did an energy cafe, as we call it, about whether to go off-grid or not (and we explained that, for us, it is not so useful if you look at it from a societal point of view, as only people who can afford it will go off-grid); we held a meeting about digital metering (in Belgium only now the switch is happening); etc.

Has *Ecopower*'s model been replicated within Belgium?

Yes, quite many times. I would say that there are certainly more than 20 RES cooperatives in Belgium. *Ecopower* is the largest (and certainly one of the largest in Europe), then *BeauVent* is the second-largest. In Flanders, I think about 4% of all wind turbines are owned by RES cooperatives. We encourage other people to start a RES cooperative locally. Of course, there do not need to be 2000 RES cooperatives in Flanders, so if people from neighbouring cities reach out to us because they want to start something new, we bring them in contact with each other and support them. All these RES cooperatives participate in meetings organised on a regional, national and European level by the respective federations.

Importantly, the model has been imitated, let us say, not replicated, by big utility companies. They establish a cooperative themselves, but it is not a RES cooperative: we call it financial cooperative or FIN cooperative. In a RES coop like *Ecopower*, citizens become cooperative members by buying a share and these shares are in the entity of *Ecopower* as project developer, the investor. The assets of *Ecopower*, all our wind turbines, photovoltaic panels, etc. are integrated in *Ecopower*, no other entity is involved – it is very transparent. By contrast, FIN cooperatives are established by other companies, and the cooperative gives a loan to a project developer, who is a distinct entity from the cooperative the citizens bought a share from. The project developer is investing in the wind turbines, but these or other generation assets are not owned by the cooperative, so its members do not have a direct say on those. It is a different model, one that does not constitute community energy. It is not only a matter of participation, voting rights and power within the cooperative: RES cooperatives like *Ecopower* do not have the goal of maximising profits on electricity supply. We supply RES cooperative to our customers as a service to them because they are our shareholders.

With reference to the Ghent pilot site of the *WiseGRID* project, what characterises *Ecopower*'s activities as a supplier and aggregator compared to other potential suppliers and aggregators?

In the Ghent pilot, we have to test new tools, first and foremost an application called *WiseHOME*. So, we first installed digital meters in the dwellings of all households participating in the project. The data collected by the meters are pushed through a server and are also displayed in an application that the users can see. This application is called *WiseHOME*. Our task is to test whether *WiseHOME* works technically. Then, in April 2020, when the project ends, we will be able to analyse the data gathered.

As aggregator, we are implementing a VPP model using all the suitable installations in the project. So, there are citizens' roof photovoltaic installations; there is a photovoltaic installation owned by the RES cooperative *BeauVent*; there are also some batteries installed by *Ecopower*. I think that the main difference with other smart-network projects is that, here, all assets are cooperatively owned.

Again, with reference to the Ghent pilot, what have you observed about the behaviour of electricity consumers or prosumers? Have you observed any change? Also, has any problem arisen so far?

It is too early now to say anything about the energy behaviour of the participants. We will see this in April, at the end of the project. We will then check for trends in the data gathered.

As to the difficulties encountered, there was initially a delay with the development of the *WiseHOME* application. Otherwise, more generally, there are sometimes problems with data connections. For example, people may have works on their electricity installation at home and, afterwards, the connection may not be automatically restored. In such cases, we have to go to their place and check why there is a data connection problem.

What is the future of cooperatives as *Ecopower* in the energy transition? Will you have close competitors?
I think our role or share in the energy transition will only grow. The EU Clean Energy Package is very encouraging. For the first time in history, the European Commission has placed the consumer in the middle of the energy transition through the concepts of Citizen Energy Communities and Renewable Energy Communities, which are closely related to the ways RES cooperatives work. In fact, these concepts made it into legislation also because RES cooperatives like us showed that they can work in practice. At the European policy level, this was translated by *REScoop.eu*. There also are initiatives like the Covenant of Mayors, to which the mayor of any town or city can sign up and, thus, commit to meeting a certain level of climate ambition. We see a big potential for collaborations between RES cooperatives and local authorities, also triggered by the Covenant of Mayors, as many wish to make their cities more sustainable, but they may not know how to do it and so may prefer to address us, who are owned by citizens, rather than a big for-profit company. We already have different kinds of projects and collaborations with cities. One, for example, is LICHT Leuven. We are a partner of the city of Leuven in reaching their climate goals for 2030 and so there we are installing many photovoltaic systems.

We will have competitors, including the previously-said FIN cooperatives. In any case, there is plenty of work to do, so if everyone pushes in the same direction, that is already something. Ultimately, we hope there will be more or bigger RES cooperatives.

In your view, which market design changes are desirable for consumers' empowerment?
I think an important one would be introducing compensations for flexibility offered at the residential level. Today, if you are a company and participate in a flexibility market, you get a remuneration. That is, the TSO pays you for the flexibility of your assets, be they batteries, a gas power plant, or whatever. However, there is no such remuneration at the DSO level. So, if you are a household and you are willing to reduce your consumption at a certain time, there is no way for you to receive a remuneration. Yet, if, say, ten thousand consumers were willing to lower their consumption at a particular time, then you would have a kind of VPP.

4.2.2 *EnergieID*

What is the origin of *EnergieID* and how has the cooperative evolved over time?
I founded *EnergieID* with a friend of mine, Diedrik Kuypers (currently board member of the cooperative), ten years ago. I was working as an engineer in an engineering company (also a cooperative) for energy efficiency and sustainable building. I was leading the energy management and monitoring area. I was selling a software for energy monitoring and I found out at this time that almost no one of my friends and family really knew how much energy they were consuming. So I thought that if I took away all the bells and whistles of the software and keep the most important part, sufficient for probably 80% of the needs and for reporting output, then perhaps I would have been able to make a monitoring platform for the use of families. I asked Diedrik, who is an IT expert, if he could help me build the website. It started off as a hobby but within four years we had 2000 users. So we faced the question of what to do next. Diederik and I decided (then I was already a member of *Ecopower*) that we should make a platform that is collaborative and shared amongst all the organizations that could use good data for their climate actions and for their services. This is the basis of our cooperative: we develop a platform that is owned by our members and all our members are dealing with some kind of climate action or energy efficiency targets, and they need monitoring or data. Through the platform, people can have more insight in their own consumption and emissions, and from there they could start working on those. We have forecasting models to show people whether they are consuming less, how they compare to others, etc.

We are a social profit company, so it is not financially driven. The reason is that we want to make sure that our platform is trustable: people put their data in the platform knowing that those will not be commercialised, and also know that no competition problems will arise with the other members. If we want cities, universities and companies working together on a large platform for energy monitoring, it should not be financially driven or owned just by two people, like me and Diedrik. Our social goal is to provide the platform to the end user for free. The users are families, but also schools. We currently have about 1000 schools and 25000 families, all using the platform for free. Our business model mainly relies on selling reporting for group measurements – this is where we can get some income. So, for example, the platform is used by the Italian cooperative *ènostra*: it means *ènostra* can measure the consumption of its members using us (but the individual members of *ènostra* can use us for free). We have a lot of these groups. Other income sources are custom developments for clients and research and innovation projects. For example, we are partner in a project with the city of Antwerp, in which we have developed an application with a blockchain wallet linked to the city's smart platform.

Who are the members of *EnergieID*? How do they participate in the governance of *EnergieID*?
Currently, the members or owners of *EnergieID* are 27, including nonprofit organizations like *EcoLife*, cooperatives like *Ecopower*, engineering companies; we also have a maintenance company owned by *ENGIE Electrabel*. So, not just families or users. Anybody can become member as long as they are a companies offering services around our platform. They want to help develop the platform and at the same time they use the platform for their services, so they can ask people to share data and help them, for instance, with energy efficiency. For example, *Ecopower*, is using us as a client portal in Flanders, and we have about 6600 clients of *Ecopower* using us.

As to the governance, there is a board of four people: me, Diederik, Jim from *Ecopower*, and Kathleen from *Efika Engineering*, an engineering company that is one of the members. The board is elected by the general assembly. Their participation of the members in the governance of *EnergieID* is mostly through the annual general assembly, plus occasionally extra events are organised.

What is the role of *EnergieID* in *WiseGRID* and, specifically, in the Ghent pilot site? Is the *EnergieID* platform related to the new applications developed for the Ghent pilot site?
That is a good question because, actually, they do not relate. While for the Antwerp project previously mentioned we built an application ourselves, in *WiseGrid*'s case we are part of the project as technical advisor to *Ecopower*. This effectively means we help *Ecopower* with the requirements and the testing of the applications developed (by other technology providers in the project). For instance, *EnergieID* sets up the servers and then makes sure that the smart meter extensions generating the data in the pilot side keep working properly, etc. In the beginning of the project it was about the technical expertise, the requirements and setting up, testing prototypes and things like this. Now, it is about helping the pilot with the IT logistics and other technical tasks like measurements of Key Performance Indicators. The pilot is now at the stage in which energy end users are starting to use the application - I am referring here to the *WiseHOME* application.

With reference to the Ghent pilot site, what have you observed about the behaviour of energy end users? For example, how intensively do they use the applications? Have they changed their energy uses? Also, has any problem arisen?
I really cannot tell you much yet about observed behaviours. We will for sure have some feedback moments with questionnaires, but have no data just as yet. Something I am able to tell you, based on previous experience, is about the importance of monitoring. We were involved in another project called *REScoop PLUS* and, there, a study was done on how energy consumption differed between *Ecopower* clients using our platform and those not using it. The former turned out to be using about 10% less electricity. The *REScoop PLUS* project indeed was about how the membership in a cooperative can lead to energy efficiency results.

The main issue we have had so far – and that is why we are a bit behind schedule – has to do with data connection, mainly because the internet connection of people at home is not always stable. So, still we have some issues on internet connectivity and then, of course, the applications and everything is not yet totally bug-free, which is normal in a project with a lot of new developments. Clearly, all this means data interchange problems. Another thing that I know from a previous project is the importance of people's motivation. Basically, however motivated people are, they will not watch the application every day, ten times a day. This means that the notifications should be advanced: not too many, not too few, but also have an automated system to sense interesting notification to people, and their timing. But this is like nudging, which is a social science. It is not included in the project, which is more focused on technical aspects. So, I would say that, in the *WiseGRID* project, perhaps we are not advanced enough on notifications and, so, at the end a problem may turn out to be that we did not sufficiently engage with the end users to get them to use the application enough.

What is the future of cooperatives as *EnergieID* in the energy transition?
We are working with a lot of well-established European cooperatives, such as *Enercoop* in France, *Carbon Co-op* in the UK, *Som Energia* in Spain, *Bürgerwerke* in Germany, with whom we recently submitted a project proposal. But we are also working on more technical solutions, let us say. So this means the future is that we can service people, help our members. And, in the future, this means more real time data and real time operations; it means the moment of consumption will be more important, it means dynamic tariffs, flexibility, load shifting. So, if *Ecopower* is focusing on supplying and producing electricity, I think there will be more cooperatives, like us, that instead will focus on the technical solutions to support communities. *EnergieID* is special in that the service we provide is a software, an online platform. As I said, it is important for a platform to be trustable, but also that it is well spread and well used by a lot of people. But achieving this is quite a task technologically, it costs a lot of time and efforts. Think of *Google* or *Facebook*, they have "zillions" of people to work on it. We need to cooperate to be able to tackle technical solutions.

In your view, which market design changes are desirable to maximise consumers' empowerment
On consumer empowerment, I think we have two different issues. One concerns the design of the electricity market. As I said, we are moving toward dynamic tariffs and real-time tariffs, 15-minute billing, smart meters, etc. So I think this market design has been done. And of course we are waiting for the implementation of the Clean Energy Package to see whether Renewable Energy Communities and Citizen Energy Communities will be allowed to become real market players. But then, the other issue is that we have a very big consumer economy, with too much power in the hands of very big companies. So, in my view, part of the market design should be about reducing the excessive power of big players. But this is very hard because these companies are able to put a lot of pressure on governments. The alternative is empowering people, and this is not about regulation. It is us, communities that should be able to bring people to other mindsets and make them consume differently, make different choices. But, as we know, these choices are heavily influenced by money, marketing, internet. So, as long as the big players have so much power on people's views, it will be hard for communities to change people. But because technologically everything changes so fast, and internet becomes one deep fake ecosystem, maybe people will go back to people and talk to others, because they can trust talking to people and they cannot trust what they see on the internet. We, as communities, should be able to have new trust of people to help them change their economic decisions. And if we can change this and bring other kinds of jobs to people, we might change the economy bottom up. The real alternative is not just bringing renewable energy, but is forming communities. It is really important for the happiness of people being part of a community, feeling a connection with other people. The bottom line for me is that, as cooperatives, we can help with the climate and the energy transition by forming communities: empower people to be more connected and then take more responsibility.

5 Conclusions
Our three case studies capture many aspects of RES communities in Europe, as they present themselves today and possibly in the future. Taken together, these aspects provide a fairly broad picture in which particularly salient are the acquired data regarding a) the nature and the raison d'être of RES communities, b) their evolution, c) their expectations about the future, and d) the role of regulation for their development.

Nature and raison d'être of RES communities
A fundamental distinction, the relevance of which is even more evident these years as the Clean Energy Package legislation is being developed, is that between what RES communities *are* and what RES

communities *do*. Our investigation focuses, on the one hand, on (modern) RES cooperatives: the type of RES community best equipped to combine the pursuit of mutual and social benefits with complex, large-scale activities in the electricity system, such as electricity supply. On the other, we focus on collective self-consumption (CSC): an emerging model for producing and consuming electricity – an activity – that may give rise to many new local RES communities. It is worth recalling, however, that for a RES community to be considered as such, just as important as *what* the community does is *how* the community carries out its activities. Notably, effective participation of its members in the decisions regarding the community is normally considered a requisite. In this sense, the democratic principle is a defining feature of RES communities.

Regarding the raison d'être of RES communities, the investigation (specifically, the first and third case studies on *ènostra* and *WiseGRID*, respectively) has revealed the recognition by their members of a community value that it is intrinsic as well as functional. The intrinsic value lies in the fact that the community itself is considered a good, not only for the material benefits it offers to its members, but also and perhaps especially for the immaterial ones: feeling part of a community and feeling empowered makes people happy. At the same time, the community has a functional value, as being an appropriate tool (notably, more appropriate than profit-oriented companies) for increasing the common good. With the words of one of the interviewees: *"The bottom line for me is that, as cooperatives, we can help with the climate and the energy transition by forming communities: empower people to be more connected and then take more responsibility"*. A key word that recurs in the interviews and reveals a fundamental reason why RES communities respond to someone's needs and, therefore, exist, is indeed *empowerment*. The need addressed by RES communities through people empowerment mainly is that of citizens or organisations wishing to take direct action in the energy transition. *Trust* – also a frequently recurring word – can be regarded as the dual of empowerment, as trust among the subjects taking collective action is a requisite for their effective empowerment.[41]

Evolution of RES communities

In Europe, modern RES cooperatives, some of which were already active in the 1990s (or even earlier, in some Northern countries) and since 2011 are united under the *REScoop.eu* federation, have played an absolutely central role in affirming the concept of RES community. If today the Clean Energy Package opens potentially very interesting opportunities for the future development of RES communities, it is also because RES cooperatives have shown that they can be active players in the electricity system and that their activities can benefit society, however difficult quantifying such social benefits may be. Indeed, in recent years, there have been many EU-funded research and innovation projects in which RES communities, especially RES cooperatives, have had central roles.[42] Similarly, the number of projects seeing partnerships between RES cooperatives and local public authorities has been growing. In this connection, RES cooperatives demonstrate a clear will and ability to collaborate with other subjects that may be more or less similar in terms of organisational form and of services or products offered, but with whom they share a certain view of sustainable development and society. While very different may be the local contexts (in cultural, political, regulatory, physical, or other terms) in which they were born, European RES cooperatives generally exhibit this strong propension to collaborate. Accordingly, RES cooperatives are also taking the opportunity to encourage the emergence of local RES communities by participating in CSC operations as supplier, aggregator or third party investor.

As regards the individual evolution of RES cooperatives, it also emerges from the case studies the significance of their expanding the business activity from electricity generation only (often initiated thanks to the availability of feed-in tariffs or premia supporting renewable energy sources) to the supply of electricity (and possibly other activity areas). This is a key step for its implications. The first implication is that the members of the cooperative no longer cooperate only as producers, but also as consumers, being customers of the cooperative. Therefore, the interests of end users, such as those related to energy saving, are internalised by the cooperative. The second implication is that the supply activity involves a number of additional operations and obligations and, therefore, it requires the

[41] On the role of trust in RES communities, see Walker *et al*. (2010) and Kalkbrenner and Roosen (2016).

[42] Most of the recent or ongoing research and innovation projects in the area of smart grids and energy storage in Europe are brought together under the BRIDGE initiative of the European Commission (www.h2020-bridge.eu).

acquisition of new professional skills. The third implication is that with the supply activity, the growth potential of a cooperative is greatly expanded, normally exceeding the local dimension. A cooperative that makes this step will likely grow considerably in terms of members and resources available, thus becoming also less dependent on the existence of RES support schemes. As a consequence of this growth, however, it is also possible that the intensity of the relations between the cooperative members and their effective participation in decision-making processes will be greatly diluted. The risk, therefore, is to weaken and perhaps even lose de facto a defining feature of genuine RES communities.

Expectations about the future

All the people interviewed in the case studies expressed a certain optimism regarding the future development of RES communities. This optimism is linked primarily to the new prospects offered by the Clean Energy Package, but remains cautious until the relevant directives will be implemented by the Member States. Related risks concern the effective possibility for RES communities to become important players in the electricity market (within the segment of residential consumers and small consumers more generally). In particular, the risks mentioned include the insufficiency of support schemes dedicated to RES communities and the advantages that traditional market players, while not real RES communities, might be able to derive from those schemes by exploiting normative loopholes. Apart from the expected policy choices and regulatory treatment, which in principle should generally be favourable, the growing interest of citizens and local authorities in taking direct action in the energy transition and the fight against climate change is also a reason for optimism. This trend clearly plays in favour of RES communities, which have the empowerment of citizens as part of their lowest common denominator.

The CSC model, whose future diffusion will critically depend on policy and regulatory choices, raises special hopes. It is a model that, if and when it becomes economically viable (the evolution of storage technology costs is also a very important variable in this respect), may involve many more citizens in the energy transition. Some RES cooperatives, for their part, already participate in pilot CSC projects and, indeed, this is an area where we will likely see much collaboration between RES cooperatives and local RES communities in the next few years.

The role of regulation

The case study on CSC in France highlights the crucial role that policy and regulatory choices have in determining the future of this new way of producing and consuming electricity. In the face of benefits for the electricity system that are certainly plausible but difficult to estimate ex-ante (in the short term: savings on the operating costs of the network; in the long term: savings on the expansion of the network), the introduction of a special network tariff for participants in CSC operations is the question that has received the most attention in the public debate. The reason for this are the possible consequences that a new special network tariff may have and which specifically concern the risk of opening the door to free-riding behaviours while potentially imposing unfair extra costs on consumers who do not participate in CSC operations. The French regulatory authority has developed an optional special network tariff for a type of CSC operation the effects of which will be assessed in five years. A related issue is the recognition of the possible further societal benefits of the CSC model (additional to the savings achieved through a more efficient electricity system) which would include the expansion of RES production and its greater social acceptability (ownership countering the so-called NIMBY phenomenon), but also the opportunities for economic development and greater social cohesion for local communities. In the face of these additional benefits, which are also plausible but difficult to estimate ex-ante, a possible special tax treatment of CSC (mainly, reduced taxes on self-consumed energy) and the provision of dedicated support schemes are a central issue in the public debate.

Appendix[1]

***Partagélec*: a pilot project of collective self-consumption in Pénestin (Brittany, France)**[2]

Origin of the project and basic technical information

The project started in 2016 when the municipality of Pénestin and the community of municipalities CAP Atlantique considered developing a photovoltaic project in their territory. The municipality, which already had photovoltaic installations on some of its communal buildings, including the town hall, wanted to launch a major operation in one of its small-business areas (in French: *zone d'activité artisanale*). It was in fact the continuation of an older project, since in 2012 there had already been talks about installing solar panels on the roof of a technical building owned by the municipality in the same area. However, the project failed because the response to the government's call for tenders had not been submitted in time. In 2016, ambition was higher as the municipality and the community of municipalities CAP Atlantique were considering a massive installation over the entire activity zone. But the installation of solar panels on the roofs of several private buildings was problematic: it would have meant convincing each owner to invest in solar panels and create a collective investment structure. The implementation of the new regulatory framework for collective self-consumption (CSC), in 2017, was an opportunity to concentrate the installation of solar panels on the only public building in the area while still integrating proximate small businesses. The project was thus no longer a rather standard RES electricity production project but an innovative one experimenting with the new CSC framework. Along with the municipality of Pénestin and the community of municipalities CAP Atlantique, the project was steered by the energy syndicate, which is the technical body managing energy networks at the *department* level.[3] For this actor, the main objective was to experiment with the emerging CSC regulatory framework with the aim of replicating it on a larger scale. The project received funding from the region.

Table A1 – Leading actors in the *Partagélec* CSC pilot project.

Actor	Description	Function in the project
Municipality of Pénestin	Local political entity	Owner of the production building, in charge of political aspect locally.
Inter-municipality *CAP Atlantique*	Local political entity	Financing feasibility studies.
Energy syndicate of Morbihan, *Morbihan Energies*	Political-technical body managing the energy networks at the scale of the *Department*	Producer, in charge of the main technical questions, financing solar panels.
Engineering firm	Private firm	Assisting the syndicate on technical matters
ENEDIS	DSO	Metering
Enercoop	Supplier	Buyer of production surplus
SMILE	Association regrouping private and public entities and promoting the development in smart-grids in *Region Bretagne* and *Region Pays de la Loire.*	Financing, network support
Région Pays de la Loire	Political entity	Financing technical studies
Energy syndicate of *Pays de la Loire*	Political-technical body managing the energy networks at the scale of the *Department*	Financing technical studies

Solar panels were installed on the roof of a municipal building in the said businesses area. The surface covered by the panels is 234 m^2, for a total generation capacity of 40.6 kWc and an investment

[1] This appendix draws on the field work done by Thibaut Fonteneau (PhD candidate at Grenoble Alpes University) as part of his PhD dissertation.
[2] https://www.enercoop.fr/content/partagelec-cest-parti
[3] In France, municipalities own the public distribution grid. But especially in rural areas, where municipalities do not necessarily have the resources needed, they delegate this administrative competence to a syndicate.

cost of €38500 (technical studies excluded). The producer is the syndicate, *Morbihan Energies*. It sells electricity to the ensemble of collective self-consumers, which are 12 small businesses. The surplus electricity is bought by *Enercoop*. Specifically, the electricity from the solar panels goes directly to the municipality building. What is left is sold to the consumers or the collective self-consumers and, in turn, what is left after that, is sold to *Enercoop*. The electricity produced is allocated between the consumers, pro-rata of the consumption of each user.

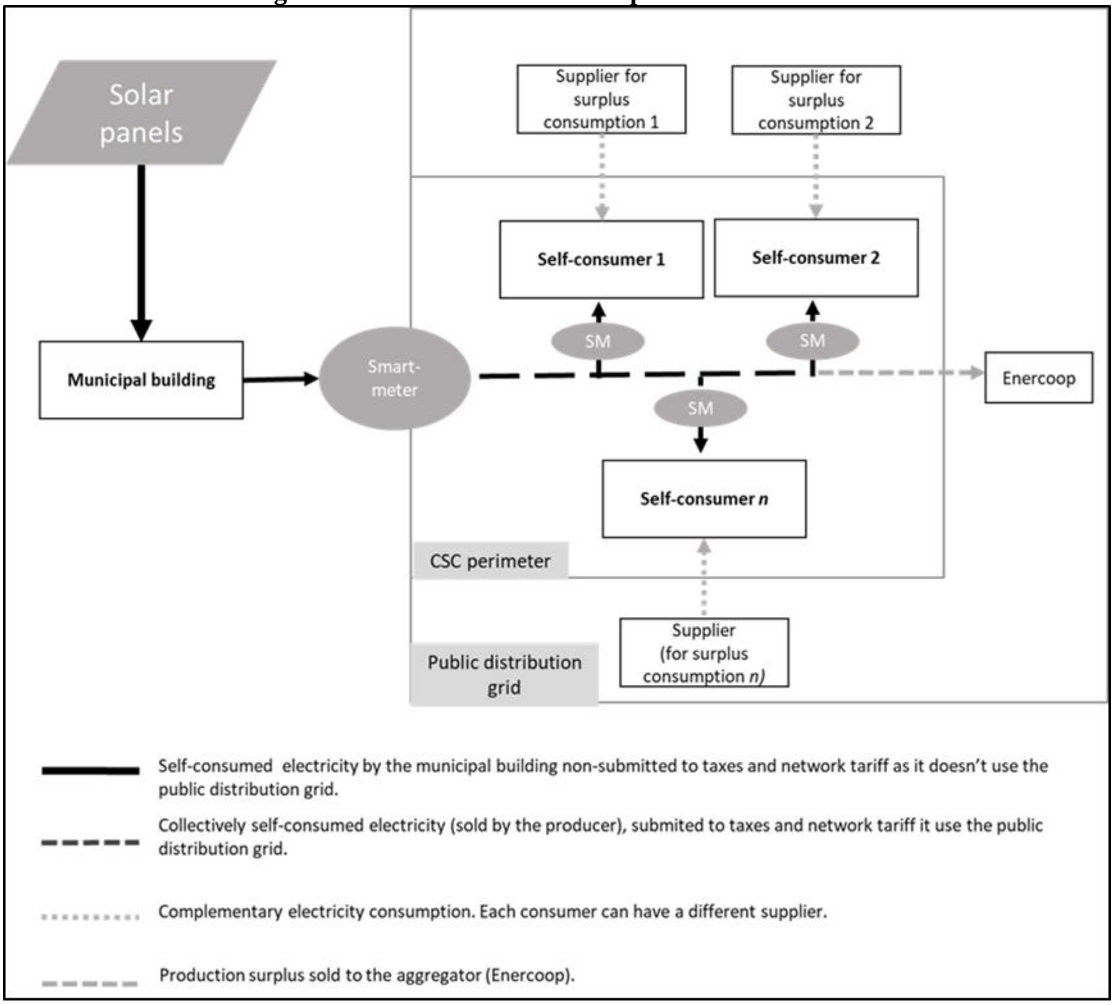
Business model

Combining individual and collective self-consumption
At the start of the project, because the cost of photovoltaic production was too high to be competitive against the regulated tariff of electricity, the actors were hoping that a network tariff exemption would compensate for the difference. The CSC-specific network tariff was not yet in effect at that time (though, as it transpires from the interviews in Section 3.2, it is unclear whether this tariff really acts as an incentive for CSC operations). In order to partially balance the economic model, the stakeholders decided not to allocate the entire electricity flow produced to the CSC operation. Specifically, the municipal building, on which the panels are installed, consumes in priority the locally produced electricity. This upstream diversion allows to benefit from the individual self-consumption regime for which self-consumed electricity is exempt from grid taxes and CSPE. This combination of individual and collective self-consumption is used in many CSC projects in France, particularly those led by public actors. The typical configuration is that the public actor first consumes the electricity from the panels under the individual self-consumption regime and, then, it redistributes the rest to other buildings under the CSC regime.

Prices setting
The project required two prices to be set. First of all, the producer must set a selling price for consumers in the area: it is the price of electricity that is collectively self-consumed. This price was set by *Morbihan Energies*. The second price applies to the sale of the surplus. For this purpose, *Morbihan Energies* contracted with *Enercoop*. The setting of a local electricity sale price was based on a double logic. On the one hand, it was necessary for *Morbihan Energies* to ensure a certain budgetary balance, though without seeking profitability; on the other, to meet a political objective of experimentation and of promotion of a local and cheap energy, honouring the promise of *Morbihan Energies* to consumers that the local electricity would not cost them more than that from their supplier. *Morbihan Energies* chose to set the price for 20 years. Anticipating that the market price and regulated electricity selling rates would increase, the syndicate bet that local electricity would be increasingly profitable for consumers. Beyond the economic interest for consumers in the area, which remains rather low given the limited amounts of electricity produced, this fixed price offers a political argument for the syndicate to develop future projects. Indeed, if the price of electricity significantly increases in the future, the project leaders will be able to demonstrate ex-post the profitability of the project for consumers and their own ability to offer competitive local energy. Offering this fixed price is a political decision that has been used to encourage consumers to join the project and to attract new consumers in future projects.

For its part, *Enercoop* has agreed to buy the surplus from the operation and to take up the role of balance responsible for the perimeter of the self-consumed electricity. Volumes of excess electricity are expected to be very low given the power installed in the area and the purchase price is high (6 cents per kWh). This privileged prize is granted by *Enercoop* to a limited number of projects. For *Enercoop*, it is more a question of supporting the experimentation of this type of projects and promoting local electricity production and consumption than of making a profit. The high purchasing price could be an incentive for the participant to reduce self-consumption and sell more surplus. Yet, again, the objective of the project is not rentability but rather demonstrating the political interest of CSC.

Figure A1 – Scheme of the CSC operation in Pénestin.



In short, the business model of the project is not representative of what the financial structure of this type of project could be if it were to be scaled up. It is assumed that in such case, and in particular if private investors are involved, the projects will have to be financially profitable. Nevertheless, the project does not benefit from unlimited funds and a certain economic optimisation has been sought, as demonstrated by the combination of individual and collective self-consumption aimed at reducing the cost of taxes and network tariffs. These optimisation efforts and the potential financial loss for *Morbihan Energies* demonstrate that the political and experimentation value of this project is significant. In that sense, this project is not just about producing electricity but goes beyond that. Choosing CSC rather than trying to apply for a feed-in tariff was a way for the municipality and the intercommunal organisation to involve local business which would have been harder to do with a feed-in tariff scheme.[4]

Governance

Establishment and operation of the legal entity

In the *Partagélec* project, as in other similar projects in France, the legal form chosen was that of an association. This form was chosen mainly for the sake of simplicity. The establishment of an association is an administrative process that only requires the creation of a statute and its submission to the prefecture. Concerning management, the freedom to define the statutes has also made it possible to define simple operating rules that do not overburden the municipality, whose resources and technical

[4] This would have required the local businesses to collectively invest in the installation.

competences are limited. Moreover, the freedom allowed by this legal form allowed members to participate in the project without giving them decision-making power, which is not the case for certain shareholding structures. Accordingly, the statute of *Partagélec* distinguishes between active and historical members. The latter are actors who have participated in the project by financing it or carrying out studies, for example, but who are not consumers or producers. The association as a legal form is generally convenient because it allows to combine simplicity, participation and political visibility.

Mission of the legal entity

In addition to the legal obligations of the legal entity, *Morbihan Energies* anticipated a potential evolution of the legal entity's role when drafting the articles of the association. Indeed, the statute specifies that the association promotes "energy efficiency and the development of renewable and recovered recuperative energies" as well as "all innovations in the field of energy production, distribution, consumption and storage". While the association does not currently carry out actions to control energy demand, the presence in the statute of the notion of energy efficiency opens the possibility for the association to carry out actions in this direction in the future. New generation capacity could be installed in the area in the future, as well as storage capacities and consumption management measures. If this happens, the legal entity will be empowered to address these issues. This will certainly depend on the evolution of the regulatory framework.

Consumers' involvement

The project is mainly carried out by public actors. It is the result of joint political will to develop an energy project in the local area. Although consumers are all active members of the association, their role in the project is quite limited and the initiative for the project did not come from them. It was the municipality and an engineering firm that approached potential consumers in the area. Recruitment was facilitated by the regular contacts between the entrepreneurs of the small-businesses-area and the municipal team, including the deputy mayor. He personally visited the craftsmen to explain the project to them. This direct contact and familiarity between elected officials and local entrepreneurs seems to have been decisive in the choice to join the project. At the same time, the choice to focus the project on an area gathering small firms and therefore targeting a public of professionals rather than individuals was considered easier to manage, as it limited the number of interlocutors. This choice was balanced against the possibility of a greater diversity of load curves and therefore a principle of energy optimisation. Given the very small amount of electricity committed, and the absence of any demand side management scheme in the project, it is unlikely that this will have an immediate effect on consumption practices. However, participation in this project has raised a form of awareness on these subjects, and consumers have acquired knowledge about energy in general. This is also true for some members of the municipality team who have followed the project.

References

Bauwens, T., Huybrechts, B. and F. Dufays (2019), *Understanding the diverse scaling strategies of social enterprises as hybrid organisations: the case of renewable energy cooperatives*, Organization and Environment, 33(2), 195-219.

Boon, F.P. and C. Dieperink (2014), *Local civil society based renewable energy organisations in the Netherlands: exploring the factors that stimulate their emergence*, Energy Policy, 69, 297-307.

Campos, I., Pontes Luz, G., Marín-González, E., Gährs, S. Hall, S. and L. Holstenkamp (2020), *Regulatory challenges and opportunities for collective renewable energy prosumers in the EU*, Energy Policy, 138, 111212.

Candelise, C. and G. Ruggieri (2020), *Status and evolution of the community energy sector in Italy*, Energies, 13, 1888.

Capellán-Pérez, I., Campos-Celador, A. and J. Terés-Zubiaga (2018), *Renewable energy cooperatives as an instrument towards the energy transition in Spain*, Energy Policy, 123, 215-229.

CEER (2019), *Regulatory aspects of self-consumption and energy communities*, CEER Report C18-CRM9-DS7-05-03, Council of European Energy Regulators.

CEER (2020), *Electricity distribution tariffs supporting the energy transition*, CEER Report C19-DS-55-04, Council of European Energy Regulators.

CRE (2017), *Ce qu'il faut savoir pour comprendre l'autoconsommation*, Commission de Régulation de l'Énergie, Document prepared for the *Conférence Débat* on self-consumption, July 2017.

Frieden, D., Tuerk, A., Roberts, J., and G. Andrej (2019), *Collective self-consumption and energy communities: Overview of emerging regulatory approaches in Europe*, Working Paper of the Compile Project, June 2019.

Huybrechts, B. and S. Mertens (2014), *The relevance of the cooperative model in the field of renewable energy*, Annals of Public and Cooperative Economics, 85(2), 193-212.

Kalkbrenner, B. and J. Roosen (2016), *Citizens' willingness to participate in local renewable energy projects: the role of community and trust in Germany*, Energy Research and Social Science, 13, 60-70.

Magnani, N. and G. Osti (2016), *Does civil society matter? Challenges and strategies of grassroots initiatives in Italy's energy transition*, Energy Research and Social Science, 13, 148-157.

Pellicer-Sifres, V., Belda-Miquel, S., Cuesta-Fernandez, I. and A. Boni (2018), *Learning, transformative action, and grassroots innovation: Insights from the Spanish energy cooperative Som Energia*, Energy Research and Social Science, 42, 100-111.

Schittekatte, T. (2020), *Distribution network tariff design for behind-the-meter: balancing efficiency and fairness*, In: Sioshansi, F. (ed.), *Behind and beyond the meter: digitalization, aggregation, optimization, monetization*, Academic Press.

Schittekatte, T. and L. Meeus (2020), *Least-cost distribution network tariff design in theory and practice*, The Energy Journal, 41(5), 97-133.

Schittekatte, T., Momber, I. and L. Meeus (2018), *Future-proof tariff design: recovering sunk grid costs in a world where consumers are pushing back*, Energy Economics, 70, 484-498.

Walker, G., Devine-Wright, P., Hunter, S., High, H. and B. Evans (2010), *Trust and community: exploring the meanings, contexts and dynamics of community renewable energy*, Energy Policy, 38, 2655-2663.

3

Conceptualisation and scenarios

1 Introduction

The future of renewable energy communities (hereafter, RES communities) is still mostly unexplored.[1] So far, only a few studies have investigated the role that RES communities can play in the EU in the coming years. A quantitative assessment by CE Delft commissioned in 2016 by a group of non-governmental organisations suggests that the number of 'energy citizens', i.e. households, small enterprises and public entities involved in the production of electricity, could increase by ten times between 2015 and 2030, and more than double again by 2050 (Kampman et al., 2016). By investing in wind turbines, photovoltaic panels and energy storage, the study suggests that energy citizens could cover almost a quarter of overall EU electricity demand in 2030 and nearly half in 2050. Of this, individuals and households producing electricity collectively through organisations such as cooperatives and associations could be responsible for a third, i.e. around 8% of total electricity demand in 2030 and around 15% in 2050. However, the same research acknowledges that these numbers should be taken with caution and represent only rough estimates of the potential of energy citizens, given the various assumptions made in the modelling, the limited data on the current situation and the uncertainties about future market conditions and the regulatory framework.

As we saw in Chapter 1, a comprehensive understanding of RES communities and their interactions with relevant contextual factors is still in the making. Statistical data are sparse and not always comparable across countries (Caramizaru and Uihlein, 2020). On top of that, community energy often involves dimensions that are difficult to quantify, making any quantitative assessment of the future of RES communities not only a laborious exercise but also a somewhat partial representation of reality. Nevertheless, the literature review conducted in Chapter 1 and the case studies presented in Chapter 2 can support us in performing a qualitative evaluation and providing the reader with indications as to where RES communities in the EU might go in the coming few years and why. In this regard, 2030 represents a time horizon that is distant enough to allow a significant evolution of community energy, while at the same time not so far that uncertainties, particularly relevant to this rather new energy model, grow too large and any projection loses solid grounds.

Three steps are considered to envision the future of RES communities over the next decade. In the first step, we address the question of what RES communities do. Understanding what they offer to their current and prospective members and how they respond to their needs and aspirations allows us to identify the fundamental driving forces behind their organic uptake in the energy system. RES communities enable people and, usually small, organisations to deal collectively with renewable energy sources, locally or at a wider geographical level. By acting collectively, the members of a community have the possibility of achieving economies of scale and scope and reducing the average cost of the green electricity they produce or consume. However, a community may not only improve the economics

[1] With the expression 'RES community', we refer to any energy community dealing with renewable energy sources. As a result, RES communities should not be confused with RECs in EU legislation. According to the definition adopted in this report, a REC is a RES community but a RES community may not necessarily be a REC.

of RES; it may also offer an opportunity to explore new forms of interactions and exchange among its members. Energy sharing and micro-grids are examples of this.

In the second step, we explore the EU legal framework for RES communities. The scientific literature and our case studies highlight the relevance of institutional factors which can foster or hinder the emergence of energy communities. At the EU level, this implies looking at the content of the Clean Energy Package (CEP). Adopted after intense policy debate, for the first time in EU energy law the Package formally defines the concept of energy communities, introduces a set of dedicated rules and tasks Member States with the implementation of an enabling framework at the national level.

In the third and final step, we reflect on how the policies put in place by individual Member States may support or oppose the organic development of RES communities. Depending on the decisions they adopt, national governments, regulators and local authorities can address (or not) the limits of the various types of RES communities and help (or not) them realise their potential. Different scenarios are then possible at the national and European level.

The structure of the chapter follows this three-step approach. Section 2 analyses the concept of RES communities, identifies its fundamental dimensions and provides a typology, suggesting the potential of and limits to the organic development of the different types of community. Section 3 explores the relevant provisions introduced in the EU legal framework by the CEP, highlights the obligations and options available to Member States in the implementation process and relates them to the types of RES community introduced in Section 2. Section 4 elaborates possible scenarios for the development of RES communities over the next decade by distinguishing between supportive and unsupportive Member States. The alternatives of a persistent heterogeneity and a gradual convergence at EU level are discussed too. Finally, Section 5 concludes the chapter by summarising the primary considerations that have emerged.

2 What do RES communities do?

The development pathways of social organisations and institutions are usually determined by the concurrent action of several forces. Some of these forces are internal and reflect the inherent logic and endogenous dynamics of the organisation or institution under consideration, while others are external and represent contextual factors able to steer the organic development of the organisation or institution in a certain direction rather than another. RES communities are no exception. To appreciate the future of RES communities, one needs to explore both the internal and the external forces and see how they interact and where such interaction can lead. On the one hand, one needs to understand members' motivations to establish or join a RES community and how the functions performed by the community can satisfy them or not. On the other hand, it is necessary to consider external factors, as for instance technological trends, social norms, market conditions and the legal framework in place, and how they affect the possibility for a RES community to perform its intended functions well and satisfy its members.

This section develops a conceptualisation of what RES communities do and how they try to address the needs and aspirations of their members. The typology it identifies constitutes an important first step towards building scenarios about the future of RES communities since it illustrates the potential for organic growth of this type of social organisation. Indeed, if a RES community delivers on the goals set by its members, it will be likely to grow by attracting other members and expanding its operations. The ability of a RES community to meet the expectations of its members is also likely to help promote a broader uptake of similar initiatives. On the contrary, if there are intrinsic limits to a RES community's ability to perform its functions and satisfy the expectations of its members, the community will stagnate or even disappear altogether, eventually discouraging others from undertaking similar initiatives elsewhere. In this case, the future of RES communities will not be rosy. Clearly, the success or failure of a RES community depends on the combination of its inherent logic and dynamics with relevant contextual factors, such as the availability of suitable and competitive generation technologies and the existence of an enabling regulatory framework. Nonetheless, by looking at the fundamentals of what a RES community does and how it responds to the motivations of its members, it is possible to identify its main strengths and weaknesses, its potential and limits.

The remainder of the section is organised as follows. Section 2.1 introduces our conceptualisation of RES communities and describes the two dimensions on which it is developed. Section 2.2 builds on the two dimensions and presents the four types of RES community that they identify. Their potential and the limits to their development are highlighted.

2.1 Geographical scope and prevailing motivation

As was mentioned in Chapter 1 and confirmed by the case studies discussed in Chapter 2, RES communities are an extraordinary multifaceted phenomenon. In essence, they are collective entities made of individuals, households, possibly small and medium-sized enterprises (SMEs) and (local) public bodies that together deal with renewable energy sources. At least to some extent, community members normally consider themselves peers, sharing something in common and enjoying similar rights in a collective initiative they usually join voluntarily. In other words, RES communities are normally characterised by open and inclusive governance that assures all community members some form of democratic participation in the decision-making process.

However, beyond these core characteristics, RES communities differ in several respects. First, they differ in terms of the activities they carry out. Although electricity generation from RES is the most common activity, many communities are involved in other initiatives too: from supplying green electricity to aggregating distributed energy resources (DER) controlled by their members; from giving advice and financial support for pro-energy efficiency investments to the construction and management of micro-grids and the recharging of electric vehicles (EV); and from conducting awareness-raising campaigns on energy sustainability to the implementation of measures that tackle energy poverty. Second, RES communities differ in terms of their members. Some communities may have thousands of members while others only have a few. In some communities, the members may be relatively homogeneous while in others they may be highly differentiated in terms of socio-demographics or motivations. Third, RES communities differ in terms of their geographical scope: in certain cases, the members and activities of the RES community are limited to a local area, while in other cases they may span an entire region or a country. Fourth, RES communities may differ in terms of their prevailing motivation: while in most cases, environmental concerns and the impact on the whole society are high on the agenda of the members and the community as a whole, in other cases interest in the economic benefits for community members deriving from acting together may play a significant role. Fifth and finally, RES communities may differ in terms of their legal form and governance structure. A cooperative form and a fully democratic decision-making process are a frequent case, but they are not the only possible configuration.

In order to build a framework to investigate the future development of RES communities, it is necessary to reduce this apparent heterogeneity by focusing on a few fundamental dimensions and abstracting from the details of specific and concrete cases of RES communities. If one looks closely at the scientific literature discussed in Chapter 1 or at the case studies presented in Chapter 2, it is possible to notice that RES communities can: 1) operate at different geographical levels; and 2) answer to different needs and aspirations of their members. These two factors define two dimensions, which we call geographical scope and prevailing motivation, on which it is possible to build a basic but meaningful conceptualisation of what RES communities do and what they offer to their members.

Each of the two dimensions can assume, at least from a theoretical point of view, two clear-cut values (reality is undoubtedly more nuanced and full of grey areas). In terms of geographical scope, a RES community can operate either locally or at a dispersed level. It operates locally when its members live close to each other and collective action takes place in the same space, i.e. in the same neighbourhood, village or district.[2] A possible example of this option is an association of businesses all located in the same block that installs a PV plant on a building's rooftop to self-consume the energy

[2] The distinction between local and dispersed communities does not reflect exclusively the extension of the area on which community members are located and act jointly. Other factors like population density may play a role since they change the possibility for community members to meaningfully interact and be part of the same collective action. For instance, while a local community can exist and operate in a rural district that covers a few tens of square kilometres but is sparsely populated, the same may not be true in a similarly wide urban area, where hundreds of thousands people live.

produced (see the case of *Partagélec* described in the Appendix to Chapter 2). Alternatively, one can imagine a cooperative of farmers living in a village that builds and supplies a biogas power plant located nearby and feed the energy generated from it into the public grid. In these cases, community members tend to share 'thick' relations. Frequent interactions involving multiple aspects of life and a common knowledge of the local situation tend to organically favour collective initiatives to solve common issues or deal with common resources in a constructive way (Ostrom, 2012). The possibility of constantly monitoring the behaviour of the other community members and the externalities generated by the various production and consumption choices minimise any incentive for free-riding and allow the community to re-align private and public interests by internalising these externalities.

By contrast, a RES community operates at a dispersed level when its members do not live close to each other and collective action may take place far away from them, i.e. at the regional or country level. An example of this possibility is provided by a cooperative of producers and consumers that invests in renewable energy generation assets and procures green electricity to supply themselves. If, as in the case of *ènostra* (see Chapter 2 Section 2), the members are scattered over a large area and often far away from the generation unit, then the cooperative is an example of a dispersed RES community. In this case, relations between community members are less frequent and usually 'narrower' in scope ('thin' relations). A specific interest or worldview rather than a place is what is shared within the community. Here, the possibility of monitoring the cooperative behaviour of the members and of internalising the externalities of the various economic choices is reduced. However, a community that operates over a vast territory has the chance of working on a larger scale and accessing more specific skills and resources. Interestingly, the development of information and communication technologies in recent decades has allowed a strengthening of this type of community by providing new ways for members to interact and share information and knowledge (see, e.g., Sundararajan, 2016; Rajan, 2019).

In terms of the prevailing motivation, a RES community can provide its members either with economic value or with relational value. It provides economic value and can be said to be 'economics-driven' when it represents a means for its members to generate, consume or save energy from RES more efficiently than if they acted individually (consider, again, the case of *Partagélec* and *ènostra*). By sharing their economic resources, community members can invest, for example, in a larger and more efficient wind turbine. Alternatively, by combining their different load profiles, they can increase the amount of energy produced by a shared generation unit that they are able to self-consume. In both cases, the RES community is seen as a way to reach a more efficient level of production or consumption of energy, thereby improving the economics up to a point that would be hardly attainable by a single household or a single small enterprise and that might be competitive with market prices.

Conversely, a RES community provides relational value and can be said to be 'relation-driven' when it is a means for its members to create relationships and new forms of interactions among themselves. In a relation-driven community, the members look for interactions with their peers, including the production and sharing of goods and services with specific characteristics, such as green and locally generated electricity. In this case, the added value of the community, and the prevailing motivation to establish or join it, is not the possibility of being more efficient than acting individually but instead the opportunity to perform activities and create products that are intimately collective. Of course, the economics are never ignored completely, but the return on the investment or the costs of the specific products shared are not the focus since they can be neglected to some extent because other more relevant objectives and preferences are identified and pursued. An example of this type of RES community is represented by the pilot in Ghent, developed within the *Wise GRID Project* and discussed in Chapter 2 Section 4. In this case, people within the community invest in RES generation, smart meters, batteries and new digital applications that allow them to improve the way they generate and use energy and to recharge a fleet of EVs that ensures a local service of shared mobility.

2.2 The potential and limits of RES communities

The two dimensions and four options presented above allow RES communities to be classified into four distinct types, the potential and limits of which can be rationally investigated, thereby laying the groundwork for exploring future scenarios of community renewable energy (Table 1).

Table 1 – Conceptualisation of RES communities.

	Prevailing Motivation	
Geographical Scope	Local & Economics-driven	Local & Relation-driven
	Dispersed & Economics-driven	Dispersed & Relation-driven

A local and economics-driven RES community provides its members with the possibility of operating collectively at the local level to achieve higher economies of scale and scope in performing activities related to renewable energy sources. This type of community builds on the human and economic resources of local actors who share thick relations. This allows them to develop mutual trust and align private and collective interests, thereby simplifying the performance of collective action. However, given the local nature of the community, the resources available to support collective action are limited. Indeed, a community of this type can hardly gather more than a few hundred people and manage more than a few hundred thousand euros to finance its initiatives.[3] This may be sufficient to install a small-to-medium-sized PV power plant (e.g., 200 kW) or a small wind turbine (e.g., 1 MW), but it is definitely not enough to allow larger and more cost-effective projects like a wind farm with several turbines or to differentiate the community's activities and the respective risks by investing, for instance, in both PV and wind energy. In a similar way, a local community may not be big enough to have adequate technical or organisational skills in-house to manage not only larger initiatives but also more sophisticated activities, like direct marketing of the energy produced or supplying energy to its members. Resorting to relevant third parties seems necessary in this respect.

From this description, it is quite clear that a local and economics-driven RES community will have the possibility of thriving if the economies of scale and scope within its reach are sufficient to make collective action economically sustainable and attractive to the current and prospective members of the community. This condition depends on several contextual factors, like the technologies available, the endowment of natural resources in the place where the community is located, the price of energy provided by conventional players, the strength of local cooperative traditions and so on. Among such conditions, as we saw in Section 4.1 of Chapter 1, the policy and regulatory framework is especially relevant. In particular, the presence of support schemes for the uptake of renewable energies that are 'community-friendly' have proved to make a significant contribution to the establishment of RES communities dealing with the generation of electricity from wind, sun and other renewable energy sources. However, once such schemes have been downsized or phased out altogether, the establishment of new local communities or the growth of the existing ones have frequently been negatively affected, confirming one of their intrinsic limitations (also see the case of *Retenergie* reported in Chapter 2 Section 2.1).

A dispersed and economics-driven RES community provides its members with the possibility of operating collectively at a supra-local level to achieve higher economies of scale and scope in performing activities related to renewable energy sources. Unlike the previous case, this type of community builds on the human and economic resources of actors that are scattered over a broader area and not concentrated in a single place. As a result, they tend to share a specific goal or worldview rather than a place and have thinner relations that may not always be sufficient or effective to solve the usual problems that collective action raises. On the other hand, the fact that the scope of the community is larger implies that greater scale in the activities performed can be reached. With several thousand members it becomes possible to invest in bigger power plants and acquire specific technical and organisational skills that can make collective action more efficient and competitive with conventional actors.

Nonetheless, growth can also draw attention to one of the main limits of this type of RES community. Indeed, a quantitative expansion of a dispersed community tends to make the relations

[3] A partial exception could be the case in which local public authorities or SMEs are part of a RES community and actively support it. Nevertheless, the number of such members endowed with significant resources cannot usually be that large if the community only operates at the local level.

among its members even thinner and to attract new members that are mainly interested in the economic benefits provided by the community but are less inclined to be actively involved in its life and decision-making process (see Chapter 1 Section 3). The result is the emergence of looser or watered-down communities that may gradually lose one of their characterising features – participatory and participated governance – resembling more and more other traditional large organisations that deal with energy. On top of that, although quite substantial in terms of scale and sophistication, even this type of community may find it difficult to compete on the same playing field with energy utilities that have resources one or two orders of magnitude bigger and swifter decision-making processes.[4]

A local and relation-driven RES community provides its members with the possibility of operating collectively at the local level to create relations and new forms of interactions. By building on the human and economic resources of local actors that share thick relations, this type of RES community offers its members the possibility of being part of something bigger and of producing forms of social value that are often hard to quantify (e.g., the option of 'donating' surplus electricity to neighbours in trouble). In this case, energy may well be just a starting point or an 'excuse' to act together in other areas, be they the protection of the environment, the empowerment and regeneration of the local community, the support for the less well-off, the promotion of cultural initiatives and so on.

For this type of community, the main challenge is to create enough relations and social value to compensate for the possible economic inefficiency of the collective action and to attract enough members and induce them to invest enough time and resources in joint initiatives so that the community can prosper. Therefore, fundamental to the success of this type of community is the presence in the local area of a large enough number of individuals interested in the new forms of interaction enabled by the community, the availability of support by public bodies and a legal framework that acknowledges the social value generated by this type of collective action and compensates for its somewhat lower efficiency level. As the Ghent pilot described in Chapter 2 highlights, local and relation-driven communities may also blossom by networking and federating with other more structured communities.

Finally, a dispersed and relation-driven RES community provides its members with the possibility of operating collectively at the supra-local level to create relations and new forms of interaction. In this case, the community builds on individuals that live in different places but share some ideals or goals, such as the democratisation of energy or a commitment to fight climate change and support the decarbonisation of the energy sector. Digital technologies are important in strengthening this type of community by improving the sharing of information and knowledge between members that otherwise would have only very thin relations. Nonetheless, dispersed and relation-driven communities may find it hard to scale up, precisely due to the difficulties in mobilising their members or acquiring new ones that are ready to be actively involved in the life of the community.

This last type of community is only likely to thrive if the social value it produces is recognised and appreciated by public policies. Indeed, if the legislator acknowledges the importance to society of this type of initiative and the fact that the entity implementing it has a nature different to that of other market actors, then it is possible to imagine that non-profit-oriented community initiatives will have their space and may grow, possibly with the support of or in cooperation with relevant public bodies or other communities that share similar values and goals. In particular, one can imagine dispersed and relation-driven communities that partner with more localised communities which are either relation-driven or economics-driven. These partnerships could be mutually beneficial since they would enable the sharing of limited material and immaterial resources, eventually fostering the creation of value for the members and/or for society at large.

[4] The relative disadvantage of RES communities vis-à-vis energy utilities may increase if the evolution of RES technologies leads to more significant economies of scale and scope or calls for more specialised competencies. A case in point is provided by offshore wind electricity generation. In the past few years, the efficient scale of this technology has increased, both at the turbine and plant level, hence favouring initiatives by a few large and specialised commercial players that run gigantic projects which are definitely not within the reach of RES communities. See IEA (2019) and IRENA (2020).

3 How does the EU treat RES communities?

The future of RES communities not only depends on what such communities offer to their members but also, and to a significant extent, on the contextual factors that define the environment in which these communities operate (see Chapter 1 Section 2.1). Among these factors, the legal and regulatory framework plays a fundamental role because it defines the rights that an entity is entitled to and the obligations it must abide by. This is all the more important in the case of RES communities, since they operate in a sector – energy – where several distinct entities interact and the relations among them are characterised by significant legal intervention and pervasive regulation.

In the case of the EU, the legal and regulatory framework is particularly important to understand the future development of RES communities, also because it changed significantly between 2018 and 2019. Indeed, before the adoption of Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources (RED II) and of Directive (EU) 2019/944 on common rules for the internal market for electricity (IEMD), EU energy law did not explicitly consider the concept of community energy, either with regard to any form of energy or with regard only to renewable energy. The adoption of the CEP, of which the two directives mentioned are important elements, represents a watershed because it formally introduces four relevant concepts. These are the notions of the jointly acting active customer (JAAC), the jointly acting renewables self-consumer (JARSC), the citizen energy community (CEC) and the renewable energy community (REC). Beyond the definitions, for each of them the CEP provides a list of rights and obligations that Member States are required to implement in their national legislation. Transposition is undergoing and Member States are supposed to complete it by December 2020 in the case of the IEMD and by June 2021 in the case of the RED II.

Given the novelty of the two directives and the usual long gestation period of any major revision of EU legislation, it is likely that the EU legal framework currently in place will be the one shaping the development of RES communities for most, if not all, of the decade up to 2030, the time reference in this report. In addition, although individual Member States may introduce or maintain additional legal institutions relevant to community renewable energy, and other communities may emerge from private law arrangements, there is no doubt that the EU legal framework and the concepts it introduces will play an important reference role in any legal development. For these reasons, an assessment of the future of RES communities in the EU cannot abstain from considering the content of the new provisions in the CEP and investigating how they may impact on the potential and limits of RES communities that were presented in Section 2.2. In doing this, it is particularly important to highlight the tasks of the Member States and the options they have available. Indeed, due to the room for manoeuvre that Member States enjoy in transposing European directives, it is inevitable that the legal and regulatory framework will differ to some extent from one Member State to another. Therefore, the current heterogeneous situation of RES communities may continue in the future, with certain countries more supportive than others. Indeed, as we will see in Section 4, such differentiated legal 'treatment' combined with the potential and limits deriving from what RES communities offer to their members will largely determine the possible scenarios for their uptake in the energy sector in the coming years.

The remainder of the section is organised as follows. Section 3.1 presents an overview of the new European legal and regulatory framework for RES communities, focusing on the definitions, rights and obligations of the new concepts of JAAC, JARSC, CEC and REC. Later, Section 3.2 expands the analysis by looking more closely at the duties of Member States and the room for manoeuvre at their disposal when defining their national frameworks for community energy.

3.1 The new European legal and regulatory framework

The adoption of the CEP represents a watershed in the EU legal framework for energy communities. In the previous legal acts reforming the energy sector and promoting the decarbonisation of the energy mix, a specific role for collective initiatives was not foreseen (Jasiak, 2018; Roberts, 2020). Groups of citizens, potentially with the contribution of local authorities or enterprises, could join forces and, for instance, establish a cooperative for the production or the purchase of green electricity. However, they could not benefit, at least at the European level, from any specific legal provision recognising their intrinsic difference from other commercial initiatives or the positive social impacts they generate. The CEP goes beyond this situation and formally introduces four relevant concepts consistent with the ambitions set by the European Commission to offer a new and fair deal to consumers and to achieve global leadership in renewable energy (Lowitzsch, 2019, p. 14).

Several contributions addressing the concepts of active customers, renewables self-consumers, citizen energy communities and renewable energy communities have already been published (e.g., Lowitzsch, 2019; Tounquet et al., 2019; Frieden et al., 2019; CEER, 2019; Roberts, 2019; Nouicer and Meeus, 2019; Hannoset et al., 2019; Jasiak, 2020). Therefore, it is not the aim of this section to present an exhaustive legal analysis. Instead, its purpose is to summarise the key elements of the new European legal and regulatory framework and link them to the typology of RES communities developed in Section 2. By doing this, this section provides an assessment of the EU's general approach to RES communities. This approach will be further expanded in Section 3.2, where the tasks and options for individual Member States will be considered in more detail.

The four relevant legal concepts are included in the IEMD (active customer and citizen energy community) and in the RED II (renewables self-consumer and renewable energy community). For the sake of simplicity, let us consider first the two concepts contained in the IEMD and later the two concepts covered by the RED II.

Jointly acting active customers

As is well known, the IEMD adopted in June 2019 aims to reform the European electricity market in order to promote further integration at the continental level, foster the decarbonisation of the generation mix and ensure that consumers are able to benefit from direct and active participation in the market, either individually or collectively. The notion of active customer is introduced in art. 2.8 and the relative set of rights and obligations is provided in art. 15. The active customer is defined as:

"a final customer, or a group of jointly acting final customers, who consumes or stores electricity generated within its premises located within confined boundaries or, where permitted by a Member State, within other premises, or who sells self-generated electricity or participates in flexibility or energy efficiency schemes, provided that those activities do not constitute its primary commercial or professional activity" (art. 2.8 IEMD).

From this definition, it is apparent that the active customer is what is usually referred to as a prosumer, or even more recently and precisely a prosumager, i.e. a consumer that produces and stores part of or all the electricity it consumes. Self-consumption, potentially coupled with the sale of electricity or flexibility in the relevant markets, is a core activity of the active customer and, importantly, the directive recognises that it can be done collectively. However, it is equally important to observe that the definition of a JAAC does not necessarily involve the establishment of a community. No specific provision mentions the way in which the activity of collective self-consumption must be organised and it is possible that conventional (i.e., professional) market actors, like electricity retailers or independent aggregators, manage groups of jointly acting active customers (Frieden et al., 2019, p. 5). Since in this case customers can basically only choose whether to join a group or not – like they can normally choose whether or not to buy a service from a retailer – it is not possible to talk about an energy community in the stricter sense that we have presented in Section 2. Moreover, it must be highlighted that the concept of active customer is technology-neutral but limited to the case of electricity. No reference to RES or to other energy vectors is foreseen, although it is likely that most of the time solar photovoltaic panels will be the technology of choice for active customers and electricity will be the energy vector employed.

In terms of the typology of RES communities developed in Section 2, it is possible to link the concept of JAAC with all the types of RES communities we identified (Table 2). JAACs can form either a local and economics-driven or a local and relation-driven community. At the same time, they can form a dispersed and economics-driven or a dispersed and relation-driven RES community. This is a consequence of the fact that active customers, although they must generate electricity within their premises, are not obliged to be close to each other when they act jointly. And the definition in the IEMD does not say much about the motivations for those customers to act together. However, it is important to highlight that the relation between JAACs and RES communities is not one-to-one: JAACs may form a RES community, but they do not necessarily have to do so as they can act in a governance framework that is not that of a community.

Table 2 – Types of RES communities and related relevant categories in the CEP.

Type of RES community	Economics-driven	Relation-driven
Local	JAAC CEC JARSC REC	JAAC CEC JARSC REC
Dispersed	JAAC CEC	JAAC CEC

Legend: JAAC = jointly acting active customer; JARSC = jointly acting renewables self-consumer; CEC = citizen energy community; REC = renewable energy community.

Regarding the relevant rights and obligations, art. 15 IEMD clearly states that active customers, either acting individually or in a group, must not be discriminated against or subject to disproportionate treatment with regard to technical and administrative requirements, procedures and charges. In addition, active customers are entitled to network charges that are cost-reflective, transparent and non-discriminatory. Active customers owning a storage facility have the right to a grid connection within a reasonable time after the request, are not subject to any double charge for stored electricity remaining within their premises, are not subject to disproportionate licensing requirements or fees and are allowed to provide several services simultaneously (art. 15.5).

At the same time, art. 15 does not foresee any explicit privilege for active customers. In particular, network charges, beyond being cost-reflective, must separately account for the electricity injected and the electricity withdrawn from the grid, thereby ensuring that active customers contribute in an adequate and balanced way to the overall cost-sharing of the system (art. 15.2, letter c). Consistently, after a transition period, net metering will no longer be allowed (art. 15.4). In a similar way, active customers are financially responsible for the imbalances they cause to the electricity system, either directly or via third parties to which they can delegate the role of balancing responsible party (art. 15.2, letter f).

Citizen energy communities

The IEMD provides a second concept which is fundamental to understanding the new legal framework for community energy in the EU, that of citizen energy community. According to the directive, a CEC is:

"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" (art. 2.11 IEMD).

This definition mentions a set of activities in the energy sector, but its focus is clearly on the membership, governance and purpose of the collective entity. Indeed, as emerges from the recitals of the directive and the list of rights and obligations provided in art. 16 IEMD, it is apparent that the aim is to provide a legal space for people, local authorities and small enterprises to freely join forces and participate together in the energy sector. However, to receive the label of CEC and benefit from the corresponding enabling regulatory framework, a few criteria must be satisfied. First, although no specific legal form is required, a CEC must be a recognised legal entity, like a cooperative of producers or an 'official' association, participation in which is voluntary and open.[5] Second, although membership is open, the governance of a CEC must be arranged in such a way that effective control is only exerted

[5] The cooperative is one of the most common forms energy communities take in Europe. Nevertheless, it is far from being the only one.

by natural persons (i.e., individuals), local authorities (including municipalities) or small enterprises (i.e., enterprises with fewer than 50 employees or an annual turnover below € 10 million). Other actors like medium and large companies may participate in a CEC or have relations with it but cannot exert any effective control.[6] Third, the primary purpose of the collective entity cannot be the generation of financial profits but the provision of environmental, economic or social community benefits to its members or to the places in which it operates. Conversely and contrary to the provision originally proposed by the European Commission, no geographical requirement exists: members or shareholders and the activities performed by the community do not have to be located close to each other but they can be dispersed and even have a cross-border component (art. 16.2, letter a). Finally, as in the case of JAACs, the use of renewable energy does not represent a constraint: it is possible but not necessary, as a CEC can deal with other energy sources for the generation of electricity.

In terms of the typology of RES communities developed in Section 2, it is possible to link the concept of CEC with all the types of RES communities we have identified (Table 2). Indeed, a CEC can be local or dispersed over a wider geographical area. It can be relation-driven or it can be economics-driven, as long as the economies of scale and scope obtained through collective action are not used primarily to generate financial profits but rather to provide economic benefits to the members or the areas where the community operates (e.g., supplying electricity, improving the efficient use of energy, recharging electric vehicles, etc.).

Art. 16 of the directive provides a list of rights and obligations that CECs are entitled to as a result of their special characteristics and in order to ensure they have the possibility of participating in electricity markets on a level playing field with other professional market actors, which are usually larger and profit-oriented. In this regard, art. 16.1 states that CECs must benefit from an enabling regulatory framework that ensures: i) cooperation with the relevant distribution system operator to facilitate electricity transfers within the community; ii) "non-discriminatory, fair, proportionate and transparent procedures or charges, including with respect to registration and licensing, and […] transparent, non-discriminatory and cost-reflective network charges." Art. 16.3 further adds that CECs: i) shall be "able to access all electricity markets […] in a non-discriminatory way"; ii) "are 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"; iii) "are treated like active customers with regard to consumption of self-generated electricity"; and iv) "are entitled to arrange […] the sharing of electricity that is produced by the production units owned by the community."

The content of art. 16 is even more relevant than it might seem at first sight if one considers the meaning attributed to the expression "non-discriminatory and proportionate treatment" in EU legal jargon. Indeed, as confirmed by the jurisprudence of the European Court of Justice (ECJ), an obligation to not discriminate implies that different situations must be treated differently. This seems to be the case for CECs: given their particular nature in terms of membership, governance and primary purpose, the duty to not discriminate against them translates into the application of specific rules that favour them vis-à-vis other market actors and that in this way re-establish a level playing field (Roberts, 2019).

Jointly acting renewables self-consumers

RED II, which was adopted in December 2018 before a final agreement on the IEMD was struck between the European Parliament and the Council, aims to promote the penetration of RES in the European energy mix and achieve binding targets for 2030. In order to do so, the directive recognises the importance of mobilising private investments, included those by households and non-energy enterprises, and overcoming local opposition to the construction of new RES-based power plants (see, e.g., recital 70). Consistently with the idea that citizens, firms and local public authorities can speed up the decarbonisation of the energy mix and their involvement can provide additional benefits in terms of jobs and social cohesion, the directive gives formal recognition of the concepts of individual and

[6] In the IEMD, 'control' means "rights, contracts or other means which, either separately or in combination and having regard to the considerations of fact or law involved, confer the possibility of exercising decisive influence on an undertaking, in particular by: a) ownership or the right to use all or part of the assets of an undertaking; b) rights or contracts which confer decisive influence on the composition, voting or decisions of the organs of an undertaking" (art. 2.56).

collective self-consumption of renewable energy and of renewable energy communities. In the directive, a renewables self-consumer is defined as:

"a final customer operating within its premises located within confined boundaries or, where permitted by a Member State, within other premises, who generates renewable electricity for its 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" (art. 2.14 RED II).

Immediately afterwards, the directive provides a separate definition of jointly acting renewables self-consumers:

"a group of at least two jointly acting renewables self-consumers in accordance with point (14) who are located in the same building or multi-apartment block" (art. 2.15 RED II).

These definitions are very similar to those of active customer and jointly acting active customers provided in the IEMD. They introduce the concept of a customer or a group of customers that perform a specific activity: self-consumption. In both cases, electricity should be generated within the premises of the customer(s) or within other premises if so desired by a Member State. In both cases, the generation of electricity cannot be the primary commercial or professional activity of the customers involved.[7] In both cases, there is no reference to any specific organisational structure or governance. JARSCs can establish an energy community but this is not a necessity: they may simply enter a scheme led and managed by a commercial organisation like a traditional electricity retailer. However, some differences between JAACs and JARSCs are equally visible. Apart from the fact that the definition of JARSC is provided in a separate clause to that of (individual) renewables self-consumers, a first, but obvious, difference is technological: renewables self-consumers must generate electricity from RES. A second difference is the lack of any reference to flexibility or energy efficiency schemes. Nonetheless, this is likely to have limited consequences in that a renewables self-consumer is also an active customer and the omission may be a mere result of the fact that the RED II does not address electricity markets specifically. Conversely, the limit to the geographical distribution of renewables self-consumers acting jointly is much more relevant: they must all be in the same building or multi-apartment block. Contrary to the case of JAACs, JARSCs must share the same place.[8]

In terms of the typology of RES communities developed in Section 2, it is possible to link the concept of JARSC with those of local and economics-driven or local and relation-driven RES communities (Table 2). However, it must be clear from what has been said above that this relation is not one-to-one: JARSCs may form a local and economics-driven or local and relation-driven RES community, but they do not necessarily have to do so.

Art. 21 of the RED II provides a list of rights and obligations associated with renewables self-consumers. As in the case of active customers, renewables self-consumers must not be subject to discriminatory or disproportionate procedures and charges or to network charges that are not cost-reflective. Moreover, for the energy that remains within their premises, renewables self-consumers must not be subject to any charge or fee unless certain conditions occur (art. 21.2, letter a).[9] JARSCs are entitled to install and operate storage systems without been liable for any double charge for the energy stored that remains on their premises (art. 21.2, letter b). Finally, they maintain their rights and obligations as final customers and have the right to receive remuneration for the self-generated renewable energy that they feed into the public grid (art. 21.2, letters c and d).

[7] In the case of JARSCs, this prohibition does not apply to household customers.

[8] This choice to limit the geographical scope of JARSCs is consistent with the goal of RED II to realise the benefits of decentralised energy production, increase local acceptance of renewable energy and mobilise additional private capital (see recitals 65 and 70).

[9] There are limits to this right which are related to the need to ensure the financial sustainability of the energy system and achieve a fair and efficient distribution of its costs, including those for the promotion of renewables, among the various actors (art. 21.3).

Paragraph 4 of art. 21 is particularly relevant since it explicitly extends the rights of individual renewables self-consumers to the case of a group of jointly acting self-consumers, who are entitled to engage jointly in generation, storage, sale and self-consumption of electricity from RES. Moreover, JARSCs are permitted to arrange the "sharing of renewable energy that is produced on their site or sites between themselves, without prejudice to the network charges and other relevant charges, fees, levies and taxes applicable to each renewables self-consumer."

Unlike the case of JAACs, renewables self-consumers have the right to an enabling framework that promotes and facilitates the development of renewables self-consumption (art. 21.6). This framework must: i) address issues of accessibility of renewables self-consumption by all final customers, including those in low-income or vulnerable households; ii) address unjustified barriers to the financing of projects; iii) address other unjustified barriers, including those for tenants; iv) provide incentives to building owners to create opportunities for renewables self-consumption, including for tenants; v) grant access to relevant existing support schemes and to all electricity markets. Finally, the directive states that renewables self-consumers must contribute in an adequate and balanced way to the overall cost-sharing of the system when electricity is fed into the grid.

Renewable energy communities

Immediately after the notion of renewables self-consumer, the RED II introduces the concept of REC, which is defined as:

"a legal entity: a) which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity; b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities; c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits" (art. 2.16 RED II).

This definition is similar to that of CECs, but even more focused on the 'organisational' aspects rather than the activities performed, which are actually not mentioned at all. Indeed, a REC is a legal entity that, depending on the applicable national legislation, provides a framework for any (bottom-up) initiative in the field of renewable energy which satisfies certain criteria in terms of membership, governance and purpose. As in the case of CECs, participation in a REC must be open and voluntary, while the prevailing goal is to generate environmental, economic or social community benefits rather than a return on the investment. However, unlike the case of CECs, a REC must be "autonomous" from its individual members[10] and membership is limited to natural persons (i.e., individuals), SMEs and local authorities, including municipalities. On top of that, a REC must be effectively controlled[11] by shareholders or members that are located in the proximity of the renewable energy installation owned and developed by the community itself. Consistently with the aim of improving the social acceptability of renewable energy projects, a REC must present a strong local dimension, thereby increasing project ownership and the probability of effectively solving any problem or opposition to it. Finally, private undertakings can participate in a REC only if such participation does not constitute their primary commercial or professional activity (art. 22.1 RED II).

In terms of the typology of RES communities developed in Section 2, it is possible to link the concept of REC with those of local and economics-driven or local and relation-driven RES communities

[10] The autonomy requirement is explained in recital 71: "To avoid abuse and to ensure broad participation, renewable energy communities should be capable of remaining autonomous from individual members and other traditional market actors that participate in the community as members or shareholders, or who cooperate through other means such as investment." From this recital, it is clear that autonomy is related to 'effective control' and implies the ability of the community to resist against the will of a specific member or an external partner, thereby ensuring the protection of the collective will of the members (see Roberts, 2019, p. 15; Hannoset et al., 2019, p. 37).

[11] The RED II does not provide a definition of what control or effective control is. However, it is possible to refer to the definition provided by the IEMD which is reported in footnote 6.

(Table 2). Indeed, although some members or shareholders of a REC may not be located close to the renewable project developed by the community, most of them, i.e. those collectively exerting effective control, must be in its proximity. This criterion is not further defined, but the geographical scope of a REC should clearly be local rather than countrywide. On the other hand, in terms of primary motivation a REC can be relation-driven or economics-driven, as long as the economies of scale and scope obtained through collective action are not used primarily to generate financial profits but rather to provide economic benefits to the members or the areas where the community operates.

The stricter conditions to satisfy in order to be a REC match up with the larger set of rights that a REC is entitled to. Consistently with the goal of promoting the deployment of renewables in the energy mix and the intention to leverage bottom-up initiatives, RED II states that RECs are entitled to produce, consume, store and sell renewable energy, share renewable energy produced within the community and access all suitable energy markets, both directly or through aggregation (art. 22.2). Unlike the case of CECs, there is no reference to the distribution service or distribution grids.

However, the directive does not only require the introduction of a formal level playing field for this new type of market actor. Given their non-commercial nature, RECs are entitled to an enabling framework that promotes and facilitates their development (art. 22.3). This enabling framework must ensure: i) the removal of unjustified regulatory and administrative barriers; ii) the cooperation of the relevant distribution system operator to facilitate energy transfers within the community; iii) the possibility of participating for all consumers, including those in low-income and vulnerable households; iv) the availability of information and the provision of tools that facilitate access to finance; and v) the provision of support for public authorities in enabling, setting up and directly participating in RECs (art. 22.4). Like the provisions applicable to CECs, the enabling framework must ensure that a REC is not subject to discriminatory treatment with regard to the activities it performs. It must be subject to “fair, proportionate and transparent procedures, including registration and licensing procedures, and cost-reflective charges, as well as relevant charges, levies and taxes,” to ensure that it contributes “in an adequate, fair and balanced way” to the energy system cost-sharing (art. 22.4, letter d).

However, a REC must also respect a series of obligations. In particular, it cannot violate the rights and obligations of its members as final customers and must be subject, when performing services such as supply and aggregation, to the relevant provisions that regulate these activities (art. 22.4, letter b). Consumers participating in a RECs must also receive equal and non-discriminatory treatment (art. 22.4, letter i).

If Member States desire so, they can allow cross-border participation in RECs (art. 22.6). In any case, when designing support schemes for RES they are obliged to take into account the specific characteristics of RECs and ensure that they can compete for the awarding of such support on an equal footing with other market participants (art. 22.7).

3.2 The role of Member States in the definition of the legal and regulatory framework

EU Member States play a fundamental role in the definition of the legal and regulatory framework for community energy. In the EU legal order, directives provide the general rules and goals that legislation in Member States must respect and pursue but they are not directly applicable and neither do they contain all the necessary details for implementing those general rules and goals. It is up to the Member States to transpose, within a certain timeframe, the content of European directives in the relevant national legislation and fill the gaps that the European legislator leaves undefined or open to national differentiation.

IEMD and RED II are in this regard no exception. Member States have until the end of 2020 to transpose the first directive and until June 2021 to transpose the second. The process is currently ongoing and Member States have to take important decisions and benefit from some discretionary margins, also because a clear legal and regulatory practice in this field is generally lacking (Roberts, 2019; Hannoset et al., 2019; Jasiak, 2020; REScoop.eu and Client Earth 2020). Thanks to this room for manoeuvre, Member States can implement within their borders a legal and regulatory framework that might be more or less conducive to the development of community energy in general and of RES communities in particular (Roberts, 2019). Following the same sequence as in Section 3.1, we highlight here the main options available to Member States and show how they can provide more or less support for the uptake of RES communities.[12]

Jointly acting active customers

Member States can be more or less supportive of JAACs in various ways. First, they can permit or not permit active final customers to consume, store or sell electricity generated on premises that they do not own. This is an option left open by the definition of active customers in art. 2.8 IEMD, which can be used by Member States to facilitate or not facilitate the ‘activation’ of final customers, either individually or collectively.[13]

Second, Member States have to introduce technical and administrative requirements, procedures, charges and network charges that are not disproportionate or discriminatory. Network charges must also be cost-reflective, transparent and separately account for electricity fed into the grid and electricity consumed from it. These principles are clear in abstract terms, but their concrete implementation can take different forms and leaves margins for choices that are more or less supportive of active customers and the RES communities they may form. On top of that, Member States have the possibility of applying different provisions for individual and jointly acting active customers (art. 15.4 IEMD). Although any difference in treatment must be proportionate and duly justified, it is clear that a Member State may decide to favour individual rather than collective active customers. As a result, RES communities can be penalised.

Citizen energy communities

Member States can be more or less supportive of CECs in various ways. First, they can choose: a) whether or not to open CECs to cross-border participation; b) whether or not to allow them to own, establish, purchase or lease distribution networks and to autonomously manage them; and c) whether to provide them with exemptions if they manage a closed distribution network (art. 16.2 IEMD). In all these cases, the European legislator leaves the final decision to the Member States. A State that is particularly willing to promote the emergence of bottom-up initiatives can then decide to allow a CEC to be involved in the distribution service, thereby further expanding the number of activities that can be performed collectively and the possible relations and added value that can be created and managed within the community. Conversely, a State that is more concerned, for example, with the provision of a standard quality level of the distribution service can decide to not allow citizen energy communities to undertake such activity. As a result, they will have fewer opportunities to provide value to their members or the society in which they operate.

Second, as in the case of JAACs, Member States can implement the obligations foreseen in art. 16 IEMD in different ways. An example of this is the obligation on Member States to allow CECs to arrange internal sharing of the electricity generated by the production units owned by the community itself (art. 16.2, letter e). The same article states that energy sharing must occur “without prejudice to applicable network charges, tariffs and levies, in accordance with a transparent cost-benefit analysis of distributed energy resources developed by the competent national authority.” Except for the fact that the analysis must be transparent and performed by the competent national authority, the directive does

[12] The discretion of Member States is not limited to the possibility of meeting in different ways the requirements foreseen by the two directives with regard to JAACs, CECs, JARSCs and RECs. In fact, Member States can go beyond the mere ‘box-ticking’ of the prescriptions contained in the directives and, also depending on their specific histories, current conditions and potential, establish or confirm the existence of additional types of energy communities to CECs and RECs. In particular, a Member State may follow a ‘liberal approach’ and introduce or confirm the existence of an inclusive national model of energy community that must respect less strict requirements but also enjoys fewer rights than a CEC or a REC. On the contrary a Member State may follow a ‘national golden standard’ and introduce or confirm the existence, where already in place, of a restrictive national model of energy community that must respect more stringent criteria but also benefits from more rights and privileges than a CEC or a REC (Jasiak, 2019). For the sake of simplicity, we will not consider these possibilities in the present analysis.

[13] It is clear that if a Member State allows active customers to consume, store or sell electricity generated only on their premises located within confined boundaries, customers willing to become prosumers or prosumagers will face more constraints than if the Member State allows them to generate electricity also on other premises. The constraint could be particularly hard for residential customers living in small dwellings in urban areas.

not say anything about what the analysis should include and what the key performance indicators should be. In this regard Member States are quite free, a situation which may clearly lead to different results and to different choices over the network charges, tariffs and levies that apply to the electricity shared. In turn, they may lead to regulatory frameworks that are more or less favourable to this activity and to the energy communities that focus on it.

Jointly acting renewables self-consumers

As in the case of active customers, Member States can be more or less stringent in the identification of the spaces where renewables self-consumers can operate. Although the definition of JARSCs provided in art. 2.15 of the RED II limits the location of jointly acting renewables self-consumers to the same building or multi-apartment block, the definition of renewables self-consumers provided in art. 2.14 RED II leaves a margin of flexibility open by stating that if it so desires a Member State can allow renewables self-consumers to operate not only on their premises located within confined boundaries, but also "within other premises." The consequence of this is a possibility for JARSCs to position the generation or storage unit in a part of the building or multi-apartment block that they do not own. This can be helpful since space may be limited in the JARSCs' premises, not allowing an optimal sizing of the generation or storage unit.

Member States can then offer different degrees of support to JARSCs by differently implementing the provisions contained in art. 21 RED II. Among these provisions, there is the definition of the remuneration for self-generated renewable electricity that is fed into the grid. Art. 21.2, letter d states that such remuneration "reflects the market value of that electricity and may take into account its long-term value to the grid, the environment and society." This statement gives ample discretion to Member States. Although they must all ensure that the remuneration for electricity injected into the grid reflects electricity market prices, they are then free to provide additional remuneration based on the "system value" of this electricity, possibly through dedicated support schemes. Depending on the choice made at the national level, the economics of renewables self-consumers can then change significantly. This may foster the development of certain local RES communities which are able to generate additional revenue to cover their cost or provide additional services and other benefits to their members or the society in which they are embedded.

Similarly, the economics of JARSCs and the related RES communities can be affected by Member States' choices whether to apply "non-discriminatory and proportionate charges and fees in relation to the self-generated renewable electricity remaining within the premises of the renewables self-consumers" (art. 21.3). While as a general rule the directive sets the non-applicability of any charge or fee, art. 21.3 provides for some exceptions. However, a Member State is not obliged to apply them. It is free to continue to exempt self-generated electricity that remains within the premises of self-consumers from any charge or fee even if this electricity benefits from support schemes, comes from installations larger than 30 kW or, after 2026, the share of self-consumption installations in the Member State exceeds 8% of the total installed capacity. Again, the choice to not burden self-consumed electricity with any charge or fee could represent a significant benefit for certain local RES communities, which can provide their members with energy at a lower overall cost, thereby increasing their attractiveness.

Art. 21.4 provides Member States with another option: as in the case of active customers, they have the possibility of differentiating between individual and jointly acting self-consumers. A Member State can then introduce certain rules that are more (or less) favourable to JARSCs. In any case, such differentiation must be "proportionate and duly justified."

Finally, Member States can include more or less support in the enabling framework they are obliged to put in place for the development of renewables self-consumers (art. 21.6). Indeed, the description of such mandatory enabling framework provided by the directive is quite 'high level'. The directive says that the framework must be based on an "assessment of the existing unjustified barriers to, and of the potential of, renewables self-consumption in the territories and energy networks" of the Member States. Among other things, the framework must also include a set of measures to address issues such as access by low-income or vulnerable households to self-consumption, but the details of such measures are generally up to the Member States. As a result, implementation of the directive at the national level will be key in determining how effective the enabling framework will be.

Renewable energy communities

The implementation of the RED II at the Member State level is also extremely important for the definition of the legal and regulatory framework for RECs. First of all, Member States need to further specify the eligibility criteria provided in the definition of RECs that can be found in art. 2.16 RED II. The autonomy, effective control and proximity criteria mentioned there are likely to require further specification. The notion of proximity is particularly vague and needs to be clarified. The choice made at the Member State level will have an impact. If proximity is interpreted in a very narrow sense, only a limited number of people, enterprises and local authorities will satisfy the criterion and RECs will be somewhat small entities, usually unable to exploit significant economies of scale and scope. On the contrary, if it is interpreted in a less narrow sense, on average a larger number of people, enterprises and local authorities will be allowed to be among the community members or stakeholders exerting effective control. In this case it will be possible for RECs to achieve greater sizes and higher efficiency.

Moreover, Member States can exert their discretion and differentiate their levels of support in the implementation of the enabling framework they are mandated to put in place to promote and facilitate the development of RECs. According to the RED II, among other things Member States must ensure the removal of unjustified regulatory and administrative barriers, the cooperation of distribution system operators, the participation of all consumers, the capacity-building of local public authorities, the provision of tools to facilitate access to finance and information, and so on and so forth. Among the elements of this enabling framework, there is also the definition of fair, proportionate and transparent procedures, cost-effective network charges, and other relevant charges, levies and taxes, which must ensure an adequate, fair and balanced contribution of communities to the overall cost-sharing in the system (art. 22.4, letter d). Interestingly, the contribution to overall cost-sharing must be in line with "a transparent cost-benefit analysis of distributed energy sources developed by the national competent authorities." As in the case of citizen energy communities mentioned above, no further details on how this analysis should be carried out are provided.

In a similar fashion, art. 22.7 prescribes that Member States should "take into account the specificities of renewable energy communities when designing support schemes in order to allow them to compete for support on an equal footing with other market participants." The rationale for this mandate is apparent but the provision clearly leaves the Member States with the possibility of deciding how they need to design RES support schemes in a way that ensures competition on an equal footing.

Finally, it is up to Member States to decide whether to open RECs to cross-border participation (art. 22.6). This could be a relevant opportunity for the emergence of communities along the borders of two or more Member States, but not only. Provided that the members or stakeholders located in the proximity of a renewable project exert effective control, the right to cross-border participation would allow inclusion in the community of members from another country not necessarily located close to the project. This may facilitate the collection of resources and skills to support the activities performed by the community.

4 What scenarios for the next decade?

RES communities play today a limited role in the European energy system and it is hard to predict their future, as they are not a homogeneous phenomenon and several factors affect their development. Nevertheless, the typology of RES communities introduced in Section 2 and the new European legal framework described in Section 3 provide the basis for building qualitative development scenarios of RES communities in the EU in the next decade.

The implementation of the CEP offers Member States the opportunity to create at the national level a favourable legal and regulatory framework that addresses the potential and limits of RES communities and foster their uptake. Indeed, the new legislation provides Member States with various options and the duty to support, in particular, those local energy communities that invest in renewable energy assets. However, the way rules are written is such that Member States enjoy significant room for manoeuvre: it is up to them to choose, to a significant extent, which type of energy community to support and by how much. Depending on the choices taken by Member States, different development scenarios for RES communities are possible at the national level. A country that introduces network charges that are particularly favourable to local self-consumption can provide a tremendous push to the emergence of local RES communities, while a country that adopt a generous feed-in tariff for RES units owned by community initiatives may support the proliferation of cooperatives of energy producers, not necessarily local.

The importance of these national decisions and the leeway available to Member States means that the current heterogeneous landscape for RES communities in Europe may persist in the coming years. Building on a differentiated set of contextual factors, different national decisions are likely to prolong the diversity in the national development pathways of RES communities: while certain countries will develop a relatively large set of energy communities, possibly of a specific type, in other countries community energy will not leave the niches it currently occupies. Some form of convergence in the development pathways cannot be excluded; however, for the period considered in this report it is likely to be limited to Member States that share some commonalities in contextual factors like the endowment of renewable energy sources or the prevailing attitude to collective action and cooperatives.

The remainder of the section is organised as follows. Section 4.1 illustrates how the different implementation of the CEP by supportive and unsupportive Member States translates into alternative development scenarios for the various types of RES communities at the national level. Later, Section 4.2 briefly investigate whether heterogeneity rather than convergence is more likely to characterise the future of RES communities in the EU in the coming decade.

4.1 Supportive vs unsupportive Member States

The implementation of the new legal and regulatory framework provided by the CEP represents an opportunity for EU Member States to support the development of the various types of RES communities to a greater or lesser extent. The legal categories of JAAC, CEC, JARSC and REC and the related set of rights and obligations define a space within which Member States are free to move and support RES communities.[14] Depending on the decisions they take in the implementation process at the national level, Member States can address the potential and limits of RES communities and foster their development. However, given the fact that RES communities are not all the same and are characterised by different strengths and weaknesses depending on their geographical scope and prevailing motivation, assessing the impact of the implementation process on future development scenarios requires the various types of RES communities to be considered separately.

Let us start with local and economics-driven communities. As we saw in Section 2, the potential for this type of community is related to the possibility of more easily aligning the private interests of the members and coordinating collective action, while the main limit is given by the restricted size and scope of the community, which might translate into higher costs or an impossibility *tout court* of performing complex activities. All the new legal categories provided by the CEP can be relevant in this regard and several tools are assigned to Member States for the promotion of local and economics-driven RES communities (Table 2). In particular, the legal framework for JARSCs and RECs recognises a series of options that can weaken the negative effect of limited size and scope on the development of local and economics-driven RES communities. According to the CEP, the electricity self-generated by renewables self-consumers that remains within their premises is exempt from any charge or fee, while the energy that is injected into the grid must be remunerated. In this regard, Member States can define the remuneration level considering not only the market price of energy but also its long-term value to the energy grid, the environment and society. Furthermore, in the case of RECs, Member States must consider their specific characteristics when designing public schemes to support renewable energies. The procedures and processes for awarding support must provide a level playing field and the concrete possibility for RECs to access the available subsidies. All of this, coupled with other elements of the enabling framework that Member States are obliged to introduce for CECs, JARSCs and RECs, implies that a country willing to do so can effectively improve the 'economics' of local RES communities and allow them to be competitive in terms of costs with other non-community based ways of generating or consuming green electricity.

Of course, it is up to Member States to choose how much support to provide and how many resources to mobilise. Member States are free to limit remuneration for electricity fed into the grid by

[14] As mentioned in footnote 12, Member States can also introduce additional legal models of energy community; arrangements based on private law are also possible.

jointly acting renewables self-consumers to the level of electricity market prices or to introduce charges for self-generated electricity that remains within the premises of renewables self-consumers whenever the possible exemptions provided for in the RED II are applicable. Alternatively, a Member State may simply offer such inadequate support schemes for renewable energy sources in general that communities will not have anything to compete for on a level playing field with non-community actors.[15] A Member State may also be less supportive of the development of local and economics-driven RES communities if it implements the proximity condition for RECs in a very strict way. By doing this, the maximum size of a REC could be reduced to the minimum with the result that it would be even more difficult for it to be cost-effective.[16] In all these cases, assuming the other contextual factors remain the same, the development of local and economics-driven RES communities is likely to be less significant.

Second, dispersed and economics-driven communities. The potential for this type of community is connected to the possibility of mobilising a larger amount of resources and operating at a higher level with a more diverse set of activities or contexts, while the main limit is related to the possibility that the expansion and professionalisation of the community, although still far away from the levels reached by traditional energy market players, may lead to it attracting less committed members and a loss of the participatory and participated governance that characterises a true community. The relevant categories provided by the CEP are in this case JAACs and CECs, the definition of which does not mention any limit to their geographical scope (Table 2). In particular, the IEMD mandates the adoption of an enabling framework by Member States with the purpose of promoting and facilitating the emergence of CECs (e.g., the adoption of transparent, non-discriminatory and cost-reflective network charges, the cooperation by DSOs, etc.), but only reserves this framework to legal entities that satisfy certain criteria in terms of membership, governance and purpose, criteria that are up to the Member States to specify beyond the general principles stated in the directive. By limiting the applicability of the enabling framework, Member States can target support and induce dispersed communities to preserve their original characteristics based on voluntary participation, effective control by the members and a non-financial primary purpose.

As was observed in Section 3, CECs are not RES-specific and no dedicated measure is foreseen to support their economics beyond the requirements to avoid any discrimination in their treatment as market actors, in the definition of the relevant technical and administrative procedures or the computation of related network charges. In this sense, the CEP does not provide for targeted support of communities that deal with renewable energies and that go beyond the local dimension. It is then up to Member States to introduce, if they want, additional and specific schemes. If they do not, the development prospects for dispersed and economics-driven RES communities could be less rosy since they may continue to suffer from a limited size or the lack of professionalism that do not allow them to be as efficient as other traditional market players.

Third, local and relation-driven communities. The potential for this type of community is associated with the possibility for its members to develop new forms of relation and share specific products that address their preferences and needs, while the main limit is given by the limited size of the community, the frequently high cost of what it does and possibly the difficulty in attracting a sufficient number of members willing to commit time and resources. All the new legal categories provided by the CEP can be relevant in this regard and allow Member States to support the emergence of this type of RES community. In particular, the new rules enable local communities to be involved in a broad number of activities: not only the generation, storage, consumption and sale of energy but also its sharing within the community and the possibility of participating in flexibility and energy efficiency schemes. Supportive Member States can also allow communities to own, establish, purchase or lease

[15] Experience shows how the absence of easily accessible and stable RES support schemes is a major barrier to the fast uptake of RES communities that are focused on the generation of electricity, probably the most common type of RES community in the EU during the past decade (Wierling et al., 2018).

[16] As seen in the case study of collective self-consumption in France (Chapter 2 Section 3), the higher average cost of smaller generation assets represents a challenge for the uptake of local communities based on local generation and consumption of electricity produced from RES.

distribution grids and to autonomously manage them.[17] Member States are required to ensure that the energy communities involved in these activities are treated in a proportionate and non-discriminatory manner and that cooperation by distribution system operators for the transfer of energy is ensured. As a result, communities can provide their members with a whole set of activities and sources of value, making them free to act collectively in several energy-related initiatives.

The new provisions also support this type of RES community by relieving the pressure exerted by costs and by allowing them to internalise some of the benefits they provide to the electricity grid, the environment and society. As mentioned above, renewables self-consumers and communities performing this activity are exempt from any charge or fee for electricity self-generated from RES that remains within the premises of the self-consumers. They also benefit from remuneration for excess energy injected into the grid and from cost-reflective network charges. The latter provision allows national regulators to recognise the cost savings that localised energy self-consumption may provide the electricity system with and to define reduced network charges for communities involved in this activity. Moreover, within the enabling framework that Member States must implement, there are other measures that can be of help in the development of local and relation-driven RES communities: rules and incentives that promote the involvement of tenants and building owners, tools that support access to finance and the sharing of relevant information, and regulatory and capacity-building support for public authorities willing to enable, set up or participate in RECs.

Member States can implement all these measures more or less strongly, as they can define the boundaries of RECs more or less narrowly. As a result of this, supportive countries seem to have the tools to foster the uptake of local and relation-driven RES communities, whereas less supportive countries that implement the provisions contained in the CEP to the minimum possible extent will probably see a much more limited emergence of this type of RES community.

Fourth and finally, dispersed and relation-driven communities. The potential for this type of community is connected to the possibility of bringing together people from different places and backgrounds that share similar views of the world and are willing to interact and do things together, although from a distance, while the main limit is represented by the lack of thick relations among the participants and the weakness of the bonds that link them. The consequence will be frequent difficulty and slowness in transforming common ideas and preferences into collective initiatives and producing value capable of mobilising the current members and attracting new ones. In this regard, the provisions of the CEP are somewhat less helpful than for the other types of RES communities. First of all, only the categories of JAACs and CECs are relevant since JARSCs and RECs refer to local realities.[18] Second, the new rules open various possibilities for dispersed communities to be actively involved in the energy sector. As said above when discussing the scenarios for dispersed and economics-driven communities, the IEMD foresees the possibility for CECs to be involved in the generation, storage, consumption, self-consumption and sharing of energy. CECs can also participate in flexibility and energy efficiency schemes and, when they are allowed by Member States, can be involved in distribution. All of this enables community members to interact and get value from their participation in the community.

However, beyond this recognition of the right to perform several activities, there is not much else that the new European legal framework provides. Member States are mandated to ensure proportionate and non-discriminatory treatment of such communities when performing the functions of generators, distributors, sellers or consumers of energy but nothing is provided in terms of additional policies that acknowledge the social benefits of dispersed and relation-driven RES communities and that support their uptake . As a consequence, it seems that implementation of the CEP alone may not be sufficient to promote the emergence of this type of RES community. If countries want to see them thriving, they probably need to do more and adopt additional provisions that target this specific category of collective actors. A possibility in this regard may be the promotion of networks or federations of communities, both local and dispersed, which can build on their differentiated strengths and support each other in dealing with their relative weaknesses.

[17] This possibility is foreseen for CECs. Although possible, a CEC is not necessarily a dispersed community: its geographical scope can be merely local.

[18] Individuals not living close to the RES project owned or operated by a REC can be members of the community. However, members satisfying the proximity requirement must exert effective control of the REC. This means that a REC has always a strong local connotation.

4.2 Persistent heterogeneity or gradual convergence?

The way Member States implement, and complement, the CEP will play a crucial role in the establishment of a favourable legal and regulatory framework for RES communities. Depending on the choices adopted by national governments, regulatory authorities and local public bodies, different types of RES communities will likely receive support to a greater or lesser extent. Given the specific requirements provided for in the RED II, it is probable that local RES communities will be supported more and may thrive more than other types. However, this is not necessarily the case. Member States can in fact introduce additional legal types of communities and adopt other support policies; by doing this, they may decide to address more carefully the case of dispersed RES communities, a category that does not benefit from dedicated attention in the CEP and only indirectly and partially benefits from the legal framework that covers JAACs and CECs.

The room for manoeuvre that is available to Member States and the differentiated situations currently existing at the national level are likely to lead to a persistent heterogeneous development of RES communities. In some less supporting countries, RES communities will not move much from where they stand today and remain marginal in the evolution of the energy system, while in other more favourable countries RES communities may thrive and exit from the niche in which they presently operate. Diversity between Member States could characterise not only the penetration level achieved by RES communities as a whole but also the relative importance of the various types of RES communities on the total. In some countries, for instance, public policies may push particularly hard local RES communities, enabling them to multiply as fast as individual PV-based prosumers did after the adoption of the Energy and Climate Package in 2009. In others, dedicated support schemes may allow dispersed RES communities to bid for RES subsidies and be able to install significant amounts of new generation capacity by 2030, thus becoming important actors in the energy transition.

Although likely, heterogeneity in the national scenarios for RES communities is not necessarily the only possibility. Convergence may occur between a few Member States that share similar contextual factors, as for instance the specific endowment of renewable energy sources or the presence of a strong cooperative movement. Convergence may also well occur between Member States that adopt similar legal and regulatory frameworks, perhaps because of the choice to pursue similar policy goals or due to the development of a common understanding of the phenomenon of RES communities and the best policies to ensure its appropriate development.

Convergence may also be the consequence of the adoption of more harmonised and detailed set of rules at the European level. This represents a frequent dynamic in several European policy areas. After an initial phase in which Member States are allowed to preserve a certain degree of freedom and experiment with national solutions, a more harmonised and detailed set of European rules is adopted, often by means of regulations instead of directives. However, this type of convergence at the EU level requires: a) an agreement on the fact that a harmonised approach is better or is actually necessary to achieve fundamental EU goals; and b) an agreement on the rules to adopt and their implementation. The fulfilment of these conditions usually calls for considerable time, possibly even decades.[19] First, experience with nationally differentiated policies must be collected; then dissatisfaction with those policies needs to emerge and become broadly accepted; finally, new and harmonised legislation must be proposed, negotiated and adopted. In the light of these considerations, 2030 could be too close to allow the harmonisation of the legal and regulatory framework for RES communities at the EU level and to support, as a result, the convergence of their national development pathways.

5 Conclusions

RES communities currently play a limited role in the EU energy system and their future is still largely unexplored. They represent an extraordinarily multifaceted phenomenon, whose potential for development and limits to diffusion can be investigated by considering what they do and how the legal and regulatory framework treats them, both at the EU and national level.

[19] Almost 20 years passed between the adoption of the first European directive on the internal market for electricity (1996) and the adoption of the first EU network code specifying a harmonised set of rules for the cross-border trade of electricity (Glachant et al., 2015; Meeus 2020).

RES communities are essentially groups of people that, possibly in conjunction with small and medium-sized enterprises and local public authorities, together deal with renewable energy sources. Based on rules and decisions that are chosen collectively, RES communities may produce, supply, distribute, share and consume energy from RES. Two basic dimensions allow mapping the various particular cases of RES communities: the geographical scope at which they operate and the prevailing motivation that drives collective action. The first can be local or dispersed, while the second can be economic or relational. These two dimensions identify four fundamental types of RES communities that are characterised by different strengths and weaknesses and that can be used to investigate the future development and diffusion of the phenomenon.

Local RES communities operate at the neighbourhood, village or district level and usually build on the thick social relations that exist among members living close to each other and that favour the implementation of collective initiatives. This strength is counterbalanced by the limited resources that can be mobilised locally and that may prevent the achievement of an economically efficient production level. On the contrary, dispersed RES communities are active over a wider area and involve members that share some ideas or interests rather than a specific place. This broader geographical scope allows the deployment of a larger amount of resources and a more efficient production level; however, such advantage may be offset by the greater difficulty to coordinate collective action in the presence of thinner social relations among community members.

Economics-driven RES communities are motivated by the possibility to achieve higher economies of scale and scope in the production, supply or consumption of renewables by acting together instead of individually. In this case, collective action reduces costs and may attract a large number of people. However, the emergence of a more 'utilitarian' membership can change the nature of the community and transform it into something more similar to conventional market actors. On the contrary, relation-driven RES communities are motivated by the possibility to develop new relations and forms of interaction, thereby satisfying members' preferences for specific products and a genuinely communitarian approach to energy. Yet, this key strength of relation-driven RES communities can be counterbalanced by their idiosyncratic nature and the likely higher cost of the services they provide to their members. These weaknesses may limit the potential for growth and scale-up.

The Clean Energy Package (CEP), adopted between 2018 and 2019, is expected to represent a turning point for the development and diffusion of RES communities in Europe, as for the first time both their very existence and their potential role in the energy transition receive legal recognition at the EU level. Within the Package, particularly relevant are Directive 2018/2001 on the promotion of the use of energy from renewable sources (RED II) and Directive 2019/944 on common rules for the internal market for electricity (IEMD). They introduce in the EU four new legal concepts. Two of them refer to groups of customers, not necessarily organised in communities, to which is recognised the right to be collectively active in the electricity markets and the right to collectively self-consume the energy locally produced from RES. They are called, respectively, jointly acting active customers (JAACs) and jointly acting renewables self-consumers (JARSCs). The other two concepts refer to two specific types of community-based initiatives in the field of energy that are entitled to an enabling regulatory framework due to their specific characteristics in terms of membership, governance and purpose. They are called, respectively, citizens energy communities (CECs) and renewable energy communities (RECs).

The two directives provide a set of rights and duties for these new categories of collective entities and specify a list of obligations that Member States must implement at the national level in order to ensure them a proportionate and non-discriminatory treatment and, under certain circumstances, a series of advantages to promote and facilitate their development. By 2021, all EU Member States will have to transpose the CEP's directives into national legislation. However, substantial room for manoeuvre is left to Member States in accomplishing the task. Indeed, the directives set the general principles and duties, but it is up to Member States the definition of all the details that must ensure fair, proportionate and transparent procedures and requirements, cost-reflective and non-discriminatory network charges, levies and taxes, and so on. Moreover, Member States have the possibility to specify the criteria that must be satisfied in order to qualify as a CEC or a REC and the limits within which JAACs and JARSCs can operate. Member States can also choose whether to assign or not certain rights to CECs and RECs, as the possibility to own and manage distribution grids for electricity or be open to cross-border participation. Finally, it is up to Member States to decide their effort level in the implementation of the enabling framework they are mandated to establish for JARSCs, CECs and RECs.

The new legal framework, introduced by the CEP and to be completed by Member States at the national level, will impact on the development of RES communities in the EU during the next decade. Although a perfect correspondence is difficult, it is possible to broadly match the four categories established by the CEP with the four different types of RES communities identified by the basic dimensions of geographical scope and prevailing motivation. Due to the absence of a specific spatial boundary, JAACs and CECs can be linked with all the types of RES communities while, on the contrary, JARSCs and RECs can be linked only with local RES communities, both economics and relation-driven. However, it is important to notice that JAACs, JARSCs and CECs do not always constitute a RES community: for instance, a CEC may not make use of renewables, while a group of JAACs or JARSCs may operate under the lead of a conventional market actor.

The matching of the legal categories introduced by the CEP with the conceptual types of RES communities highlights the possibility for Member States to support the uptake of local communities, both economics and relation-driven. The provisions contained in the CEP recognise the opportunity for groups of people, enterprises and public authorities organised at the local level to invest jointly in renewable power plants, to participate in electricity markets collectively, to share the energy produced, to enter into peer-to-peer trading arrangements, etc. Member States are mandated to ensure that when performing these activities communities are not discriminated or subject to non-proportionate requirements. Moreover, local RES communities that qualify as RECs or are made by JARSCs can benefit from the enabling frameworks that the CEP obliges Member States to adopt. In this case, the right to a remuneration for the energy injected into the grid, the right to be exempt from charges and levies on the energy that does not leave the premises of the community members, and the right to effectively access support schemes for renewables can improve the economics of collective action and ease those financial constraints that represent a frequent barrier to the diffusion of local RES communities. The CEP also enables Member State to support the development and diffusion of dispersed RES communities. However, this happens in a more indirect and partial way since the provisions for JARSCs and RECs are not applicable and those for JAACs and CECs do not target specifically communities dealing with renewable energy.

In the coming years, Member States can be more or less supportive of RES communities in general and of specific types of them in particular. This can be the result of them implementing the European provisions for JAACs, JARSCs, CECs and RECs to a different extent and making different choices on the options that the CEP leaves to national governments. Member States can also be more or less supportive by recognising legal models for RES communities in addition to those included in the CEP, by designing renewables support schemes in a way that RES communities other than RECs can have easy access to, or by promoting the emergence of networks of RES communities able to take advantage of their respective strengths and weaknesses and better support each other.

It is likely that during the next decade the relevance of national legal and regulatory choices coupled with the leeway that the CEP gives Member States will translate in a persistent heterogeneity of national development pathways of RES communities. While in supportive countries RES communities, or at least certain types of them, will thrive, in other less supportive countries they will remain marginal in the evolution of the energy system. Convergence of these development pathways cannot be entirely excluded, especially between Member States that share similar conditions and adopt similar legal and regulatory frameworks; nevertheless, it will be probably gradual and become more visible towards the end of the decade because of the time needed to share experiences and learn from each other, to consolidate an accepted regulatory practice on energy communities, and to possibly agree on, develop and implement a more harmonised set of detailed rules at the EU level.

References

Caramizaru, A. and A. Uihlein (2020), *Energy communities: an overview of energy and social innovation*, EUR 30083 EN, Publication Office of the European Union, Luxembourg.

CEER (2019), *Regulatory aspects of self-consumption and energy communities*, CEER Report C18-CRM9-DS7-05-03, Council of European Energy Regulators.

Frieden, D., Tuerk, A., Roberts, J., and G. Andrej (2019), *Collective self-consumption and energy communities: Overview of emerging regulatory approaches in Europe*, Working Paper of the Compile Project, June 2019.

Hannoset, A., Peeters, L., and A. Tuerk (2019), *Energy Communities in the EU – Task Force Energy Communities*, Bridge Horizon 2020, December 2020.

IEA (2019), *Offshore Wind Outlook 2019*, IEA Publications, Paris, October 2019.

IRENA (2020), *Renewable Power Generation Costs in 2019*, International Renewable Energy Agency, Abu Dhabi.

Jasiak, M. (2018), *Energy communities in the Clean Energy Package*, European Energy Journal, 8(1), 29-39.

Jasiak, M. (2019), *Prosumers in the Clean Energy Package – the way forward*, EUSEW, 19 June 2019, Brussels.

Jasiak, M. (2020), *Energy communities in the Clean Energy Package: Assessment of the adopted regulatory framework*, European Energy & Climate Journal, 9(1), 48-55.

Kampman, B., Blommerede, J., and M. Afman (2016), *The potential of energy citizens in the European Union*, CE Delft, Delft.

Lowitzsch, J. (2019), *Investing in a Renewable Future – Renewable Energy Communities, Consumer (Co-)Ownership and Energy Sharing in the Clean Energy Package*, Renewable Energy Law and Policy Review, 9(2), 14-36.

Nouicer, A. and L. Meeus (2019), *The EU Clean Energy Package*, Technical Report, Florence School of Regulation, Florence.

Ostrom, L. (2012), *The Future of the Commons. Beyond Market Failure and Government Regulation*, The Institute of Economic Affairs, London.

Rajan, R. (2019), *The Third Pillar: How Markets and the State Leave the Community Behind*, Penguin Press, New York.

REScoop.eu and ClientEarth (2020), *Energy Communities under the Clean Energy Package – Transposition Guidance*, Brussels.

Roberts, J. (2019), *What energy communities need from regulation*, European Energy Journal, 8(3-4), 13-27.

Roberts, J. (2020), *Power to the people? Implications of the Clean Energy Package for the role of community ownership in Europe's energy transition*, Review of European, Comparative & International Environmental Law, 29(2), 232-244.

Sundararajan, A. (2016), *The Sharing Economy: The End of Employment and the Rise of Crowd-Based Capitalism*, MIT Press, Cambridge.

Tounquet, F., De Vos, L., Abada, I., Kielichowska, I., and C. Klessmann (2019), *Energy Communities in the European Union – Revised final report*, Asset Project.

Wierling, A., Schwanitz, V.J., Zeiß, J.P., Bout, C., Candelise, C., Gilcrease, W. and J.S. Gregg (2018), *Statistical evidence on the role of energy cooperatives for the energy transition in European countries*, Sustainability, 10, 3339.

QM-04-20-447-EN-N

Publications Office

doi:10.2870/754736
ISBN:978-92-9084-928-5