European Commission

JRC SCIENCE FOR POLICY REPORT

Energy communities: an overview of energy and social innovation

Aura Caramizaru
Andreas Uihlein

2020

Joint Research Centre

EUR 30083 EN

Contact information
Name: Aura Caramizaru
Address: Rue du Champ de Mars 21, 1050 Ixelles, Belgium
Email: aura.caramizaru@ec.europa.eu
Tel.: +32 229 82 303

EU Science Hub
https://ec.europa.eu/jrc

JRC119433

EUR 30083 EN

PDF ISBN 978-92-76-10713-2 ISSN 1831-9424 doi:10.2760/180576

Luxembourg: Publications Office of the European Union, 2020

How to cite this report: Caramizaru, A. and Uihlein, *A., Energy communities: an overview of energy and social innovation*, EUR 30083 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-10713-2, doi:10.2760/180576, JRC119433.

Contents

Acknowledgements

The authors would like to thank the JRC colleagues that made suggestions and helped review this report: Antonios Marinopoulos, Anna Mengolini, Julija Vasiljevska (JRC.C.3); Tessa Dunlop (JRC.H.1); Giorgos Koukoufikis, Evangelos Tzimas, Alain Marmier, Veronika Czako, (JRC.C.7). The report benefited from valuable discussions and insights from Jan Steinkohl, Olav Berg and Ana Maria Sanchez Infante (DG ENER). We would especially like to thank to Achille Hannoset (University of Ghent), Joshua Roberts (REScoop.eu), Roland Tual (REScoop.eu) for their valuable reviews and additions.

Authors

Aura Caramizaru

Andreas Uihlein

Executive summary

Context

The participation of citizens and communities as partners in energy projects are transforming the energy system. Community energy initiatives are offering new opportunities for citizens to get actively involved in energy matters.

Community energy refers to collective energy actions that foster citizens' participation across the energy system. It has received increased attention in recent years, developing a wide range of practices to manage community energy projects.

The European Commission's Clean Energy for All Europeans Package confirms the prominent role prosumers and their collective forms will play in the future energy system. The EU legislative framework formally acknowledges and defines specific types of community energy as 'renewable energy communities' and 'citizen energy communities'.

Objectives

The aim of this report is to provide an overview of the activities, organisation and implications of energy communities as participants across the energy system. It also aims to inform and identify paths for future policy implications and research initiatives.

The report explores findings by looking at a wide range of activities, organisational forms, drivers, societal benefits of energy communities and their contributions to renewables expansion. It also analyses the implications of energy communities as new actors for consumers and the energy system. The analysis draws evidence from literature review and 24 case studies of community energy projects as described in the Annex.

The Joint Research Centre (JRC) has previously expressed interest in the concept of collective energy actions. A 2018 paper analyses projects from the JRC smart grids database that present a community-oriented approach (Marinopoulos, Vasiljevska, and Mengolini, 2018). Another paper explored the use of blockchain in energy communities (Kounelis et al., 2017). The current report continue this work by delving into the analysis of community energy projects that could be potentially considered energy communities.

Main findings

Fostering supportive energy policy frameworks

The Clean Energy Package now recognises and offers an enabling legislative framework for citizen and renewable energy communities. Its transposition into national law will be essential for the successful development of energy communities. When developing their national energy and climate plans, Member States should identify concrete measures to implement the new rights given to citizen and renewable energy communities in the revised Internal Electricity Market Directive and, respectively, the revised Renewables Directive.

Community energy projects have increased rapidly partly driven by renewable energy support schemes providing incentives and increased awareness on collective actions. Their long-term sustainability will be contingent on the development of viable business models moving towards innovative financing and remuneration schemes, smart technologies, national regulatory support and their wider social acceptance and degree of citizen participation.

In order to allow them to compete on an equal footing with other market participants, the procedures for participation in market-based support schemes such as auctions and tenders can be simplified to include, for example, criteria for local community benefits.

Empowering customers and boosting social innovation

Engaging citizens through collective energy actions can reinforce positive social norms and support the energy transition. Community energy can foster citizens' participation and control over decision-making in renewable energy. Its social innovation potential also resides in the ability to integrate consumers independently of their income and access to capital, ensuring that the benefits of decentralisation are also shared with those that cannot participate.

In parallel, innovative social policy and revisited regulatory structures are needed to address the potentially regressive effects that could arise when some societal groups might be impaired by an inability to invest in renewables projects while having to pay the socialised costs of policy support and grid fees. Ensuring that as many people as possible can participate in community energy can release the creative forces of social innovation and sustainable lifestyles across different social groups.

This report recommends carrying out an EU-wide exercise assessing the potential of energy communities in reducing energy poverty - including lowering the barriers that prevent socially vulnerable groups from participating in distributed generation and communities.

Taking an energy system approach

Energy communities can bring a host of benefits to the energy systems. They can support system operations by providing flexibility services locally and alleviating the need for traditional network upgrades. Customers may also benefit from lower energy prices and access to private capital from renewables investments through citizen participation.

The case studies analysed in this report show that while the majority of community-based projects remain engaged in generation, their roles are gradually expanding. Their rise into new areas such as energy supply, energy efficiency and electro-mobility is likely to continue to disrupt activities traditionally held by energy/or car companies, addressing initiatives across the energy system. Estimates suggest that by 2030, energy communities could own some 17% of installed wind capacity and 21% of solar (European Commission, 2016). By 2050, almost half of EU households are expected to be producing renewable energy (Kampman, Blommerde, and Afma, 2016).

Energy communities will largely remain connected to the energy system, even though stand-alone systems may apply for example on islands or in remote areas. Their integration into the energy system must be done in a cost-efficient way, accounting for real savings in the energy system as a whole and delivering value to all customers.

Driving Research and Innovation

Although energy communities can bring much-needed innovation potential, their contribution to the energy transition is not yet fully understood EU-wide. More research is needed to clarify and quantify their potential at local, regional and/or the national levels, and analyse their economic, environmental and social effects. This should also investigate the barriers preventing people and communities from participating in energy projects.

EU funding programmes already support community energy action helping energy customers to engage in the generation and management of sustainable energy. Member States with a lower concentration of energy communities should be able to access funds and strengthen their capacity building to replicate successful practices.

1 Introduction

Community energy refers to a wide range of collective energy actions that involve citizens' participation in the energy system. Community energy projects are characterised by varying degrees of community involvement in decision-making and benefits sharing (Walker and Devine-Wright, 2008). They may describe a community limited by a geographical location or a community of interest (Walker and Devine-Wright, 2008).

The Clean Energy Package recognises certain categories of community energy initiatives as 'energy communities' in European legislation. Energy communities can be understood as a way to 'organise' collective energy actions around open, democratic participation and governance and the provision of benefits for the members or the local community (Roberts et al., 2019). There are two formal definitions of energy communities: 'citizen energy communities' which is included in the revised Internal Electricity Market Directive (EU) 2019/944 (European Parliament & Council of the European Union, 2019), and 'renewable energy communities' which is included in the revised Renewable Energy Directive (EU) 2018/2001 (European Parliament & Council of the European Union, 2018).

These two EU legislative documents provide for the first time an enabling EU legal framework for collective citizen participation in the energy system. They describe energy communities as new types of non-commercial entities that, although they engage in an economic activity, their primary purpose is to provide environmental, economic or social community benefits rather than prioritise profit making (REScoop.EU, 2019).

This report focuses on 24 community energy schemes that could potentially be considered types of energy communities. Nevertheless, some examples may not correspond entirely to the EU definitions as they are preceding the Clean Energy Package. Some have, for instance emerged as pilot projects and do not have a legal entity. Furthermore, the transposition of the EU directives may also lead to diverse structures at the national level (CEER, 2019).

In a broad sense, energy communities are contiguous processes of both the energy transition and social innovation. As decentralised and renewable-based energy projects, they can promote sustainable energy production and consumption practices. As consumer-empowerment and community-driven initiatives, energy communities can play a key role for social innovation as they reflect a fundamental shift in consumer behaviour. The traditionally passive consumer is becoming an energy prosumer, co-owner of renewable energy facilities and community energy participant (Van Der Schoor et al., 2016).

In Europe, there are about 3 500 so-called renewable energy cooperatives - a type of energy communities, which are found mostly in North-Western Europe (REScoop MECISE, 2019). This number is even higher when including other types of community energy initiatives. Figure 1 shows an indicative number of community energy initiatives such as cooperatives, eco-villages, small-scale heating organisations and other projects led by citizen groups for the nine European countries analysed in this report.

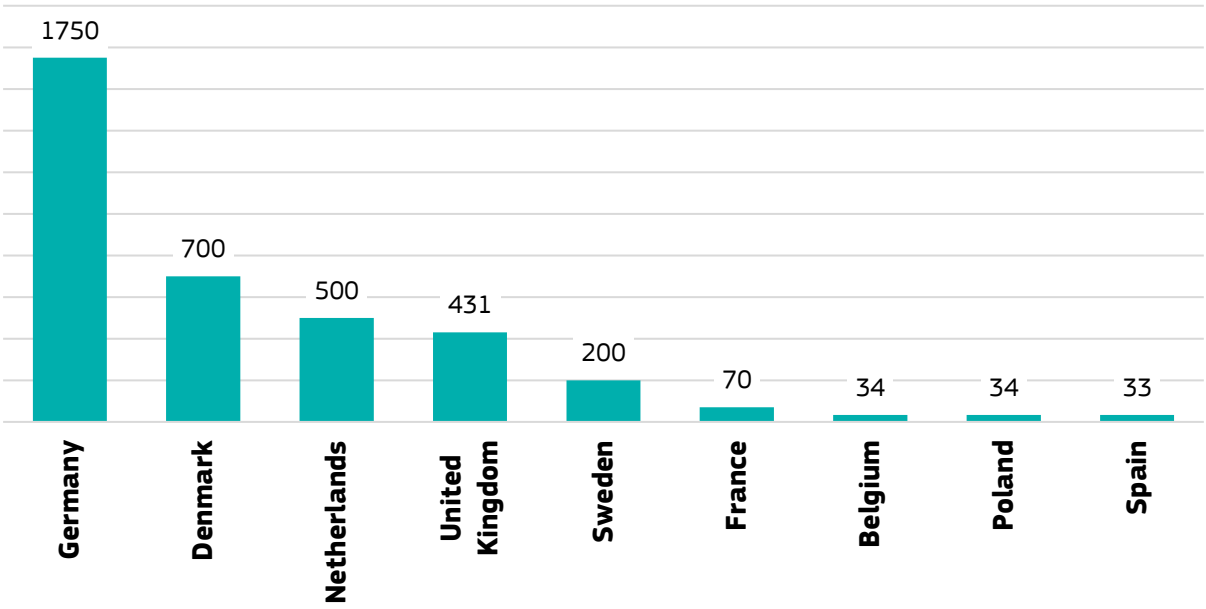
Germany and Denmark, two countries with strong traditions of community ownership and social enterprises have the highest number of citizen-led energy organisations. COMETS, a Horizon 2020 project will strive to provide a more complete overview of community energy initiatives in view of the currently available sparse data[1].

The case studies the Joint Research Centre (JRC) analysed show that community energy projects exist in diverse forms across Europe. The most widespread involve energy generation. Examples include school buildings or farm roofs equipped with solar panels, or windmills installed by residents in a village. Further, small biomass installations, heat pumps, solar thermal and district heating networks are popular technologies for some community groups. While their overall proportion as investors in renewables may remain small (Yildiz et al., 2015), citizens and communities have a huge potential to invest in

[1] https://cordis.europa.eu/project/rcn/222013/factsheet/en

renewables. An increasing number of projects is also getting involved in energy efficiency and energy services that return profits to the community.

Figure 1 Approximate number of community energy initiatives from the nine countries of the 24 case studies



Source: JRC based on various sources, 2019

Energy communities are very heterogeneous in terms of organisational models and legal forms. The most common type are energy cooperatives that have been established since the introduction of renewables support schemes. Limited partnerships, development trusts and foundations represent additional types of structures that allow for citizens' participation and ownership in renewables.

To reflect this diversity and better understand their roles and activities, the JRC focused on case studies from nine countries: Belgium, Denmark, Germany, France, Poland, Spain, Sweden, Netherlands, and the United Kingdom. The report draws on academic literature review, websites, and phone interviews to the extent possible. The criteria used for the selection of the case studies (see Annex) was to be as diverse as possible in terms of:

- Activities: generation, supply, consumption and energy sharing, distribution (electricity and heating networks), energy services, electro-mobility, financial services
- Energy technologies: wind, solar, small hydro, bioenergy, heat pumps, district heating networks or electric vehicles
- Organisational structure and ownership: cooperative, association, partnership, development trust, private company
- Variation in geographical spread and size from the local to regional to nation-wide levels with membership from a few to thousands of members
- Varying membership motivations and socio-economic innovation (bioenergy villages, co-housing communities, agricultural cooperatives)

The case studies represent community energy projects that refer to collective participation in energy schemes by citizens and local actors. Common criteria among the selected projects include a concern for citizens' participation in energy production and

use, and benefits delivering value to members locally and to the broader community. The detailed characteristics of the case studies are presented for each of the nine countries in the Annex. The findings are summarised throughout the chapters of the report.

This report cannot guarantee the accuracy or validity of information as it relies on the interpretation of available information from external sources. For example, information from the websites of case study projects and other sources may at times be incomplete or inaccessible. This most notably includes the case of smaller initiatives that may lack available primary sources in English or may be unavailable to contact otherwise.

2 Concept and definitions for energy communities

Community energy reflects a growing desire to find alternative ways of organising and governing energy systems (Van Der Schoor et al., 2016). It is a new form of social movement that allows for more participative and democratic energy processes. Until recently, community energy lacked a clear status in EU and national legislation, taking different forms of legal arrangements.

2.1 EU legal framework

The European Commission's Clean Energy Package breaks new ground for consumers by recognising, for the first time under EU law, the rights of citizens and communities to engage directly in the energy sector. It formally acknowledges and sets out legal frameworks for certain categories of community energy as 'energy communities'.

Energy communities are defined in two separate laws of the Clean Energy Package. The revised Renewable Energy Directive (EU) 2018/2001 sets the framework for 'renewable energy communities' covering renewable energy. The revised Internal Electricity Market Directive (EU) 2019/944 introduces new roles and responsibilities for 'citizen energy communities' in the energy system covering all types of electricity.

The directives describe energy communities as a possible type of organising collective citizen actions in the energy system (Frieden et al., 2019). According to the Electricity Market Directive, 'the provisions on citizen energy communities do not preclude the existence of other citizen initiatives such as those stemming from private law agreements'. Both directives allow for different organisational forms of energy communities (association, cooperative and others) through a legal entity.

Energy communities are incorporated as a non-commercial type of market actors that combine non-commercial economic aims with environmental and social community objectives (Roberts et al., 2019). The revised Electricity Market Directive states that 'citizen energy communities constitute a new type of entity due to their membership structure, governance requirements and purpose'. The revised Renewable Energy Directive refers to the specific characteristics of local renewable energy communities in terms of size and ownership structure.

Therefore, the directives frame energy communities around specific criteria and activities to ensure they have an equal footing when operating in the market without discrimination (Roberts et al., 2019). But they must do so without distorting competition and without foregoing rights and obligations applicable to other market parties.

Both types of entities are characterised by the following common conceptual elements:

- **Governance:** Participation must be 'open and voluntary'. In the revised Renewable Energy Directive, participation in renewable energy projects should be open to all potential local members based on non-discriminatory criteria. The revised Electricity Market Directive states that membership should be open to all categories of entities. It further states that 'household customers should be allowed to participate voluntarily in community energy initiatives as well as to leave them, without losing access to the network operated by the community energy initiative.'
- **Ownership and control:** Both definitions emphasize participation and effective control by citizens, local authorities and smaller businesses whose primary economic activity is not the energy sector (Roberts et al., 2019).
- **Purpose:** The primary purpose is to generate social and environmental benefits rather than focus on financial profits. The directives frame energy communities as non-commercial type of actors that use revenues from economic activities to provide services/benefits for members and/or the local community (Roberts et al., 2019)

The revised Renewable Energy Directive requires Member States to provide an enabling framework promoting and facilitating the development of renewable energy communities

as a way to expand renewable energy. Member States are also required to take renewable energy communities into account when designing their renewable energy support schemes. In the revised Electricity Market Directive, the enabling framework is more intended to create a level playing field for citizen energy communities as new market actors.

In addition, both citizen energy communities and renewable energy communities can exercise similar activities, including generation, distribution, supply, aggregation, consumption, sharing, storage of energy and provision of energy-related services. Depending on the activity performed, they must comply with the obligations and restrictions applicable to the other market participants (generators, suppliers, distributors, aggregators and other market actors) in a non-discriminatory and proportional manner.

Furthermore, citizen energy communities and renewable energy communities differ in the following ways:

- **Geographical scope:** The revised Renewable Energy Directive keeps the tie to having local communities organised 'in the proximity' of renewable energy projects that are owned and developed by that community. The revised Electricity Market Directive does not bind citizen energy communities to the immediate vicinity or to the same geographical location between generation and consumption.
- **Activities:** Citizen energy communities operate within the electricity sector and can be renewable and fossil-fuel based (i.e. technology-neutral). Renewable energy communities cover a broad range of activities referring to all forms of renewable energy in the electricity and heating sectors.
- **Participants:** Any actor can participate in a citizen energy community, as long as members or shareholders that are engaged in large-scale commercial activity and for which the energy sector constitute a primary area of economic activity do not exercise any decision-making power. Participants eligible to join include natural persons, local authorities and micro, small, medium and large enterprises. Renewable energy communities have a more restricted membership and only allow natural persons, local authorities and micro, small and medium-sized enterprises whose participation does not constitute their primary economic activity (REScoop.EU, 2019). A separate provision requires Member States to ensure that participation in renewable energy communities is accessible to consumers in low-income or vulnerable households.
- **Autonomy:** According to the Renewable Energy Directive, a renewable energy community 'should be capable of remaining autonomous from individual members and other traditional market actors that participate in the community as members or shareholders.' The definition of citizen energy communities does not include autonomy; but decision-making powers should be limited to those members or shareholders that are not engaged in large-scale commercial activity and for which the energy sector does not constitute a primary area or economic activity (REScoop.EU, 2019).
- **Effective control:** Renewable energy communities can be effectively controlled by micro, small, and medium-sized enterprises that are 'located in the proximity' of the renewable energy project; while citizen energy communities exclude medium-sized and large enterprises from being able to exercise effective control (REScoop.EU, 2019). The Electricity Market Directive defines control as '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.'

Some examples of community energy initiatives analysed in this report may not fully comply with the definitions of citizen energy communities and renewable energy

communities. For example, one of the largest ones, Elektrizitätswerke Schönau (EWS) is involved, amongst others, in natural gas production, distribution and supply meaning that its gas activities would not fit with the definition of a 'citizen energy community' nor fulfil the renewables requirements of a 'renewable energy community'. The Polish energy clusters (Żywiecka Energia Przyszłości) are not legal entities but civil law agreements between a large number of partners including local governments, enterprises, municipal companies and individuals[2]. Moreover, they are technology-neutral initiatives. The Słupsk pilot implementation of 200 households equipped with solar PV facilities in Poland is a project tested under the Horizon 2020 SCORE project, meaning that it is not constituted as a legal entity.

2.2 National enabling frameworks

In addition to the official recognition of 'energy communities' as specific types of community energy initiatives in the recasts of the Renewable Energy Directive and of the Electricity Market Directive, several Member States already adopted measures and policies on community ownership or are in the process of developing regulatory frameworks.

The following policy measures and targets addressing citizen and community engagement to certain degrees exist in the nine Member States analysed in this report (Table 1). While these national instruments can act as major drivers to engage citizens in energy matters, they may not offer the full ownership rights and legal recognition granted by the Clean Energy Package.

Table 1 Summary of policies and measures addressing energy communities for the nine countries of the 24 case studies

MS	Summary of national measures and policies
BE	There is no official decree but there is political will from the government to open wind projects to investments by citizens. The Walloon government has recently introduced the concept of "communautés energie renouvelable" or renewable energy communities in the Decree of 30 April 2019. The Decree allows for collective self-consumption and provides for the possibility to use specific tariffs for the use of the network, as well as for the contribution to taxes, surcharges and other regulated tariffs (Hannoset et al., 2019). Local authorities can also include citizens' participation when tendering for renewables projects. For example, the municipalities of Amel and Büllingen started up a large wind farm that will be co-owned by the two municipalities (60%) and the citizens joining the cooperatives Courant d'Air and Ecopower (40%) (REScoop MECISE, 2019).
DE	The German government aims to preserve the diversity of actors in the energy transition. The recast Renewable Energy Act (EEG) defines citizen' energy companies as consisting of at least ten natural persons who are members eligible to vote, in which at least 51 per cent of the voting rights are held by natural persons with a permanent residency in the administrative district of the project location. Further, no member or shareholder of the undertaking shall hold more than 10 per cent of the voting rights (Yildiz et al., 2019). The act had originally introduced a number of preferential rules for 'citizens' energy companies' to participate in renewables auctions. However, as the definition proved challenging in achieving its desired objective, citizens energy projects need to have a permit when participating in auctions since 2018 (Tounquet et al., 2019). The government is considering to introduce investment grants in order to lower barriers for participation (Tounquet et al., 2019).
DK	Community participation is reinforced by a requirement for wind energy developers to offer 20% of ownership shares to residents close to new commercial wind farms, including a right to buy up to 50 shares for those citizens living within 4.5 km of the project. For 2018 and 2019, the right to local ownership will also apply for large-scale solar PV. Annual metering has been replaced by hourly to instant metering in 2017 for newly installed PV, which has reduced the advantage of solar panels (Ronne and Nielsen, 2019).
ES	The concept of 'local energy community' is being proposed by the Ministry of Ecologic Transition. The Spanish framework copies the rights, privileges and responsibilities from the EU directives for renewable and citizen energy communities (Hannoset et al., 2019). Royal Decree 244/2019 completes the Royal Decree Law 15/2018 by extending self-consumption to a group of people beyond single owners. A self-consumption facility may now be located in more than one dwelling and power surpluses may be shared with nearby consumers located in other buildings or fed into the grid (Frieden et al., 2019).

[2] See http://klasterzywiec.pl/

MS	Summary of national measures and policies
FR	Article 6bis A of the Energy and Climate Law hints at the possible introduction of the concept of "communautés energie renouvelable" in which any entity, except an enterprise whose participation constitutes their primary economic or professional activity can participate; and natural persons, SMEs and local authorities or their groupings that are located in proximity of the renewable energy projects to which they have subscribed and developed can exercise effective control. The entity enjoys the right to access all markets, either directly or through aggregation, as well as the right to cooperation by the DSO to facilitate transfer of energy within the community (Hannoset et al., 2019). The Energy Transition Law enables local governments to generate energy through public-private partnerships with businesses to engage in energy production. Article 111 provides that private or public companies and cooperative societies promoting renewables projects offer a stake to individuals, in particular nearby residents, and local governments and municipal buildings on which territory it is located. They can also allow those same entities or individuals to participate in financing the renewable energy project (Dreyfus and Allemand, 2018).
NL	The Dutch framework makes use of a regulatory sandbox and establishes regulatory exemptions for specific initiatives around microgrids and small-scale renewables generation. Article 7a of Dutch Electricity Act introduces a regulatory sandbox for types of energy associations and cooperatives. This is further implemented by the Dutch Experimentation Decree of 2015[3], which invites local experimenters to initiate projects that can derogate from the Dutch Electricity Act. Under this experimental regime, it is possible to operate a local microgrid for households, to get an exemption from the supply license requirement for supply of electricity to small consumers and special grid tariff structures for a period of maximum 10 years (Hannoset et al., 2019). Only projects operated by cooperatives and associations of owners are eligible for permission; DSOs/TSOs or legal persons that are (in)directly producer or supplier of electricity shall not have any say in the management of the community; and 80% must be end-consumers. The community energy associations and cooperatives can organize energy sharing and set their own internal tariffs for supply (Tounquet et al., 2019).
PL	The Renewable Energy Sources Act of 2015 (amended in 2016, 2017) focuses on individual prosumers, but the law recognises energy cooperatives (1982 Cooperative Law). The government focuses on developing so-called 'energy clusters'. An energy cluster is a civil law agreement – both a cooperation agreement and a commercial partnership agreement between its participants that does not have legal personality. It includes a large membership base: natural persons, local government units, entrepreneurs, research institutes, universities. It is technology-neutral and focuses on energy generation and balancing, within a distribution network with a rated voltage lower than 110 kV. The main societal value of a cluster is that it contributes to the local economy.
SE	There is no framework for energy communities, only measures for self-consumption. Collective self-consumption within a building is allowed if all apartments belong to the same grid connection but not when the electricity is transported over a grid covered by grid concession (Frieden et al., 2019).
UK	The UK's regulator, Ofgem introduced regulatory sandboxes that enables innovators to trial new products, services and business models without some of the usual rules applying[4]. Examples of sandboxes granted include a trial by Chase Community Solar, a community benefit society which has fitted solar panels to homes owned by Cannock Chase District Council; and a peer-to-peer trading using blockchain technology supported by Repowering London, a community benefit society. The Scottish government actively promotes community and local ownership. It has committed to support community and locally owned renewable energy projects with new targets of 1 GW by 2020, and 2 GW by 2030. The Welsh government has set a target of 1 GW of locally-owned renewable electricity capacity by 2030 and an expectation that new projects from 2020 have an element of local ownership.

Source: Various including (Dreyfus and Allemand, 2018), (Tounquet et al., 2019), (Frieden et al., 2019)

Although not amongst the countries from where the case studies derive, Greece is a notable example as it introduced a new law that expanded the scope of virtual net metering to energy communities in 2018. Law N4513/2018 defines energy communities as urban partnerships with the aim of strengthening the sharing economy and innovation in the energy sector. Central elements of the law include:

- Locality as a necessary condition for the creation of synergies and partnerships for the implementation of energy projects to respond to local needs, utilising local renewable sources, with the aim of disseminating benefits to energy communities members and generating added value for the greater local communities.
- Insularity, in which special arrangements and privileges are introduced for the case of very small islands with population below 3 100 people, to address issues such as the high cost per kWh as well as the environmental, economic and social issues raised by the use of conventional forms of potential production.

[3] See https://wetten.overheid.nl/BWBR0036385/2015-04-01
[4] See https://www.ofgem.gov.uk/publications-and-updates/what-regulatory-sandbox

- The activation and enhancement of technological tools such as energy offsetting and virtual energy offsetting in particular to shield vulnerable consumers.
- Financial incentives and support measures which mainly concern the development of renewables power plants, in order to exploit domestic potential with the involvement of local communities as defined in national energy targets.

The criterion of locality translates into the obligation of at least 50% plus one of the members to relate to the place where the registered office is located. Financial incentives include an exemption from bidding procedures for projects up to 6 MW for wind farms and 1 MW for photovoltaics (PV). There is also an exemption from the obligation to pay the annual fee for the right to hold a power generation license, and a reduced guarantee payment of 50% for participation in the auction-based subsidy scheme.

3 Activities and organisational forms

Community energy initiatives are gradually taking on new activities and energy services– from renewables generation to investments in electro-mobility services. They can also take diverse legal forms – with the most common type being renewables cooperatives, also reflected in the organisation type of the 24 case studies studied in this report.

3.1 Towards innovative social enterprises

Energy communities can perform both traditional activities and engage in new business models. Usually, smaller scale citizen-led initiatives are mostly involved in renewable generation activities. However, an increasing number of energy communities have been taking on new roles of energy and energy services providers. The energy initiatives JRC analysed show that they might engage in some or all of the following activities:

- **Generation:** community energy projects collectively using or owning generation assets (mostly solar, wind, hydro) where members do not self-consume the energy produced but feed it into the network and sell it to a supplier (CEER, 2019)
- **Supply:** the sale (and resale) of electricity and gas to customers (electricity, wood pellets, biogas and others). Large communities can have a large number of retail customers in their vicinity, and may also engage in aggregation activities combining customer loads and flexibility or generate electricity for sale, purchase or auction in electricity markets (European Parliament & Council of the European Union, 2019)
- **Consumption and sharing:** the energy produced by the energy community is used and shared inside the community. This includes both consumption (individual and collective self-consumption) and local sharing of energy amongst members that is produced by the generating installations within a community
- **Distribution:** ownership and/or management of community-run distribution networks, such as local electricity grids or small-scale district heating and (bio)gas networks; often cooperatives can do both energy generation and distribution, but the network infrastructure is central to their business (Yildiz et al., 2015)
- **Energy services:** energy efficiency or energy savings (e.g. renovation of buildings, energy auditing, consumption monitoring, heating and air quality assessments); flexibility, energy storage and smart grid integration; energy monitoring and energy management for network operations; financial services
- **Electro-mobility**: car sharing, car-pooling and/or charging stations operation and management, or provision of e-cards for members and cooperatives
- **Other activities**: consultation services to develop community ownership initiatives or to establish local cooperatives, information and awareness raising campaigns, or fuel poverty measures (e.g. Energie Solidaire Enercoop, France)

Findings from the 24 cases studied in this report (Figure 2) shows that a large majority of initiatives are engaged in energy generation, usually owning generation assets. While some communities perform only generation activities (Beauvent[5] for electricity), others undertake both generation and supply (Ecopower), as well as distribution (EWS Schönau) which can be an exception to the unbundling criteria[6]. Some cooperatives that cannot perform supply activities due to their size or difficulties in obtaining a supply license may act as resellers of a sustainable energy provider (Amelander Energie Coöperatie[7]).

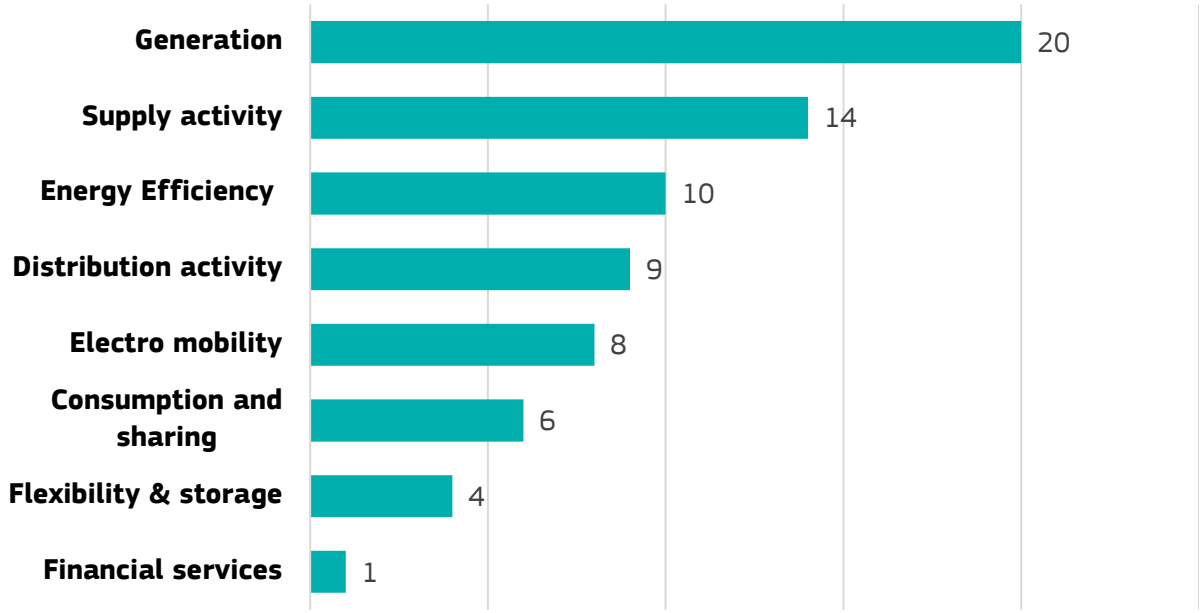
[5] Beauvent mostly acts as an electricity producer from 100% renewables projects, it only supplies electricity to a small customer base where it has PV installations without a license (households, schools, city buildings)

[6] According to the Third Energy Package, the electricity system is built on the separation between regulated (transmission and distribution system operators) and unregulated (supply activities), with exception for small distribution system operators with less than 100 000 customers.

[7] More than 80 cooperatives in the Netherlands founded the VanOns which acts as a cooperative energy supplier with a license. Sources include the large cooperative co-owned solar parks in Ameland. Local cooperatives can agree to a reseller's contract and can get a share of profits from the energy supplier.

In addition, energy efficiency such as measures to improve renovation of buildings is already well established amongst some cooperatives. In Belgium, Courant d'Air is involved in mobilizing citizens to replace their lamps with LED lighting. Also, Ecopower developed a cost-covering service, Ecotrajet[8] which advises its members how to commission deep energy innovations in their homes (REScoop MECISE, 2019).

Figure 2 Overview of activities corresponding to the 24 case studies



Source: JRC based on the case studies, 2019

Additional services in the field of electro-mobility are becoming increasingly popular. For instance, Som Mobilitat and Mobicoop are purchasing electric cars charged with green electricity and renting parking spaces in cities to offer electric car sharing services. The Mobility Factory is a European cooperative enterprise founded by eight cooperatives to offer electric car sharing services to their members. Its main service is a digital application that can be used by the member cooperatives so that their members can access cars via their phone (it also applies across cooperatives so a member of Partago in Flanders could use a car owned by Som Mobilitat if they are on holiday in Spain).

Electric cars can also serve as flexible demand making use of the excess electricity from the local renewables farm. Flexibility services and storage are also considered or tested in some initiatives. Storage devices or services are particularly interesting as they enable community energy projects to make use of the renewable energy they produce locally. Their participation in flexibility markets can also provide an additional source of revenue.

Some cooperatives supplying electricity from wind or solar energy - or providing local pellets, stoves and boilers for small-scale heating of buildings and domestic hot water can serve large numbers of retail customers. The largest supply cooperatives include: Ecopower which supplies about 2% of the Flemish households with their own green electricity[9]; Enercoop in France; Som Energia in Spain; and EWS Schönau, a German-wide electricity supplier. Some other initiatives are in the process of developing future supply activities, energy trading or distribution activities such as Spółdzielnia Nasza Energia cooperative and energy clusters (Żywiecka Energia Przyszłości) in Poland.

Supply may not necessarily be understood in the sense of the strict rules applicable to suppliers in the Internal Electricity Market Directive (Jasiak, 2018). For instance, a cooperative company can supply power to its members either by buying from an external

[8] See https://www.ecopower.be/energiebesparing/ecotraject
[9] See https://www.rescoop-mecise.eu/aboutmecise/ecopower

supplier or by producing it itself. Either way, further interpretation is needed when implementing the Directives to determine whether the delivery and transfers to and within the community are treated as collective self-consumption, energy sharing or supply as defined by the Electricity Directive. This is particularly dependent on the contractual relationship between the community and its members and on whether the communities are involved in distribution or energy sharing. Obligations however need to be proportional and may be determined on a case-by-case basis on whether a business-to-customer or customer-to-customers contract will apply (Jasiak, 2018).

Overall, the expansion of energy communities in new areas traditionally held by energy utilities or car manufacturers (in the case of mobility services) reflects their advance as innovative social enterprises developing new business models. The potential of small-scale renewables generation and citizens to disrupt traditional business models in the energy sector is already underway. A caveat however might be that a growth in size and economic activities might see community goals be overridden by material profits if communities become more commercially oriented (Bauwens, 2016).

Box 1. From renewables production to supply – The story of Ecopower

Ecopower is a renewable energy cooperative in Belgium. Citizens around a kitchen table in Rotselaar established it in 1991. The origins of the Ecopower story date from 1985 when a watermill was bought as part of a co-housing project. In 2003, following the liberalisation of the electricity market in Belgium, the general assembly voted to become an energy supplier in the region of Flanders.

Today, the cooperative is both an electricity producer and a supplier operating in Flanders. With its 40 staff members Ecopower offers over 57 000 citizens the opportunity to get a grip on their energy production and supply. Projects in recent years include the development of wind turbines, solar and hydropower energy production, cogeneration, and a factory where wood pellets are produced. Together these installations produce about 100 million kWh per year. Through initiatives focused on energy efficiency, Ecopower's members have reduced their electricity consumption by an average of 50% over the past 10 years. Ecopower also enters into direct partnerships with local municipalities to support economic and social value creation for the citizens and the municipality.

More information: http://citynvest.eu/content/cooperative-case-study-ecopower

Source: (Friends of the Earth Europe, 2018)

3.2 Legal structures for energy communities

Various governance models enable citizens' participation in renewables projects. Depending on the legal form chosen, they can differ in terms of governance structure, decision-making and liabilities (Table 2). For instance, they can be fully owned by the community or developed in cooperation with public or commercial actors (shared ownership) (Yildiz et al., 2015). Further, community-managed projects can take diverse forms, ranging from large cooperatives to off-grid island systems.

Table 2 Possible legal structures for energy communities

Legal structure	Description
Energy cooperatives	This is the most common and fast growing form of energy communities. This type of ownership primarily benefits its members. It is popular in countries where renewables and community energy are relatively advanced.
Limited partnerships	A partnership may allow individuals to distribute responsibilities and generate profits by participating in community energy. Governance is usually based on the value of each partner's share, meaning they do not always provide for a one member - one vote.
Community trusts and foundations	Their objective is to generate social value and local development rather than benefits for individual members. Profits are used for the community as a whole, even when citizens do not have the means to invest in projects (for-the-public-good companies).

Housing associations	Non-profit associations that can offer benefits to tenants in social housing, although they may not be directly involved in decision-making. These forms are ideal for addressing energy poverty.
Non-profit customer-owned enterprises	Legal structures used by communities that deal with the management of independent grid networks. Ideal for community district heating networks common in countries like Denmark.
Public-private partnerships	Local authorities can decide to enter into agreements with citizen groups and businesses in order to ensure energy provision and other benefits for a community.
Public utility company	Public utility companies are run by municipalities, who invest in and manage the utility on behalf of taxpayers and citizens. These forms are less common, but are particularly suited for rural or isolated areas.

Source: JRC based on (Roberts, Bodman, and Rybski, 2014; Hanna, 2017; REN21, 2016)

The majority of citizen-led initiatives are cooperatives. Cooperatives are a type of social and economic enterprise that enables citizens to collectively own and manage renewable energy projects (Yildiz et al., 2015). Local residents or from the neighbouring area can invest in renewable generation by buying shares to finance a project (Walker, 2008). In some cases, citizens can also consume and share renewable energy.

Cooperatives are common in countries with strong community traditions such as Germany (known as eingetragene Genossenschaften – eG) or Sweden. In the UK, renewable cooperatives have mainly been formed as industrial and provident societies (IPS) (Bauwens, Gotchev, and Holstenkamp, 2016). An example from this report, the Edinburgh Community Solar Cooperative Limited was formed as a Society for the Benefit of the Community ('BenCom'), a type of an IPS that is intended to benefit the community as a whole (Roberts, Bodman, and Rybski, 2014)[10]. BenComs may pose limits on the distribution of assets and shares to preserve the community benefit.

In a cooperative, the distribution of profits is limited and surpluses are reinvested to support its members and/or the community. The allocation of revenues from the projects is regulated by the statutes of the cooperative, which relate to its main purpose. Sometimes they can be distributed amongst the members through capped dividends. Other initiatives may provide energy benefits in the form of lower energy prices. Cooperatives are based on democratic governance - i.e. decisions made on a 'one member – one vote' principle.

Citizen-led initiatives can also unite in larger networks and federations that integrate or coordinate several cooperatives at the national and the EU levels. One example is Energy4All in the UK that is formed by 27 cooperatives across the country. The Energy4All network facilitates knowledge sharing as well as the creation and development of cooperatives based on experience with previous projects. One of the cooperatives it created (Energy Prospects Cooperative) specialises in taking early stage cooperatives through the development and planning application stages prior to the project launch[11]. At the EU level, more than 1 500 energy cooperatives and their 1 000 000 citizens are represented by REScoop.eu, the European federation of renewable energy cooperatives[12].

Another legal form for citizens' participation includes limited partnerships, with a limited liability company as a general partner (Gesellschaft mit beschränkter Haftung & Compagnie Kommanditgesellschaft - GmbH & Co. KG). The model is suitable for larger projects with high investment volume. It became particularly popular for citizen-owned wind parks in Germany. One example is Sprakebüll which started as a community-wind farm pioneered by a group of villagers based on the GmbH & Co. KG model. Voting rights are proportional to the capital invested, instead of the traditional one member – one vote cooperative principle (Co2mmunity, 2019).

[10] See https://www.edinburghsolar.coop/projects/rules/
[11] See https://en.wikipedia.org/wiki/Energy4All
[12] See https://www.rescoop.eu/

In Scotland, development trusts are a preferred model for community energy projects. The community group is usually the full owner of the renewables installations and raises funds through grants and loans and distributes income from renewables to community projects (Krug-Firstbrook, Haggett, and van Veelen, 2018). An example from Scotland in this report is the Isle of Eigg, an off-grid system which provides electricity for the whole island. The stand-alone system is managed by a community owned, managed and maintained company Eigg Electric Ltd, which is a wholly owned subsidiary of the Isle of Eigg Heritage Trust, a community organisation that owns the island.

In the Netherlands, there is no specific legal model for collective consumer ownership (Akerboom and van Tulder, 2019). Examples in this report include one cooperative company with unlimited liability (Amelander Energie Coöperatie U.A) and a cooperation project (Duurzaam Ameland). Duurzaam Ameland is a partnership between the municipality of Ameland, companies, research institutes and the local energy cooperative. The island's solar park co-founded by the municipality, Amelander Energie Coöperatie and Eneco, a large energy company is the first solar park of this size in the country. Off-season, it is able to produce enough electricity for more than 1 500 households on Ameland[13]. Moreover, other models used by communities to invest in renewables in the Netherlands are foundations or public ownership of energy utilities to initiate new projects.

In Poland, the Renewable Energy Sources Act defined the term of 'energy clusters' as civic-law agreements with diverse parties including natural persons, legal persons, scientific units, research institutes and local-government units. The agreement concerns the balancing of demand and generation, distribution of or trade in energy from renewables or other sources, within a distribution network with voltage below 110 kV (Wiktor-Sułkowska, 2018). The cluster functions as a civil law agreement meaning it does not have legal personality and will not run as a business activity. The cluster nevertheless shows concern for local values, sustainability of the region and engagement of local residents and municipalities. It can take the shape of a local energy community or micro-network that balances demand and supply at the local level, together with both private and public actors.

Housing associations can be found in the United Kingdom, Denmark or Sweden. In Denmark, the members or the tenants of the social housing estate are responsible for managing the estate (REN21, 2016). In Sweden, the housing association Bostadsrättsföreningen Lyckansberg's solar cell plant produces electricity for the common facilities of more than 85 tenant-owned apartments.

Non-profit customer-owned enterprises are legal forms for community ownership that can be found in Denmark. Marstal Fjernvarme is an example of a solar district heating plant on the island of Ærø founded as a cooperative limited company A.m.b.A. The company was originally financed and has been owned by the inhabitants of Marstal since the 1960s (Co2mmunity, 2019). In this not-for-profit ownership model, profits are returned to the members in the form of lower energy prices. In order to buy a share in the network, members have to be owners of properties in Marstal eligible for connection to the grid (Co2mmunity, 2019).

[13] See https://www.duurzaamameland.nl/projecten/

4 Drivers for the development of energy communities

The drivers shaping the emergence and success of energy communities include socio-economic, energy policy, individual project related factors and actors' characteristics (Ruggiero et al., 2019). The heterogeneity of community energy shows clear differences in terms of members' individual motivations and level of engagement (Bauwens, 2016). This section analyses three categories of drivers and their influence on participation: socio-cultural and economic factors (Section 4.1), energy policy factors (Section 4.2), and specific factors identified from the 24 case studies described in the Annex (Section 4.3).

4.1 Socio-cultural and economic context

The first category of factors refers to the social, cultural, economic and political setting within which community energy operates.

The geographical location of community-based energy projects implies that economic differences play a role in their development. In general, EU Member States with higher levels of disposable income have a higher concentration of community energy initiatives. Community energy is mostly prevalent in the higher-income countries of Northern-Western Europe, and less in Southern Europe and in Eastern Europe. This means the level of citizen welfare can play a role in providing the purchasing power and sufficient capital to cover the investments.

In addition to differences in economic status, another argument which may have impaired participation in Eastern European countries is the perceived negative connotations associated with cooperatives and trust in centrally-planned economies (Beckmann, Otto, and Tan, 2016). This is in contrast with countries such as Denmark, Germany or Belgium which have a strong tradition of social enterprises and community ownership (Simcock, Willis, and Capener, 2016). If similar values are high, it is more likely that collective action like energy communities emerge. However, the cultural differences in Eastern Europe may not necessarily be caused by distrust in social activity overall, but rather in the national and local political institutions (Lissowska, 2013).

The variety of initiatives shows however that there is an interdependency of economic benefits and wider social and moral goals that are tied to community engagement. Research shows that a mix between social capital, civic minded behaviour, environmental concerns and interpersonal trust are important factors that motivate members to join energy cooperatives (Bauwens, 2016). This interdependency of social and financial interests can strongly influence the size, type and design of successful community energy projects. The correlation between regions with higher levels of education and engagement in community energy projects is another factor highlighted in research (Ruggiero et al., 2019).

4.2 Energy policies

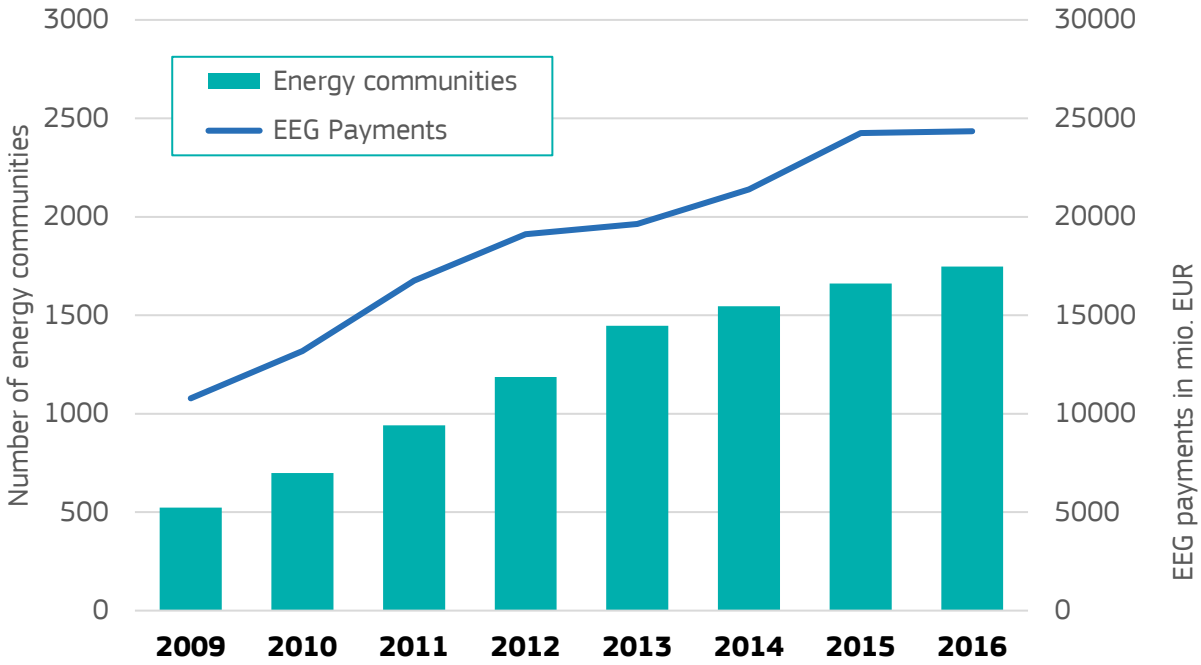
The origin of community energy is generally associated to the environmentalist movements driven by anti-nuclear sentiments and the oil shocks of the 1960s and 1970s. This certainly reflects an early commitment to defy corporate control of the energy system. However, the rapid expansion of community energy projects after the 1990s and recent waves of development shows a clear correlation to policy support schemes (Hewitt et al., 2019).

Policy tools promoting renewables such as feed-in-tariffs (FiTs), tax incentives and grants are considered critical for the rise of prosumers and community ownership schemes (Curtin, McInerney, and Ó Gallachóir, 2017). Renewable support schemes have been particularly effective for mobilizing citizens and communities in countries with a strong tradition of local citizen ownership (Curtin, McInerney, and Ó Gallachóir, 2017). The introduction of FiTs in the 1990s in countries with stable policies supporting renewables such as Germany, Denmark or the UK coincided with a surge in citizens and community

investors (Hewitt et al., 2019). These schemes enable small-scale producers and communities to receive money for producing electricity from renewables.

In Germany, the feed-in-tariff laws introduced in 1991 caused considerable community ownership investments in wind energy (Figure 3). The movement was led by hundreds of local businesses and citizens who have bought shares to finance wind power projects (Morris, 2014). Since 2000, the UK passed new laws granting community and local ownership in renewables (Walker, Wiersma, and Bailey, 2014). A mix of grants and tax advantages were introduced in addition to the FiT, which was deemed insufficient to overcome the highly centralised energy system in the UK (Curtin, McInerney, and Johannsdottir, 2018).

Figure 3 Growth of payments under the German Renewable Energy Sources Act (EEG) and citizen-led initiatives in Germany



Source: JRC based on (Kahla et al., 2007)

By contrast, cuts in feed-in-tariffs can lead to decreased support and shrinking numbers of energy cooperatives (Wierling et al., 2018). The emergence of new cooperatives was delayed, and many existing ones were dismantled in Denmark after a change in the feed-in-tariff scheme in 2003 (Bauwens, Gotchev, and Holstenkamp, 2016).

In 2015, Germany had seen the number of newly founded cooperatives fall by 25% as compared to the previous year. A survey by Deutscher Genossenschafts- und Raiffeisenverband (DGRV) reports the slowdown was caused by new financial restrictions and tendering rules in the Renewable Energy Sources Act (EEG) (DGRV, 2016).

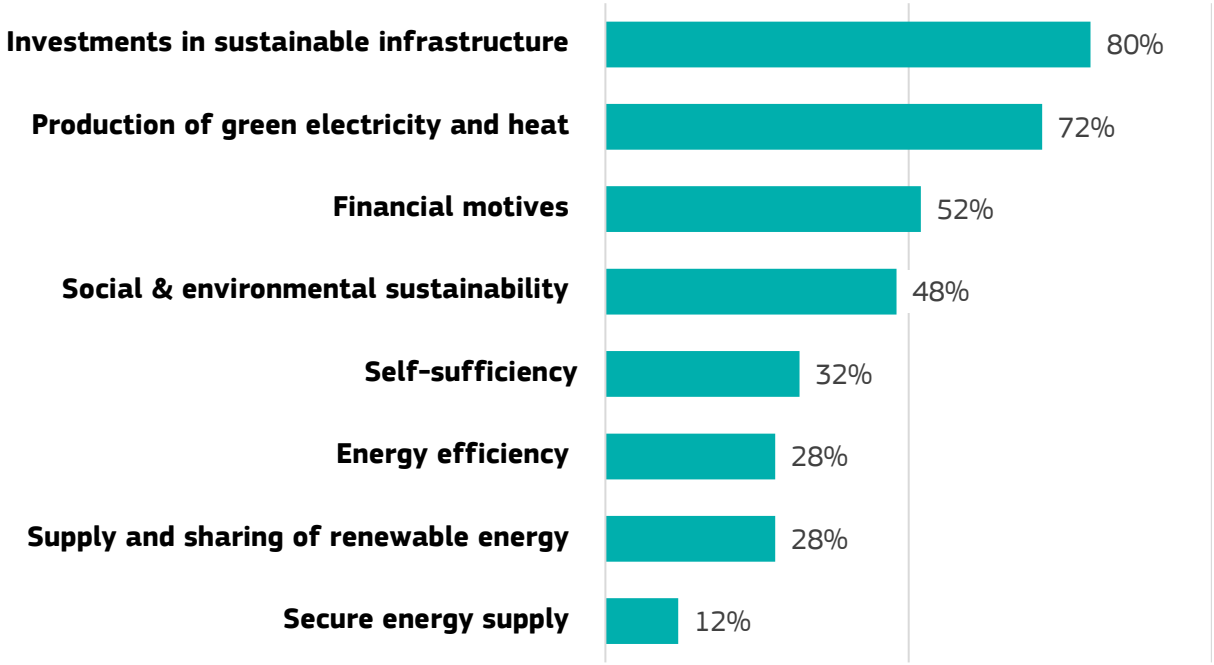
In addition to governmental support for renewables, energy prices can also play a role. In Spain, an increase in electricity prices in 2012 prompted a rise in energy cooperatives as a way to lower the costs of renewable energy (Capellán-Pérez, Campos-Celador, and Terés-Zubiaga, 2018). This may explain why many cooperatives have taken on the role of suppliers providing cheaper electricity.

Policy measures allocating preferential treatment for local ownership can also support citizens-led projects. In Denmark, local residents are offered the opportunity to invest up to 20% of shares in wind farms built in or close to their municipality (IEA-RETD, 2016).

4.3 Specific drivers from the case studies

The 24 case studies the JRC considered in this report show that there is a wide diversity of interests and motivations to engage in energy communities (Figure 4). The reason for the differences lies in the scope, geography, activity and characteristics of each energy initiative and its members. The drivers range from environmental consciousness and a desire to produce green electricity to greater ownership of local energy infrastructure.

Figure 4 Drivers motivating participation corresponding to the 24 case studies



Source: JRC based on the case studies, 2019

The most common drive is the motivation to invest in community energy infrastructure such as renewables installations, district heating, energy efficiency systems or charging infrastructure. This is particularly the case for cooperatives investing in community-owned solar and wind projects, or district heating networks. However, while financial motives and monetary benefits (such as shares or cheaper electricity prices) can be a strong motivation, they do not exclude other types of social and environmental motivations. Moreover, commercial activities such as supply to customers outside the membership base are less common, implying that community objectives prevail over profit interests.

The ambition to protect the environment and the desire to be socially, ecologically and economically self-sufficient is particularly prevalent among housing communities and bio-villages. Reliance on stable and secure energy supply was dominant in off-grid systems or energy islands such as the Island of Eigg in Scotland. In addition, the drive to take sustainability matters into one's own hands and solve local issues is another prevalent feature across many initiatives. The emergence of EWS Schönau, for instance, was motivated by an anti-nuclear sentiment in the aftermath of the Chernobyl disaster. This citizens' movement culminated in taking back the grid from the conventional utility[14].

[14]See https://bit.ly/2IzYiK3

5 Customer empowerment and social innovation

The transition towards climate-neutrality cannot be achieved through technology and markets alone (European Commission, 2018). The energy transition involves a social transformation in which civil society and citizens will play a crucial role too (Knoefel et al., 2018). One distinctive social innovation feature of community energy is the ability to combine the mutual and the public interest (Bauwens and Defourny, 2017). Another is its approach to 'commonify' decentralised renewables where people co-operate to regenerate a common good (Hammerstein, 2018).

5.1 Social implications

Energy communities can reinforce strong social norms and support citizens' participation in the energy system. According to EU legislation, their primary purpose is to create social innovation: they engage in economic activities other than for profit making (REScoop.EU, 2019). Community energy can be considered as a type of grassroots or niche innovation that can experience learning curves within the socio-technical landscape (Geels et al., 2017). Cross-cutting features of such initiatives include a commitment to place and interest, and community involvement in both processes and outcomes (Smith et al., 2016).

The complexity of grassroots innovations is intertwined with conflicting issues of local culture, local democracy, social norms and values such as local opposition to renewables (Geels et al., 2017). Scientific papers identified two dimensions of community energy. One is the 'process' which concerns the depth of involvement of local people. The other is the 'outcomes' which is more concerned with how the benefits are distributed in the community (Walker and Devine-Wright, 2008).

Communities are further defined into 'communities of place' understood as projects run by local people that bring collective benefits to the local community; and 'communities of interest' determined not by space but by some common bond (e.g. interest in green energy) (Bauwens, 2016). Ideally, an energy community should include a combination of high local participation and control, and a high degree of benefit sharing.

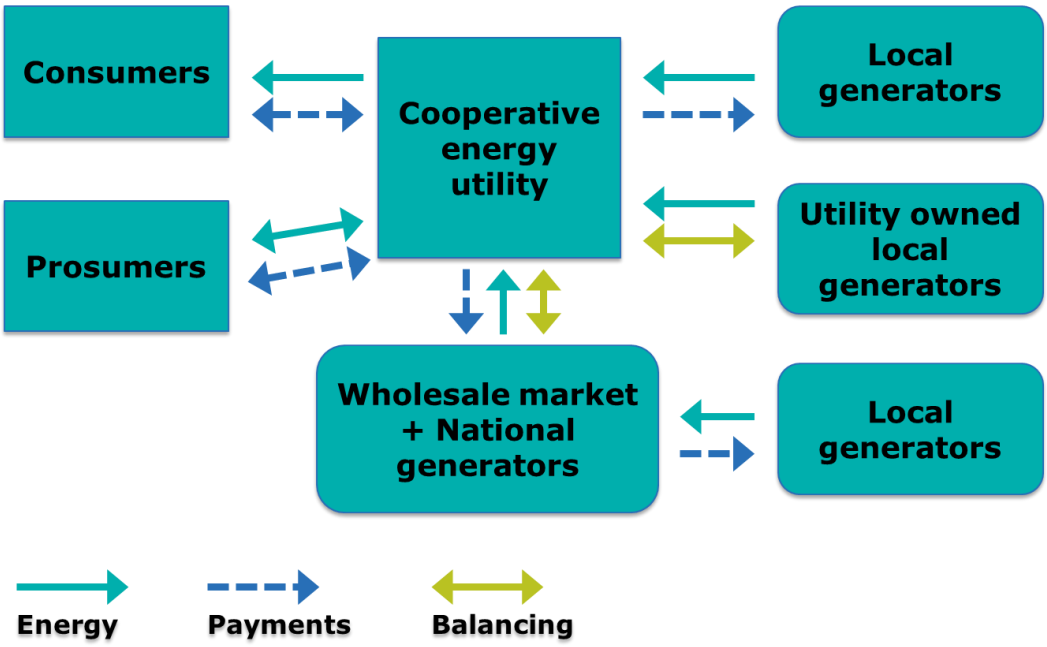
Energy communities may take on more utility-like activities such as the sale of electricity and energy efficiency services. However, even if based on commercialising energy, a cooperative business model has a different approach than a traditional utility (Figure 5) (Bryant, Straker, and Wrigley, 2018).

For example, in a cooperative – a type of energy community, the aim is not to maximise profits but rather to reinvest them in the community and provide services to its members. If the net income is allocated as a return on capital shares, the profit redistribution is usually subject to a cap (Bauwens, Gotchev, and Holstenkamp, 2016). Ecopower, for instance, sees the 6% cap on the interest it can return to its members as a financial opportunity to further reinvest in renewables schemes. Further, the community and/or citizens, instead of investors, own the cooperative.

In general, the governance of energy cooperatives is led by a set of well-established governing principles. The International Cooperative Alliance established the values of self-help, self-responsibility, democracy, equality, equity and solidarity as founding principles[15]. A cooperative subscribes a commitment to equality, fairness and social responsibility. These principles do not apply to the same extent to other types of energy communities.

[15] See the International Cooperative Alliance's values and principles of the cooperative movement https://www.ica.coop/en/cooperatives/cooperative-identity The International Cooperative Alliance the global steward of the Statement on the Cooperative Identity.

Figure 5 The cooperative energy utility business model



Source: Adapted from (Bryant, Straker, and Wrigley, 2018)

From a socio-technical understanding, communities can bring the following benefits:

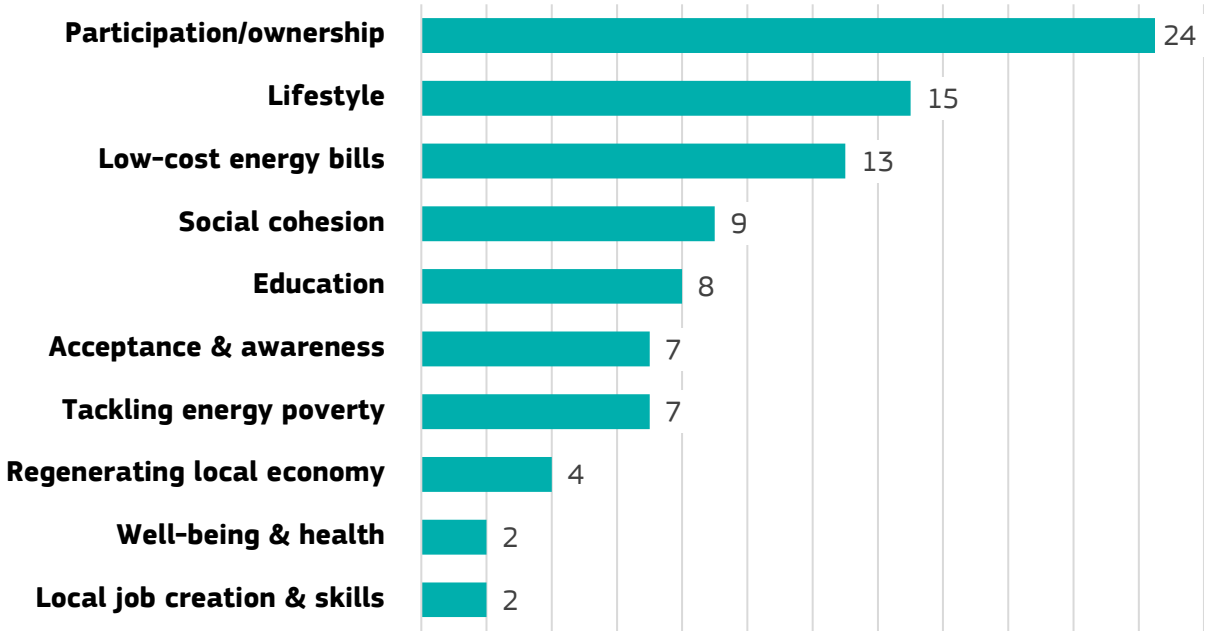
- **Local value:** Energy communities can help to implement local sustainability projects that can achieve energy independency, reduce carbon emissions and fuel poverty, as well as contribute to the local economy. They can generate local jobs and avoid the outflow of financial resources from the region (Kunze and Becker, 2014).
- **Energy citizenship and democracy:** Citizens have democratic control over energy investments by becoming co-owners of renewables installations, usually through the principle of one member one vote. Participation in renewables ownership and decision-making can either be direct, in which case members approve decisions in assembly meetings and decide how the surplus is distributed (Hanna, 2017); or indirect participation through a board of directors, as in the case of EWS Schönau eG.
- **Generating financial returns for the community:** Community assets (wind turbines, solar panels) are used to generate profits locally, within the community. Members have local control over financial resources and profit sharing. Surpluses can be reinvested in community benefit funds and other activities. Co-investments can also help create local jobs and generate stable return for investors.
- **Education and mobilisation of citizens:** Empowering citizens towards joint action for combating climate change alongside municipalities and local authorities.
- **Social cohesion:** creating a community feeling, trust.

The analysis of the 24 case studies shows that a number of socio-economic objectives are driving the push towards community-driven energy initiatives. These are expected to bring a host of benefits for citizens and the local community across economic, behavioural change, environmental, social cohesion and acceptance (Figure 6).

The majority of case studies confer to some extent community and citizen participation and/or ownership rights in decision-making and financial processes. Some initiatives may involve the participation of municipalities or commercial investors (Duurzaam Ameland, Żywiecka Energia Przyszłości) or indirectly represent people and communities through member cooperatives (Energy4All).

Community empowerment in energy matters identified through the case studies is also strongly reflected in enhancing lifestyle. This includes a desire to be self-sufficient and promote a sense of community as citizens want to become more independent from fossil fuels and from centralised energy supply (Bioenergiedorf Jühnde eG). Lifestyle choices are also associated with anti-nuclear sentiments and pro-environmental attitudes.

Figure 6 Socio-economic benefits corresponding to the 24 case studies



Source: JRC based on the case studies, 2019

Energy communities can also advance energy efficiency at the household level and alleviate energy poverty by reducing consumption and supply tariffs. Several case studies are addressing socially vulnerable households experiencing energy poverty to some degree. Enercoop supports Énergie Solidaire, a solidarity fund that encourages micro-donations from consumers and renewable energy producers to donate their surplus production. Enercoop consumers can donate 1 cent per kWh from their energy bills. EnergieSolidaire then allocates the funds to associations that fight against fuel poverty[16].

Som Energia cooperates with municipalities where the cooperative identifies cases of energy poor households. It can also pay the energy bill together with the cooperating municipalities for members that struggle to cover their energy costs[17]. The cooperative also allows members to share their membership with five people without extra costs, benefiting people of lower incomes[18]. A car-sharing cooperative, Som Mobilitat offers its members the opportunity to rent cars and bikes, and seeks to expand its electro-mobility services to poorer neighbourhoods[19].

[16] http://energies-solidaires.org/
[17] http://www.energy-democracy.net/?p=1050
[18] See http://www.energy-democracy.net/?p=1050
[19] Phone interview Som Mobilitat

Box 2. SAS Ségala Agriculture et Energie Solaire

For the example of SAS Ségala Agriculture et Energie Solaire, a company created by the local agricultural cooperative Fermes de Figeac to specifically carry out the installation of solar PV on agricultural buildings, trust in the local cooperative was a crucial aspect. This made it possible for farmers to embark on a solar photovoltaic project with a well-recognised local actor rather than engage in PV projects alone or with unknown firms.

The Fermes de Figeac' success created additional value to the community: profits to reinvest, networks and expertise in the field of renewable energy, new competencies in negotiating large-scale projects. Of special interest is what mutualisation of the solar resources through the cooperative achieved. In this way, a farm (Fermes de Figeac, agricultural cooperative) emerged as a new player in renewable energy development. It also contributed to the revitalisation of rural areas where agricultural activities are on decline. Innovation in this case supported preservation and conservation, instead of replacement and change (farm roofs of agricultural cooperatives gaining an extra role). More information: https://www.fermesdefigeac.coop/

Source: (Grandclément, Catherine; Nadaï, 2018)

5.2 Energy justice

Energy justice is a relevant concept in the context of community energy. As grassroots energy innovations, a key question is whether energy communities can bring the desired sociotechnical changes in the energy landscape in a morally, and socially just way.

Two frameworks can be used to capture energy justice in the context of energy communities: distributional justice and procedural justice (Goedkoop and Devine-Wright, 2016). Distributional justice is reflected in the 'outcomes' dimension of a project: how are the benefits and risks spatially and socially distributed between the different actors (Goedkoop and Devine-Wright, 2016). For example, in a community ownership scheme, citizens can have full ownership and control over decision-making as opposed to a company-led project. In the latter, a commercial partner may offer only limited community benefits, such as a fixed payment that may even spark negative reactions.

The community project will distribute the benefits more widely among residents. A community windmill from where a whole village can benefit is likely more attractive than a large wind turbine from a project developer benefitting from one farmer selling a piece of land[20].

However, the equitable distribution of benefits applies not only between communities and investors, but also within communities. One issue is the accessibility of higher income and social capital that may benefit some societal groups more than others - usually the less well-off and socially-disadvantaged citizens (Jenkins, 2019).

Further, the opportunities of participation may be unequal due to educational and income differences. Discrepancies in culture, economic situation and the average welfare of citizens can imply broader geographical dimensions too. For example, energy communities are more prevalent in the Northern-Western European countries with higher levels of welfare and longer traditions of community ownership.

Distributional justice may also deal with justice as 'recognition' which acknowledges patterns of respect, stigmatisation or misrecognition (Jenkins, 2019). An example of misrecognition is that vulnerable customers can be misunderstood as aloof to environmental matters or incapable of making sound economic decisions. It is often the case that environmental apathy of the energy poor is rather caused by more immediate concerns of basic food and housing provisions rather than a disinterest in the matter (Jenkins, 2019).

One gain of communities is that it can enable a large group of customers to participate in electricity markets, including those who might not otherwise have the possibility to do so

[20] See https://grunnegerpower.nl/energieleverancier-noordelijk-lokaal-duurzaam-is-100-groen/

(European Parliament & Council of the European Union, 2019). For the socially disadvantaged, community use of renewables installations benefitting from feed-in-tariffs can play a significant role in reducing energy bills (Saunders, Gross, and Wade, 2012). A local community can better coordinate funding in low-income areas, remove investment risk and enable other social effects and local value creation (Saunders, Gross, and Wade, 2012). However, the average initial investment price to become a member tends to be high; ranging from 100 – 500 EUR. In addition, recent studies show that members are primarily middle or upper class (Hannoset et al., 2019; Devine-Wright et al., 2017). Another way to target vulnerable households is found in Greece, where a percentage of the profits made by an energy community needs to be allocated to energy poverty by law.

Finally, procedural justice investigates the fairness of decision-making and the mechanism through which decisions are taken. For community ownership, a relevant issue is the degree of openness and transparency in the development and ownership processes. For many cooperatives such as Enercoop in France that has a statute of a 'social enterprise', it is important that citizens have their say in the conduct of renewables projects, and these energies create positive spin-offs for the community[21]. Citizens can either become consumers or members of the cooperative which allows them to participate in the decision-making processes (Jenkins, 2019). Other relevant issues pertaining to procedural justice are: distribution of voting rights, accountability of members, intensity, frequency and methodology of community engagement and methodology of information provision.

Box 3. Courant d'Air

Another example is Courant d'Air cooperative enjoying the juridical and fiscal statute of an enterprise "with social objective". This means that members seek only limited personal profit, and the company pursues specific social objectives set out in the statutes. Courant d'Air aims at opening renewable energy access to as many citizens as possible. Beyond the distribution of a moderate dividend, Courant d'Air seeks to initiate and support social, environmental and sustainable projects for the benefit of citizens and the common good. As part of this mission, Courant d'Air considers the raising of awareness on climate change, fossil fuels and nuclear energy as social goals, and seeks to sensitize people to the use of renewables and to the economical consumption of energy.

Source: https://www.rescoop-mecise.eu/aboutmecise/courant-dair

[21] See https://www.enercoop.fr/content/lapprovisionnement-denercoop-quelle-difference

6 Contribution to renewable energy expansion

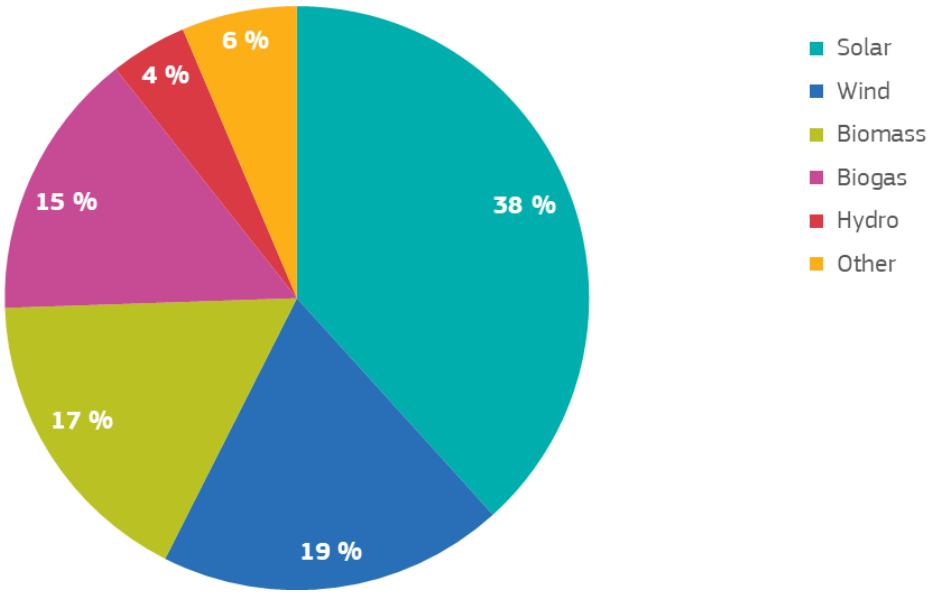
Energy communities aim to help citizens and local authorities invest in renewables and energy efficiency. The participation of citizens in renewables projects may also overcome social acceptance at the local level. Community-owned projects may allow citizens to finance investments that bring benefits locally - such as harnessing local renewable resources, increasing employment and reducing fuel poverty in the region.

6.1 Types of renewable energy

Renewables are well suited for decentralised and local generation. For example, community groups can engage in renewables generation by feeding electricity back to the grid and receiving a fixed feed-in tariff, or acting as 'islands', off-the-grid networks.

The 24 case studies JRC analysed show solar and wind are the most common used technologies (Figure 7). Examples on solar energy initiatives are from countries with favourable weather conditions such as Spain or the south of France. But solar cooperatives are also commonplace in Germany, the Netherlands, and Belgium where policy measures such as feed-in-tariffs or net metering helped expand the local production of renewables.

Figure 7 Type of energy corresponding to the 24 case studies



Source: JRC based on the case studies, 2019

In addition to the household level, solar panels can be suitable for rooftops of public buildings and farms. This is the case of Fermes de Figeac's solar installations carried out on agricultural buildings by a specific firm SAS Ségala Agriculture et Energie Solaire. The Edinburgh Community Solar Cooperative is the largest community-owned rooftop scheme in the UK, which has invested and is managing solar systems on the roofs of 24 City of Edinburgh Council buildings. In Ameland, an island off the north coast of the Netherlands, a solar park of 23 000 panels supplies more than enough power for all the island's households.

Community-owned wind turbines can be found in countries such as Belgium, Germany, France and the UK (Scotland). For example, Sprakebüll was originally formed as a community wind farm project in the Schleswig-Holstein region in Germany, which has long experience with wind power projects. In general, wind energy dominates in other areas with good wind conditions such as Denmark or Sweden. The examples from these two countries in this report mostly focus on district heating and biomass.

The projects from the case studies also show that hydro schemes are less common. Som Energia has financed a hydro power plant as part of its efforts to provide energy produced by the cooperative's own power plants. The remoteness of the Isle of Eigg in Scotland demonstrates its reliance on a hybrid off-grid electricity system including hydro as necessary to ensure constant and reliable supply.

There are a few examples of biomass community-owned schemes in Sweden, Denmark, Germany, Poland and Belgium. District heating cooperatives using wood fuel for heat and combined heat and power are particularly common in Denmark (about 300) and Germany. In Denmark, Marstal Fjernvarme, a citizens-owned district heating network uses solar heat collectors and heat pumps to provide hot water on the island of Ærø (Co2mmunity, 2019). Some multi-utility cooperatives such as Enercoop in France, EWS Schönau in Germany and Som Energia in Spain are also investing in or purchasing biogas.

Bioenergy villages represent an example of communities using biomass from local agriculture and forestry resources. For instance, Bioenergiedorf Jühnde is Germany's first village to produce heat and electricity through renewable biomass and combined heat and power (CHP) system, with a local heat network delivering heat to households (Yildiz et al., 2015).

In Sweden, there are a few eco-villages organised as locally owned, alternative-lifestyle social communities. One example is Solbyn that brings together residents sharing ecological lifestyles through a housing association. It uses insulation, solar heating and heat exchange systems to increase household efficiency.

6.2 Ownership structure of renewables investments

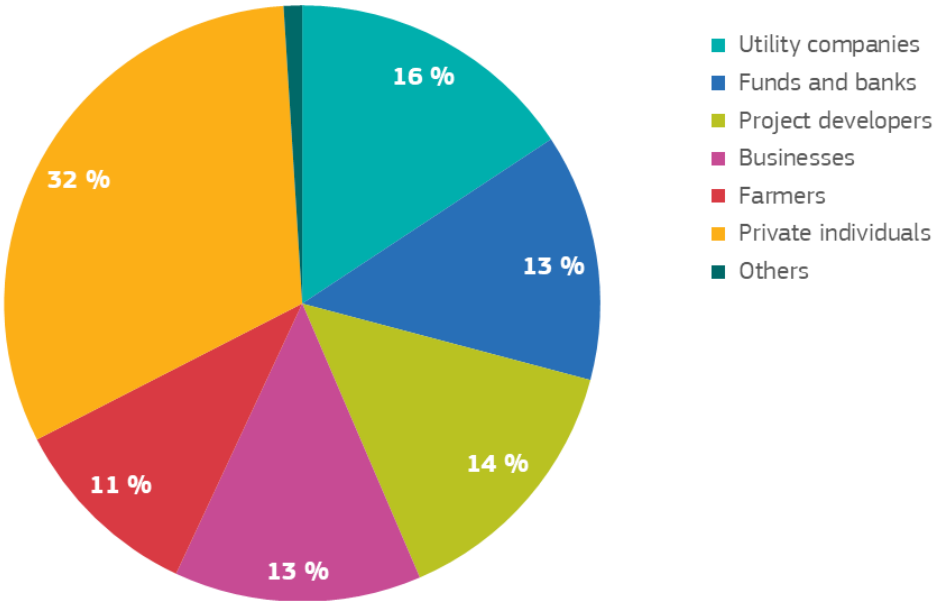
Community projects can be vital for stimulating renewables growth. Germany is a forerunner of citizen-led investments in renewables. In 2016, citizens including households and farmers owned 42% of the installed renewable energy capacity (Figure 8). Investment funds, banks, project providers and other investors owned another 41.2%, while the four biggest power utilities accounted for only 5.4%[22]. In total, there were about 1 750 citizen-led initiatives (Kahla et al., 2007), with about 855 cooperatives founded since 2006 (DGRV, 2016). More than 180 000 people are involved in cooperative projects, from production and supply to (heat) network operation and marketing[23]. The vast majority of projects concern generation (mostly solar and wind with shares of about 43% each, bioenergy at 6.2% and hydropower at 0.7%); with the rest engaging in distribution and energy services (Yildiz et al., 2015).

In the Netherlands, about 8% of final energy consumption comes from renewables[24]. Energy communities could ramp up this share by investing in vast amounts of solar panels and windmills. In 2018, 74.5 MW of solar power and 159 MW of wind was collectively-owned in the country. The number of cooperatives rose to 484, with about 70 000 members; and the first cooperatives for heat and biogas appeared (HIER opgewekt, 2018)[25].

The UK is another example where community projects have made fast progress in renewables investments over the past 20 years. In 2017, the UK community energy sector owned a total electrical generation capacity of 249 MW, including Scottish community renewables (Community Energy England, 2018). In Denmark, 60% of the heat consumption supplied in district heating systems has historically been consumer- and municipality- owned (Hvelplund, 2018).

[22] See German Renewables Energies Agency 2018 https://www.unendlich-viel-energie.de/media-library/charts-and-data/infographic-dossier-renewable-energy-in-the-hands-of-the-people
[23] See Deutscher Genossenschafts- und Raiffeisenverband e. V. (DGRV) https://www.genossenschaften.de/bundesgesch-ftsstelle-energiegenossenschaften
[24] See https://www.en-tran-ce.org/custom/uploads/2019/02/Renewable-Energy-January-2019.pdf
[25] See https://www.hieropgewekt.nl/local-energy-monitor

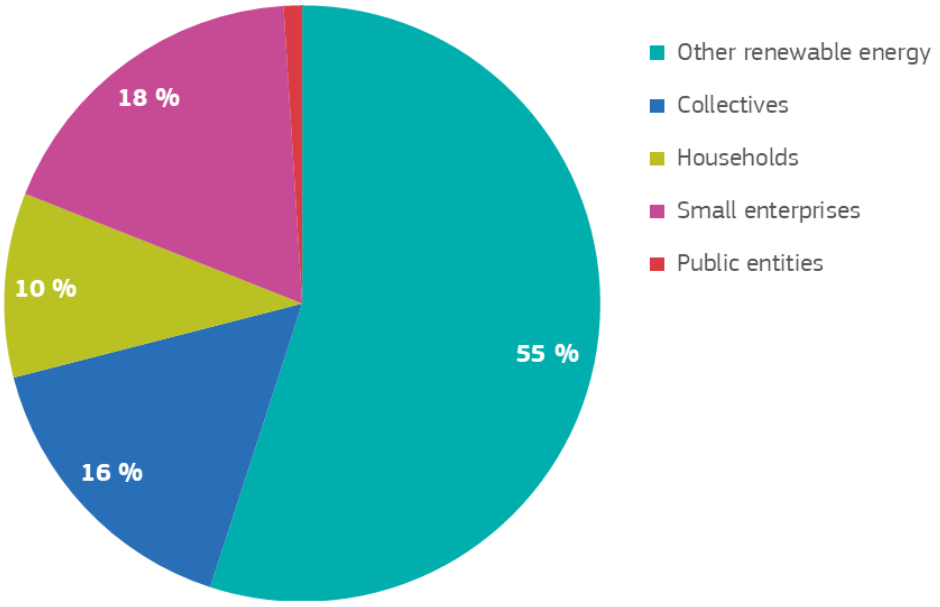
Figure 8 Renewable energy ownership by citizens in Germany in 2016



Source: (Renewable Energies Agency, 2018)

At the EU level, information on today's citizen ownership is sparse. However, a report by CE Delft estimates that over 264 million or half of European Union citizens could be producing their own energy by 2050 (Kampman, Blommerde, and Afma, 2016). About 37% of energy produced by energy citizens could come from collective projects such as cooperatives (Figure 9). Together with small businesses, households and public entities, these groups could own as much as 45% of Europe's renewable generation by 2050 (REScoop.eu & Friends of the Earth Europe, 2016).

Figure 9 Share of electricity production by investor type in the EU-28 in 2050



Source: (REScoop MECISE, 2019)

7 Impact on the energy system

Energy communities can play a key role in facilitating the decentralisation of the energy system and the local operation of renewable energy. Energy communities can also facilitate the local optimisation of power flows and the reduction in energy losses. But their long-term success will depend on their ability to operate energy networks in a cost-efficient way ensuring benefits for all customers and the whole energy system.

7.1 Energy communities affecting distribution networks

Under the recast Electricity Market Directive, Member States have the option to grant citizen energy communities the right to own, establish, purchase or lease grid infrastructure. Citizen energy communities can be engaged in network operations either under the general regime (public grid) or as closed distribution system operators. Once an energy community is granted the status of a distribution system operator (DSO), it is subject to the same rights and obligations as a DSO. These include unbundling rules and the related exemptions for DSOs that serve less than 100 000 final customers.

The ownership and management of electricity networks may be of interest to community members that want to consume local energy from their own generation assets. Three main types of energy communities could be considered that may facilitate electricity transfers: energy communities within housing companies, energy communities crossing property boundaries, and distributed energy communities (Pahkala, Uimonen, and Väre, 2018). The first two retain the local element whereas the latter is not bound to a geographical proximity.

- Energy community within a housing company: parties living or operating in the same property, such as stakeholders of housing companies sharing mutual benefits of self-consumption on their property. According to the EU definitions, an energy community within a housing company is rather an example of jointly acting renewable self-consumption that can be considered as a separate activity as part of an energy community (Frieden et al., 2019).
- Energy community crossing property boundaries: customers wanting to access renewable energy produced from a neighbour's property located within the immediate vicinity of their own real-estate property.
- Distributed energy communities: customers wanting to access production units located elsewhere than within their own property or in its immediate vicinity using the existing distribution or transmission network (Pahkala, Uimonen, and Väre, 2018).

Table 3 shows that while energy communities can bring benefits, they may also pose certain challenges for the energy system. At the distribution network level, energy communities may improve quality of service (by reducing network losses) and reduce or postpone network investments (by increasing hosting capacity and improving flexibility). They can also act as micro-grids operators of community networks offering flexibility services for a more efficient network operation. However, a key challenge is how to ensure the cost-efficiency of energy communities beyond locally-derived benefits (CEER, 2019). For example, the expected benefits of reduced grid fees due to the reduction in power flows from the main grid may only be beneficial for the members of the community. The reason is that such savings may transform into costs for customers elsewhere in the system, meaning that real-cost efficiency for the overall system is not achieved (CEER, 2019).

Table 3 Energy communities with and without public grids

Type	With public grid (on-grid)	Without public grid (off-grid)
Energy community within a housing company	No network charges for the energy that is generated and consumed within the property if it does not cross the access point to the distribution network.	Property (e.g. housing company) disconnected from the grid. Own responsibility for security and quality of supply.
Energy community crossing property boundaries	Mutual electricity line across property boundaries behind the connection point. Payment of network charges and tariffs according to general principles.	Private microgrid acting as a parallel network to the distribution system. Issue of costs and proportionality of regulation in terms of respecting consumers' rights and obligations.
Distributed energy communities	Payment of network charges and tariffs according to the general principles.	For virtual electricity sharing, customers will still rely on the public grid. Parallel networks over longer distances are not cost-efficient. Community-owned networks on islands or remote areas are possible.

Source: JRC based on (Pahkala, Uimonen, and Väre, 2018)

From a consumer perspective, energy communities are also expected to deliver high levels of security and quality of supply to its members. For instance, a community operating grids may be required to meet customer requirements for operational activities in the areas of metering, data protection, interoperability and other services benefitting customers in the energy system (CEER, 2019). Delivering such high standards in a cost-efficient way and at all times may be burdensome, most notably for smaller community-owned networks. The Electricity Market Directive provides both for proportional rules vis-à-vis other market actors, but also for ensuring that consumer rights are protected.

Where the needs arise, community-owned energy networks can be used to satisfy security of supply on certain islands or in other remote locations where grid connection costs can be significantly higher than in an autonomous system. Historically, several energy cooperatives started to build and operate distribution networks in less populated regions, for example in South Tirol in Italy. One example from the case studies, the Isle of Eigg in the UK has successfully used its own microgrid to ensure sustainable and reliable 24-h electricity supply on the island without connection to the mainland. Other community-led initiatives started to develop an interest in energy distribution (EWS Schönau by buying electricity grids) as part of wider social and environmental transformation trends[26].

EWS Schönau in Germany is an example of a cooperative utility company that fits as a distributed energy community operating its own power grid. The company became the local power grid operator for Schönau in the late 1990s, becoming the first German community to take over the grid as well as the electricity supply to the local community (EWS, 2017). When the German electricity market became deregulated, EWS Schönau started supplying all its Schönau customers exclusively with electricity generated from renewable and cogeneration sources, i.e. combined heat and power. With the opening of the German electricity market to private households, EWS began to supply customers with green electricity on a nationwide scale. In 2009, EWS Schönau expanded its activities into operating the local gas grids and supplying natural gas and biogas (EWS, 2017).

A few other energy initiatives presented through the case studies have expressed interest in energy distribution activities. In Poland, the energy clusters have the ambition to act as smart micro-networks balancing demand and supply from various forms of generation and demand in cooperation with local partners. One example is the Żywiecka Energia Przyszłości which includes cooperation with the Tauron Dystrybucja DSO and envisages to carry out distribution activities within a network of less than 110 kV. The cluster also

[26]See https://bit.ly/2kroQwS

seeks to implement a market model based on so-called micro networks in the area managed by the DSO.

The role of the cluster is to support demand-side management and the volume of energy generated from local resources (biogas, waste, solar, wind). The cluster will nevertheless remain connected to the public distribution network, and energy surpluses or shortages in the micro network (or the local energy community) will be balanced together with the DSO[27]. As a result, energy costs will be lower as participants will pay lower distribution costs (Wiktor-Sułkowska, 2018).

Box 4. Isle of Eigg (UK)

Eigg Electric is a community owned, managed and maintained company, which provides electricity for all island residents from renewable energy sources (hydro, solar, wind). Eigg is not connected to the mainland electricity supply.

The output of all renewable energy generators is brought together, controlled and distributed to all households and businesses on the island by way of an island-wide high voltage grid of approximately 11km length. Consumers are supplied via transformers which convert the grid voltage to domestic voltage and which are located in close proximity to clusters of properties.

The system has been designed to provide at least 95% of the power consumed on the island, from the three renewable resources, and to a limited extent by diesel generators.

To ensure that electricity is always available equally to all consumers without excessive reliance on the generators, domestic and small business premises were to be capped at 5kW and for larger business premises at 10kW.

Source: http://isleofeigg.org/eigg-electric/

7.2 Impact on system costs

When participating in an energy community, members may benefit from financial gains in relation to energy costs. These can include a reduction in their energy bill as the available renewable energy is cheaper than the retail tariff and can be injected into the grid through feed-in-tariffs. Other benefits may include lower network tariffs due to aggregation effects (Abada, Ehrenmann, and Lambin, 2017). A community may also ensure better local supply security in case of power disturbances elsewhere in the grid (Pahkala, Uimonen, and Väre, 2018).

Many examples from the case studies highlight economic gains in the form of lower energy prices. The cooperative Som Energia's Generation kWh, a financing scheme created in reaction to the subsidy cuts for renewables in Spain provides its members with a zero-interest loan and electricity at the cost of generation compensated annually on their electricity bill[28]. Participants keep paying taxes and grid access fees but the cost of generation is more stable since the installation, maintenance, rent, insurance and other fees are covered by long-term contracts. Each project is owned by Som Energia's limited company, and its production is sold via a bilateral contract to the cooperative, which in turn redistributes the kWh to each participant[29].

In the case of SAS Ségala Agriculture et Energie Solaire, the aggregation of solar photovoltaics rooftops regardless of their location and grid connection costs allowed for a high degree of efficiency and flexibility in operation. The distribution of costs and profits was shared according to the surface area of the photovoltaic panels installed by each shareholder, instead of the actual electricity production of each installation (Grandclément, Catherine; Nadaï, 2018).

[27] See http://klasterzywiec.pl/dzialalnosc-klastra-na-zywiecczyznie/
[28] See https://www.generationkwh.org/
[29] See https://citizenergy.eu/post/generation-kwh-novel-way-fund-energy-revolution

The ability of energy communities to share gains amongst their members is key for their long-term sustainability. Some research shows that the viability of a community may be jeopardised when simple sharing rules (such as per capita, pro-rata of consumption or peak demand) fail to fairly distribute benefits to all participants (Abada, Ehrenmann, and Lambin, 2017). In this case, some members may find it more beneficial to opt out and create another community of their own following inappropriate remuneration. One reason is the heterogeneity of households (students, families of different occupations or retired people) that have different consumption profiles. For example, those members that match their consumption during those times when the solar panels produce electricity create more value and should receive a higher share than those with evening peak consumption (Abada, Ehrenmann, and Lambin, 2017).

Local energy allocation can decrease local peak demand and the payment for grid services but it may still increase costs somewhere else in the system. If more prosumers use electricity generated locally in the community and aggregate their consumption profiles, the power flows from the main grid will decrease. Self-consumption in a community will therefore reduce recovery of distribution network costs and policy charges and levies (Abada, Ehrenmann, and Lambin, 2017).

Network costs are distributed equally amongst system users as the same type of grid warrants the same cost allocation. Therefore, the network operator will try to compensate the resulting loss of revenue by increasing the tariff to the remaining customers in the system who might not own a renewables installation (Brown and Lund, 2013). This regressive effect creates a social discrepancy between members of the community and non-members – the latter including those individuals that cannot afford to invest in renewables but indirectly supporting the former group by contributing to renewables support schemes (Yildiz et al., 2019). A redesign of network tariffs can be considered to avoid negative impacts on the overall cost base.

8 Conclusions and recommendations

Community electricity and heat projects are becoming increasingly important phenomena. The recently adopted Clean Energy Package further supports this trend as it set the foundation for energy communities under the EU legislative framework.

Energy communities can be instrumental for facilitating the energy transition at the citizen and at the local level. In addition to fostering greater citizen participation and acceptance of renewables projects, they also provide other socio-economic benefits such as the encouragement of local investments and engagement of vulnerable customers.

Prior to the adoption of the Clean Energy for All Europeans Package, there has been little support in legislative frameworks for citizens and communities wanting to invest in energy projects. Member States should take the opportunity of the new EU legislation to encourage the development of energy communities and integrate them in their energy systems.

The findings from the 24 case studies the JRC analysed show that countries with a long history and national authorities supporting community ownership made it easier for community energy to emerge. Yet differences in economic factors such as income levels and the ability to acquire ownership in renewables installations can play a role too. Community renewable energy initiatives are more prevalent in higher-income Northern European countries and less developed in Southern, Central and Eastern Europe.

Energy policies in the form of subsidies and economic support are considered a key factor that can influence the success rate of energy communities. This is seen in their rapid expansion after policy support schemes became more widely available across Europe. Some energy projects emerged out of the need to ensure reliable energy supply and self-sufficiency in certain regions. Others were more recently promoted by local governments with the involvement of energy companies to bring energy closer to local citizens.

While monetary benefits in the form of shares or cheaper electricity prices are a strong incentive, they do not exclude other types of motivations for engaging in community energy. Environmental concerns, a desire to be energy independent and use energy more sustainably to the benefit of the community represent strong drivers. The case studies reveal that various legal forms allow for community involvement in sustainable energy investments. The most common legal structures are cooperatives owned by citizens through shares. Ownership models (limited partnerships, foundations and others) may continue to thrive with the implementation of the new EU rules at the national levels.

8.1 Fostering supportive energy policy frameworks

Several Member States analysed through the case studies made progress in providing instruments and targets addressing energy communities. Yet these measures remain less ambitious than the supportive frameworks set out in the recast Renewable Energy Directive and the recast Electricity Market Directive. These EU laws are central to providing full recognition, participation and ownership rights for citizens to engage in energy matters.

The full implementation of the Clean Energy Package rules into national law will be critical for the development and viability of energy communities. When developing their national energy and climate action plans, Member States should identify concrete measures to implement the rights given to citizen and renewable energy communities in the recast Internal Electricity Market Directive and the recast Renewable Energy Directive.

Member states could include measures to support energy communities in achieving energy efficiency and energy poverty objectives where these bring benefits (for instance, by encouraging building renovations and renewables installation for tenants and private

homeowners). The UK's process to develop a Community Energy Strategy[30] provides good examples for measures supporting the future growth of community-led energy projects.

The fast development of communities can be largely attributed to policy support schemes such as feed-in-tariffs that supported investments in renewable generation assets. In the longer term, we need viable business models on how to run projects that can attract sufficient funding. Market-based remuneration mechanisms such as auctions may pose certain restrictions for energy communities because of their small size and resources.

Easing the procedures for participation in these support mechanisms – such as including criteria in tenders for local community benefits could help support local and citizen participation. Local authorities are well placed to support communities by, for example, providing quotas for local ownership of renewable energy projects for citizens. Possible business models can include enabling self-consumption, investing in large rooftop solar panels and in batteries to store excess electricity.

Innovative financing schemes are necessary to overcome barriers to investments. As renewable energy projects usually require large capital costs, one of the main challenges for energy communities is how to secure financial means up-front.

8.2 Empowering customers and boosting social innovation

Citizen participation and community co-ownership schemes play an increasingly societal role by fostering citizens' participation in energy matters and raising acceptance of renewable energy. They can bring tremendous benefits for citizens and communities by placing them closer to the energy transition and fulfilling Europe's decarbonisation goals.

Energy communities show both a commitment to place by bringing benefits to the local communities, and interest by connecting people through a common bond. Unlike in a commercial enterprise, the aim is to maximise community benefits rather than profits. Collective energy initiatives investing in renewables can provide local income and investments, and keep financial benefits from local resources within the community.

Energy communities are a type of social innovation that can promote more socially fair models of energy prosumership. They enhance citizens' democratic decision-making and control over renewable energy, which is placed into the hands of communities and people. Yet there is also a risk that energy communities might create social disparities between its members - that are more likely to come from moderate to higher income households, and other customers that might not have the financial resources to invest in distributed generation but will share a higher burden of energy policy costs and grid fees.

However, they can also offer consumers more choices to participate in electricity markets, including for those on lower-income who can otherwise not afford to participate. Several case studies show projects that help address energy poverty – for instance, by offering cuts in energy bills and cooperating with local councils to improve social conditions.

A systematic EU-wide study would be useful to assess the potential of energy communities in reducing energy poverty, including the opportunities and barriers for participation of socially vulnerable and energy poor households in energy communities. Also, assessing the impact of community-based initiatives on individual and collective behaviours can provide useful evidence for future policy initiatives on sustainable energy behaviours.

In terms of energy provisions, members of an energy community can benefit from financial gains on their energy bills because of reduced grid fees and energy costs. But more clarity is needed on how these benefits are both shared within the community's members and with the rest of the system users. Cost allocation rules should account for real-cost savings in the system and adequately distribute gains amongst users.

[30] https://www.gov.uk/government/publications/community-energy-strategy

8.3 Taking an energy system approach

Energy communities can bring both opportunities and challenges for the overall energy system. Energy communities can advance the uptake of renewables and encourage their members to consume and share part of their energy. They can also provide flexibility services for more efficient network operations. Their integration into the energy system must be done in a way that ensures cost-efficiency for all customers and real cost savings in the system.

Energy communities can be vital for stimulating renewables growth. In countries such as Germany and the UK, community energy already owns significant shares of installed renewable capacity. Estimates suggest that by 2030, energy communities could own some 17% of installed wind capacity and 21% of solar (European Commission, 2016). By 2050, almost half of the European population could be producing energy, with 37% of which could come from energy communities.

The findings from the case studies show that the rise of community projects in new areas such as energy supply and electro-mobility can result in new business models that were traditionally held by energy utilities in the power sector. While the majority of projects remain engaged in generation – mostly solar and wind energy, their roles are gradually expanding into the provision of multiple energy services. The increase in commercial activities can nevertheless be compatible with socially driven community objectives.

By aggregating individual loads, communities can offer local flexibility services such as relieving network congestions and avoiding peak demands in electricity networks. While local energy allocation may help decrease costs locally, it can still increase system costs. To recover the lost revenues from distribution charges, system operators are likely to pass the costs to the remaining customers who do not own renewable installations. As collective self-consumption rises, regulators should consider redesigning network tariffs in a way that avoids negative impacts on the overall cost base. Energy communities are most likely to succeed when delivering value for all types of customers and the wider energy system. Further research is necessary to analyse the value these can deliver to the system.

Where it is socially and economically feasible, for example on islands or in remote locations community-owned networks can be a solution as off-grid infrastructure. Following the adoption of the EU legal framework, it is necessary to implement their roles and responsibilities in a clear way at the national level to ensure citizen empowerment and overall system efficiency.

8.4 Driving Research and Innovation

Citizen and community energy activities can bring much-needed innovation potential to energy practices. They can overcome current limits on citizen engagement and adoption of new technologies in the energy system.

While the advent of energy communities in new areas is still emerging, more research is necessary to clarify and quantify their potential benefits for supporting the EU's climate and energy goals. The 24 case studies JRC analysed in this report represent only a very small sample. Further research can address a more comprehensive view based on larger, EU-wide mapping exercises.

Currently, aggregate data related to energy communities' contribution to the energy transition is largely missing. The Horizon 2020 COMETS project aims to fill these knowledge gaps by quantifying a European-wide aggregate contribution of energy communities and investigating their evolution and scaling up at an in-depth level in six selected countries.

The NEWCOMERS project aims to use an innovative holistic approach to deliver recommendations about how the European Union, national and local governments can

support new clean energy communities to help them flourish and unfold their potential benefits for citizens and the Energy Union.

An in-depth assessment is recommended to analyse the barriers facing the development of energy communities in different Member States. The study should also focus on addressing barriers for citizens' participation, including for the lower income, vulnerable customers and local authorities. When assessing the opportunities, a system perspective should be taken that looks at the energy system and society as a whole.

The Sustainable Energy Communities Initiative under Intelligent Energy Europe focused on helping local and regional authorities to build their capacity and invest in sustainable energy. EU funding programmes can help strengthen technical and financial capacities of local actors in those Member States with lower concentration of community energy action. Municipal-led initiatives such as the Covenant of Mayors can foster citizens' energy representation and boost economic growth at the local level.

References

Abada, I., A. Ehrenmann, and X. Lambin, *On the Viability of Energy Communities*, Cambridge Working Paper in Economics 1740, Cambridge, 2017.

Akerboom, S., and F. van Tulder, 'Consumer (Co-)Ownership in Renewables in the Netherlands', in J. Lowitzsch (ed.), *Energy Transition - Financing Consumer Co-Ownership in Renewables*, Palgrave Macmillan, Cham, 2019, pp. 319–344.

Bauwens, T., 'Explaining the Diversity of Motivations behind Community Renewable Energy', *Energy Policy*, Vol. 93, 2016, pp. 278–290.

Bauwens, T., and J. Defourny, 'Social Capital and Mutual Versus Public Benefit: The Case of Renewable Energy Cooperatives', *Annals of Public and Cooperative Economics*, Vol. 88, No. 2, 2017, pp. 203–232.

Bauwens, T., B. Gotchev, and L. Holstenkamp, 'What Drives the Development of Community Energy in Europe? The Case of Wind Power Cooperatives', *Energy Research and Social Science*, Vol. 13, 2016, pp. 136–147.

Beckmann, V., I.M. Otto, and T. Tan, 'Overcoming the Legacy of the Past? Analyzing the Modes of Governance Used by the Polish Agricultural Producer Groups', *Agricultural Economics (Zemědělská Ekonomika)*, Vol. 61, No. No. 5, June 6, 2016, pp. 222–233.

Brown, A., and L. Lund, 'Distributed Generation: How Green? How Efficient? How Well-Priced?', *Electricity Journal*, Vol. 26, No. 3, 2013, pp. 28–34.

Bryant, S.T., K. Straker, and C. Wrigley, 'The Typologies of Power: Energy Utility Business Models in an Increasingly Renewable Sector', *Journal of Cleaner Production*, Vol. 195, 2018, pp. 1032–1046.

Capellán-Pérez, I., Á. Campos-Celador, and J. Terés-Zubiaga, 'Renewable Energy Cooperatives as an Instrument towards the Energy Transition in Spain', *Energy Policy*, Vol. 123, No. December, 2018, pp. 215–229.

CEER, 'Regulatory Aspects of Self- Consumption and Energy Communities CEER Report', No. June, 2019.

Co2mmunity, 'Project Website, Case Story Factsheet Sprakebüll – A Pioneering Energy Community in North Frisia , Germany', *INTERREG Project Co2mmunity*, 2019. http://co2mmunity.eu/wp-content/uploads/2019/02/Factsheet-Sprakebüll.pdf.

Community Energy England, 'Community Energy State of the Sector - Infographic Booklet (Executive Summary)', No. June, 2018.

Curtin, J., C. McInerney, and L. Johannsdottir, 'How Can Financial Incentives Promote Local Ownership of Onshore Wind and Solar Projects? Case Study Evidence from Germany, Denmark, the UK and Ontario', *Local Economy*, Vol. 33, No. 1, 2018, pp. 40–62.

Curtin, J., C. McInerney, and B. Ó Gallachóir, 'Financial Incentives to Mobilise Local Citizens as Investors in Low-Carbon Technologies: A Systematic Literature Review', *Renewable and Sustainable Energy Reviews*, 2017.

DGRV, *DGRV Annual Survey of Energy Cooperatives*, Deutscher Genossenschafts- und Raiffeisenverband e.V. (DGRV), Berlin, 2016.

Dreyfus, M., and R. Allemand, 'Three Years after the French Energy Transition for Green Growth Law: Has the 'energy Transition' Actually Started at the Local Level?', *Journal of Environmental Law*, Vol. 30, No. 1, 2018, pp. 109–133.

European Commission, *Final Report of the High-Level Panel of the European Decarbonisation Pathways Initiative*, Publications Office of the European Union, Luxembourg, 2018.

European Commission, 'Staff Working Document Impact Assessment Accompanying the Document Proposal for a Directive of the European Parliament and of the Council on the Promotion of the Use of Energy from Renewable Sources (Recast)', 2016.

European Parliament & Council of the European Union, 'Directive (EU) 2018/2001 on the Promotion of the Use of Energy from Renewable Sources', *Official Journal of the European Union*, Vol. 2018, No. November, 2018.

European Commission, 'Directive (EU) 2019/944 on Common Rules for the Internal Market for Electricity and Amending Directive 2012/27/EU', No. July 2009, 2019.

EWS, *EWS Schönau. Elektrizitätswerke Schönau - Who We Are*, Elektrizitätswerke Schönau, Schönau, 2017.

Frieden, D., A. Tuerk, J. Roberts, S. D'Hebermont, and A. Gubina, 'Collective Self-Consumption and Energy Communities: Overview of Emerging Regulatory Approaches in Europe', No. June, 2019.

Friends of the Earth Europe, *Unleashing the Power of Community Renewable Energy*, Friends of the Earth Europe, Brussels, 2018.

Geels, F.W., B.K. Sovacool, T. Schwanen, and S. Sorrell, 'The Socio-Technical Dynamics of Low-Carbon Transitions', *Joule*, Vol. 1, No. 3, 2017, pp. 463–479.

Goedkoop, F., and P. Devine-Wright, 'Partnership or Placation? The Role of Trust and Justice in the Shared Ownership of Renewable Energy Projects', *Energy Research and Social Science*, Vol. 17, 2016, pp. 135–146.

Grandclément, Catherine; Nadaï, A., 'Transitioning Through Markets', in A. Labussière, Olivier; Nadaï (ed.), *Energy Transitions: A Socio-Technical Inquiry*, 2018, pp. 101–143.

Hammerstein, D., 'Community Energy as a Commons', *European Commission, Joint Research Centre Workshop: Local Communities and Social Innovation for the Energy Transition*, 2018.

Hanna, R., 'Community Renewables Innovation Lab. Energy Transition Platform Policy Briefing', *Spiral.Imperial.Ac.Uk*, Vol. 22, No. November, 2017.

Hannoset, Achille, Leen Peeters, A.T., 'Energy Communities in the EU Task Force Energy Communities', 2019.

Hewitt, R.J., N. Bradley, A.B. Compagnucci, C. Barlagne, A. Ceglarz, R. Cremades, M. McKeen, I.M. Otto, and B. Slee, 'Social Innovation in Community Energy in Europe: A Review of the Evidence', *Frontiers in Energy Research*, Vol. 7, No. APR, 2019.

HIER opgewekt, 'Local Energy Monitor', 2018. https://www.hieropgewekt.nl/lokale-energie-monitor.

Hvelplund, F., 'Consumer Ownership, and Mulitlevel Policies for an Energy Transition to 100% Renewable Energy Systems', *European Commission, Joint Research Centre Workshop: Local Communities and Social Innovation for the Energy Transition*, Ispra, 2018.

IEA-RETD, *Cost and Financing Aspects of Community Renewable Energy Projects. Volumne II: Danish Case Study*, Ricardo Energy & Environment and Ecologic Institute, IEA-RETD Operating Agent, IEA Implementing Agreement for Renewable Energy Technology Deployment (IEA-RETD), Utrecht, 2016.

Jasiak, M., 'Energy Communities in the Clean Energy Package', *European Energy Journal*, Vol. 7, No. 5, 2018, pp. 29–39.

Jenkins, K.E.H., 'Energy Justice, Energy Democracy, and Sustainability: Normative Approaches to the Consumer Ownership of Renewables', in J. Lowitzsch (ed.), *Energy Transition - Financing Consumer Co-Ownership in Renewables*, Palgrave Macmillan, Cham, 2019.

INTERREG Project Co2mmunity, 'Project Website, Case Story Marstal Fjernvarme – a Solar District Heating Plant on the Island of Ærø , Denmark', 2019. http://co2mmunity.eu/wp-content/uploads/2019/03/Factsheet-Aerö-Marstal.pdf.

Kahla, F., L. Holstenkamp, J.R. Muller, and H. Degenhart, *Development and State of Community Energy Companies and Energy Cooperatives in Germany*, 2007.

Kampman, B., J. Blommerde, and M. Afma, *The Potential of Energy Citizens in the European Union [Report Commissioned by Greenpeace]*, 2016.

Knoefel, J., J. Sagebiel, Ö. Yildiz, J.R. Müller, and J. Rommel, 'A Consumer Perspective on Corporate Governance in the Energy Transition: Evidence from a Discrete Choice Experiment in Germany', *Energy Economics*, Vol. 75, 2018, pp. 440–448.

Kounelis, I., G. Raimondo, G. Dimitrios, D.G. Rosanna, K. Georgios, S. Gary, R. Neisse, and I. Nai-Fovino, *Blockchain in Energy Communities. A Proof of Concept*, European Commission, Ispra, 2017.

Krug-Firstbrook, M., C. Haggett, and B. van Veelen, 'Consumer (Co-)Ownership in Renewables in Scotland (UK)', in J. Lowitzsch (ed.), *Energy Transition Financing Consumer Co-Ownership in Renewables*, 2018.

Kunze, C., and S. Becker, 'Energy Democracy in Europe: A Survey and Outlook', *Rosa Luxemburg Foundation*, No. January 2014, 2014, p. 63.

Lissowska, M., 'ISSN 2219-9268 The Deficit of Cooperative Attitudes and Trust in Post-Transition Economies', Vol. 10, No. 10, 2013.

Marinopoulos, A., J. Vasiljevska, and A. Mengolini, 'Local Energy Communities: An Insight from European Smart Grid Projects', *CIRED Workshop. Paper 0250*, CIRED, Ljubljana, 2018, pp. 7–8.

Morris, C., *Germany's Energiewende: Community-Driven Since the 1970s.*, *Global Sustainable Communities Handbook: Green Design Technologies and Economics*, Elsevier, 2014.

Pahkala, T., H. Uimonen, and V. Väre, 'Flexible and Customer-Centred Electricity System; Final Report of the Smart Grid Working Group', 2018.

REN21, *Renewables 2016 Global Status Report. Key Findings 2016*, REN21 - Renewable Energy Policy Network, Paris, 2016.

Renewable Energies Agency, 'Renewable Energy in the Hands of People', Renewable Energies Agency, 2019. https://www.unendlich-viel-energie.de/media-library/charts-and-data/infographic-dossier-renewable-energy-in-the-hands-of-the-people.

REScoop.EU, 'Q & A: What Are 'Citizen' and 'Renewable' Energy Communities?', *Policy Paper*, 2019.

REScoop.eu & Friends of the Earth Europe, 'Potential for Citizen-Produced Electricity in the EU', 2016. https://www.foeeurope.org/sites/default/files/renewable_energy/2016/foee-potential-energy-citizens-eu-260916.pdf.

REScoop MECISE, *Mobilising European Citizens to Invest in Sustainable Energy, Clean Energy for All Europeans, Final Results Oriented Report of the RESCOOP MECISE Horizon 2020 Project*, 2019.

Roberts, J., Frieden, D., Gubina, A., 'Energy Community Definitions', *Compile Project: Integrating Community Power in Energy Islands*, No. May, 2019.

Roberts, J., F. Bodman, and R. Rybski, *Community Power; Model Legal Frameworks for Citizen-Owned Renewable Energy*, Vol. 1, Vol. 1, ClientEarth, London, 2014.

Ronne, A., and F.G. Nielsen, 'Consumer (Co-)Ownership in Denmark', *Energy Transition -*

Financing Consumer Co-Ownership in Renewables, Palgrave Macmillan, Cham, 2019.

Ruggiero, S., A. Isakovic, H. Busch, K. Auvinen, and F. Faller, 'Developing a Joint Perspective on Community Energy: Best Practices and Challenges in the Baltic Sea Region', No. 2, 2019, p. 33.

Saunders, R.W., R.J.K. Gross, and J. Wade, 'Can Premium Tariffs for Micro-Generation and Small Scale Renewable Heat Help the Fuel Poor, and If so, How? Case Studies of Innovative Finance for Community Energy Schemes in the UK', *Energy Policy*, Vol. 42, 2012, pp. 78–88.

Van Der Schoor, T., H. Van Lente, B. Scholtens, and A. Peine, 'Challenging Obduracy: How Local Communities Transform the Energy System', *Energy Research and Social Science*, Vol. 13, No. 2016, 2016, pp. 94–105.

Simcock, N., R. Willis, and P. Capener, 'Cultures of Community Energy International Case Studies', *Lancaster Environment Centre – Lancaster University*, 2016, p. 83.

Smith, A., T. Hargreaves, S. Hielscher, M. Martiskainen, and G. Seyfang, 'Making the Most of Community Energies: Three Perspectives on Grassroots Innovation', *Environment and Planning A*, Vol. 48, No. 2, 2016, pp. 407–432.

Tounquet, F., L. De Vos, I. Abada, I. Kielichowska, and C. Lessmann, 'Energy Communities in the European Union', No. May, 2019.

Walker, B.J.A., B. Wiersma, and E. Bailey, 'Community Benefits, Framing and the Social Acceptance of Offshore Wind Farms: An Experimental Study in England', *Energy Research and Social Science*, Vol. 3, No. C, 2014, pp. 46–54.

Walker, G., 'What Are the Barriers and Incentives for Community-Owned Means of Energy Production and Use?', *Energy Policy*, Vol. 36, No. 12, 2008, pp. 4401–4405.

Walker, G., and P. Devine-Wright, 'Community Renewable Energy: What Should It Mean?', *Energy Policy*, Vol. 36, No. 2, 2008, pp. 497–500.

Wierling, A., V.J. Schwanitz, J.P. Zeiß, C. Bout, C. Candelise, W. Gilcrease, and J.S. Gregg, 'Statistical Evidence on the Role of Energy Cooperatives for the Energy Transition in European Countries', *Sustainability (Switzerland)*, Vol. 10, No. 9, 2018.

Wiktor-Sułkowska, A., 'Do the Polish Energy Clusters Have a Chance to Become Units Independent from External Energy Supplies and Can They Operate as Self-Financing Bodies?', *Inzynieria Mineralna*, Vol. 2018, No. 2, 2018, pp. 123–128.

Yildiz, Ö., B. Gotchev, L. Holstenkamp, J.R. Müller, J. Radtke, and L. Welle, 'Consumer (Co-)Ownership in Renewables in Germany', in J. Lowitzsch (ed.), *Energy Transition - Financing Consumer Co-Ownership in Renewables*, Palgrave Macmillan, Cham, 2019.

Yildiz, Ö., J. Rommel, S. Debor, L. Holstenkamp, F. Mey, J.R. Müller, J. Radtke, and J. Rognli, 'Renewable Energy Cooperatives as Gatekeepers or Facilitators? Recent Developments in Germany and a Multidisciplinary Research Agenda', *Energy Research and Social Science*, Vol. 6, March 2015, pp. 59–73.

List of abbreviations and definitions

AEC	Amelander Energie Coöperatie
BenCom	Society for the Benefit of the Community
CHP	Combined heat and power
DGRV	Deutscher Genossenschafts- und Raiffeisenverband
DSO	Distribution system operator
EEG	Renewable Energy Act (Germany)
EWS	Elektrizitätswerke Schönau
FiT	Feed-in-Tariff
IEA	International Energy Agency
IPS	Industrial and provident societies
JRC	Joint Research Centre
kW	Kilowatt
MW	Megawatt
PV	Photovoltaics
UK	United Kingdom

List of figures

List of tables

Annex: Case studies per country

This annex provides a review of 24 case studies of community energy projects from nine European countries (Belgium, Denmark, France, Germany, Netherlands, Poland, Spain, Sweden, and United Kingdom).

Belgium

BeauVent

Name	BeauVent
Country	Belgium
Year	2000
Members	>5 000
Organisation type	Cooperative Limited Liability Company (CVBA)
Activities	Generation renewable electricity, including the selling of electricity to those customers on whose roofs there are PV panels; Supply renewable heat; Energy efficiency; Third-party financing services
Technology / Energy	Wind, solar; Cogeneration; District heating network, biomass (waste incineration)
Renewable generation (or capacity)	Nieuwkapelle Park: 4 000 000 kWh; Gistel windmill: 2.4 MW; 993 978 kWh (2018)
Description	Beauvent is a cooperative that acts as a renewables producer. It sells the electricity it produces to Ecopower and large final customers. The cooperative also operates a district heating network. Beauvent collects funds to invest in wind energy, solar panels, biomass and energy-efficient applications such as CHP and heat networks.
Objectives	Target of 100% RES by 2050. Promotes using less energy and makes funds available for awareness raising and educational projects on energy issues. Encourage collective investment in renewables and low-energy houses. Ecological aims.
Website	https://www.beauvent.be

Courant d'Air

Name	Courant d'Air
Country	Belgium
Year	2009
Members	>2000
Organisation type	Cooperative Limited Liability Company (SCRL)
Activities	Generation renewable electricity; Energy efficiency; Electro-mobility; Information awareness
Technology / Energy	Wind, solar; Collective LEDs, auditing and monitoring; car sharing
Renewable generation (or capacity)	-
Description	The cooperative pursues projects in the field of renewable energy and energy efficiency measures. It developed an education programme called Generation Zero Watt to incite future generations to be zero watt. Courant d'Air is open to everyone with a share subscription of €250.
Objectives	Aims at opening renewable energy access to as many people as possible. Promotes awareness and education. Improvements in energy efficiency.
Website	https://www.courantdair.be/wp/

Ecopower

Name	Ecopower cvba
Country	Belgium
Year	1992
Members	56,000
Organisation type	Cooperative Limited Liability Company (CVBA)
Activities	Generation, supply renewable electricity; Supply renewable heat (biomass); Energy efficiency (Ecotrajet services)
Technology / Energy	Wind, solar, biomass, hydro, cogeneration; Wood eco-pellets, briquettes (domestic heating), micro-CHP
Renewable generation (or capacity)	~100 GWh/year electricity ; Towards 100% RES.
Description	Both an electricity producer and supplier of green electricity and renewable fuels in Flanders. It invests in wood pellets for small-scale heating of buildings and domestic hot water. Its Ecotrajet project assists citizens to commission deep energy renovations in their homes.
Objectives	Investments in 100% renewable energy. Supplies clean energy from local renewable sources to its members. Promotes energy efficiency.
Website	https://www.ecopower.be/

Denmark

Marstal Fjernvarme

Name	Marstal Fjernvarme a.m.b.a.
Country	Denmark
Year	1962
Members	1600
Organisation type	Non-profit customer owned enterprise Marstal Fjernvarme A.m.b.A.
Activities	District heating network based on renewables (generation, distribution and supply) supplying about 2,200 customers on the island town of Marstal; Energy storage
Technology / Energy	Solar heat collectors (50-55%), wood chips (40%), heat pump (2-3%), bio-oil, CHP; Thermal energy storage
Renewable generation (or capacity)	Annual production of about 32,000 MWh.
Description	Marstal Fjernvarme is an example of a solar district heating plant on the island of Ærø, Denmark. The collectively-owned district heating network provides hot water to nearly all of the 2,200 inhabitants of the island town of Marstal. The company provides heat to Marstal from 100% renewables.
Objectives	The aim of the project is to demonstrate a large scale innovative, cost-effective and technically 100 % sustainable renewable energy system. It aims to demonstrate that district heating can be produced with 100% RES, of which solar thermal can cover 50% or more. This is done through a large heat storage combined with CHP using renewables to produce district heating. Green branding.
Website	https://www.solarmarstal.dk/

Svalin co-housing complex

Name	Svalin co-housing complex
Country	Denmark
Year	-
Members	20 households
Organisation type	Energy collective project (Co-housing community)
Activities	Generation renewable electricity and consumption; Energy services; electro-mobility; energy sharing
Technology / Energy	Solar, geothermic heat pumps, battery storage; Colourful street lighting 'nudging'; electric cars; Community based energy sharing, peer to peer energy trading
Renewable generation (or capacity)	-
Description	Svalin is a sustainable co-housing community with 20 households in Roskilde. Houses and shared infrastructure were designed to accommodate solar panels, geothermic heat pump and electric cars. It uses colourful street lights: 'red' for fossil fuels and 'green' sources. The project is serving as a living laboratory for the Technical University of Denmark's (DTU) research project Energy Collective. The projects experiments trials with local self-sufficiency and the sharing economy.
Objectives	Aims to collectively consume 100% renewable and local by sharing their renewable energy generation, thus avoiding the traditional intermediary parties. Svalin aim is to be the first demonstration side in Denmark of a community collectively consuming and sharing electric energy among neighbours. Environmentally consciousness about the use of electricity; inspiration to municipalities.
Website	http://the-energy-collective-project.com/context/

France

Enercoop

Name	Enercoop
Country	France
Year	2005
Members	70 000
Organisation type	Société Coopérative d'Intérêt Collectif (SCIC)
Activities	Supply renewable electricity (supplier of 100% renewable electricity, purchases electricity directly from renewale energy producers) 2. Energy savings
Technology / Energy	Solar, wind, hydraulic, biogas; Dr Watt, Savings Wiki; Fuel poverty Energie Solidaire
Renewable generation (or capacity)	209 MW; 249 GWh annual production (2017)
Description	Enercoop is the only supplier of energy in the form of a 'social enterprise' cooperative. It is one of the few green electricity suppliers that buys energy directly from producers. Made up of 11 separate regional renewable energy cooperatives, Enercoop operates 100 hydro schemes, 25 windfarms, 104 solar projects and 3 biomass generator -249 GWh of electricity in 2017.

Objectives	Deliver positive environmental, socio-economic objectives. Energy democracy (Self-sufficiency). Deliver 100% renewables at a fair price for all. The long-term goal of Enercoop is to create local citizens' cooperatives for energy.
Website	http://www.enercoop.fr/

Mobicoop

Name	Mobicoop
Country	France
Year	2011
Members	20,000
Organisation type	Société coopérative d'intérêt collectif
Activities	Shared mobility
Technology / Energy	Car-pooling, car-sharing, public transport, shared bikes
Renewable generation (or capacity)	N/A
Description	Mobicoop is a cooperative in the field of shared mobility (car-pooling, car sharing). It ensures that shared mobility solutions are available to everyone (people with disabilities, the elderly, limited resources). The previous car-pooling association (Co-voiturage libre) has decided to turn into a cooperative (Mobicoop) in 2018.
Objectives	Promote electric car sharing services. Reduce transport emissions at the service of the greatest possible number. Tackle transport poverty (rural areas, disabilities)
Website	https://www.mobicoop.fr/

SAS Ségala Agriculture et Energie Solaire (SAS SAES)

Name	SAS Ségala Agriculture et Energie Solaire (SAS SAES)
Country	France
Year	2008
Members	180
Organisation type	Société Coopérative d'Intérêt Collectif Bois Énergie
Activities	Generation renewable electricity
Technology / Energy	Solar photovoltaics
Renewable generation (or capacity)	14 MW, 11 180 000 kWh; 461 agricultural buildings equipped with roofs.
Description	The Fermes de Figeac's solar PV project carried out by a specific firm SAS Ségala Agriculture et Energie Solaire. The initiative to install solar roofs on farm buildings was largely initiated as a reaction to the high feed-in-tariff in France.
Objectives	Mutualisation of a common resource as an additional income for the territory and cooperative. Guarantee regular income for farmers. Reinvest profits in local assets. Revitalisation of rural area where agricultural activities are on decline.
Website	https://www.fermesdefigeac.coop/

Germany

Bioenergiedorf Jühnde eG

Name	Bioenergiedorf Jühnde eG
Country	Germany
Year	2005
Members	1089
Organisation type	Cooperative
Activities	Generation renewable electricity, generation and supply renewable heat; District heating networks (independent supply). The heat is distributed via a local grid to the households.
Technology / Energy	Wind, Solar, Biomass (silage, wood chips); Biogas, CHP; Village heating grid (gas)
Renewable generation (or capacity)	About 5 MWh of electricity is generated annually; heating grid supply of 4.5 MWh; About 3.5 MWh is used in the households annually.
Description	Jühnde is Germany's first village to produce heat and electricity by means of renewable biomass (plants in form of silage and wood chips), thus becoming the first village to be self-sufficient and produce RES with consumers participation.
Objectives	Meet the village's full energy demand by renewables. Sustainable energy use, avoiding fossil fuels, local solutions for solving climate change; Independent heat and electricity supply through biomass for agriculture, ecology and rural life
Website	http://www.bioenergiedorf.de/en/home.html

Elektrizitätswerke (EWS) Schönau eG

Name	Elektrizitätswerke (EWS) Schönau eG
Country	Germany
Year	2009
Members	7300
Organisation type	Cooperative Vertrieb GmbH
Activities	Generation, supply, distribution (renewable electricity); supply and distribution of heat (district heating); bio and natural gas supply and distribution; Energy services; Electro-mobility; Others
Technology / Energy	Multi-energy: Wind, solar, biomass, biogas, CHP, heating networks; Tenant electricity models, services for electricity network operation, energy management; E-charging card
Renewable generation (or capacity)	-
Description	EWS Schönau is a multi-utility cooperative. In the late 1990s it was the first of its kind in Germany to take over the grid as well as electricity supply to the local community. When the electricity markets were deregulated in 1998, it started to sell almost exclusively renewable energy to its local electricity customers. The year after, EWS began to supply customers with green electricity on a nationwide scale. Its activities now also include the supply of natural gas and biogas.
Objectives	100% renewable energy goal. Campaigns against nuclear energy. Motivates people to instigate change. Civic engagement, co-determination and decentralisation.
Website	https://www.ews-schoenau.de/

Sprakebüll Village eG

Name	Sprakebüll Village eG (Energiegenossenschaft)
Country	Germany
Year	1998
Members	247
Organisation type	GmbH & CO. model
Activities	Generation renewable electricity; Supply renewable heat; District heating
Technology / Energy	Wind, solar; District Heating (CHP, biogas, and heating network)
Renewable generation (or capacity)	130 MW (wind, biogas); annual production: 1878110 kWh (wind)
Description	Sprakebüll was formed as a community wind farm project pioneered by a group of villagers. It buys heat from privately owned biogas plant and distributes it via the heating network to inhabitants. Revenues and voting rights are distributed according to the number of shares. In 2011 the Stadum-Sprakebüll wind park was further created with 3 windmills and a generation capacity of 2,5MW each. In 2014 the first repowering project was conducted. Where the original 5 windmills, each 1,65MW were replaced with ones producing 3,6MW each.
Objectives	Self-sufficiency and avoiding fossil-dominated energy. The Schleswig Holstein state plans to reach a 100% renewable electricity supply by 2020.
Website	http://co2mmunity.eu/wp-content/uploads/2019/02/Factsheet-Sprakeb%C3%BCll.pdf

Netherlands

Amelander Energie Coöperatie UA

Name	Amelander Energie Coöperatie U.A.
Country	Netherlands
Year	2009
Members	286
Organisation type	Cooperative Company U.A.
Activities	Generation renewable electricity (collective procurement energy, collective generation, collective technology procurement; Reseller of NLD energie and Green Choice); Electro-mobility (car sharing running on solar)
Technology / Energy	Solar park, electric heat pump; e-cars
Renewable generation (or capacity)	Annual production of the co-owned solar park: 14,677,478.82 kWh.
Description	The Amelander Energie Coöperatie UA (AEC) is a company founded with the aim of supplying Amelander energy users with sustainable electricity and CO2 compensated gas at attractive rates. The solar park has 23000 solar panels and supplies more than enough power for all households on Ameland. Reseller of green energy of Green Choice and NLD Energy (€ 0.0025 per KWh cheaper than the regional supplier; one joint bill for electricity and gas). AEC does not have a supplier's license, the invoicing is done through GreenChoice & NLD.
Objectives	Self-sufficient island. Sustainability and CO2 neutrality. The cooperative strives for a 100% green energy supply on Ameland in 2020.
Website	https://www.amelandenergie.nl/

Duurzaam Ameland

Name	Duurzaam Ameland
Country	Netherlands
Year	2007
Members	9 partners (municipality of Ameland, Eneco, GasTerra, NAM, Signify, Liander, TNO and Hanze University of Applied Sciences Groningen / EnTranCe, Amelander Energie Coöperatie)
Organisation type	Public-Private Partnership (Covenant of companies together with municipalities)
Activities	Generation, supply renewable energy; Distribution (smart distribution network, derogation); Energy Efficiency (green lighting, school vision light system); Public lighting; Electro-mobility (public transport (gas and electric buses)
Technology / Energy	Multiple: Solar, smart energy grid, sustainable lighting, fuel cells, hybrid heat pumps, CHP, hydrogen , natural gas filling station
Renewable generation (or capacity)	Solar park: Installed capacity: 5,980.00 kWp; total production: 14,677,478.82 kWh
Description	Cooperation project between the municipality of Ameland, corporations, research institutes and the island's energy cooperative Amelander Energie Coöperatie. It is an example of cooperation with utilities and distribution system operator: Eneco, GasTerra, NAM, Signify, Liander, TNO and EnTranCe. It is the first time that an innovative smart distribution network of this size has been developed in practice. The municipality is developing the largest smart electricity grid in the Netherlands. Zonnepark Ameland is the second largest solar park in the country. Ameland Solar Park is an initiative of the municipality of Ameland, Eneco and AEC.
Objectives	Permanently make the island's energy supply sustainable within a few years. With Duurzaam Ameland, the municipality of Ameland wants to achieve that the island can largely meet its own energy needs in 2020 in a sustainable way. The municipality is developing the largest smart electricity grid in the Netherlands.
Website	https://www.duurzaamameland.nl/over-ons/

Poland

Spółdzielnia Nasza Energia

Name	Spółdzielnia Nasza Energia
Country	Poland
Year	2014
Members	300
Organisation type	Cooperative
Activities	Generation renewable heat and electricity (heat and electricity producing biogas installations). Planned activities for energy supply and distribution.
Technology / Energy	Biogas, CHP
Renewable generation (or capacity)	1 MW
Description	The only energy cooperative initiated so far in Poland. It was set up to tackle energy security by tapping into the potential of a network of

	agricultural biogas plants. Joint project by Bio Power Sp., Elektromontaz Lublin and four municipalities: Sitno, Skierbieszow, Komarow-Osada, Labunie. The cooperative is a private-local government initiative created in response to high electricity prices by system enterprises. The task is to supply electricity and, if possible, heat energy of public buildings as well as households.
Objectives	Ensure energy independency. Create local, autonomous grids of biogas plants. Locally produce energy using the agricultural potential and tackle the regional problem of energy provision and prices, and the lack of investment in the region.
Website	https://blue-fifty.com/pl/rozwoj-projektu/spoldzielnia-nasza-energia/

Żywiecka Energia Przyszłości

Name	Żywiecka Energia Przyszłości
Country	Poland
Year	2017
Members	40
Organisation type	Civic law cooperation agreement (energy cluster)
Activities	Generation renewable electricity, renewable heat source; Energy storage; Electro-mobility (retail only to members). Planned activities for energy supply and distribution.
Technology / Energy	Multiple (Bio CHP plant, Biogas reactor, Biomass boiler, Electric battery, EV charging station, Heat Pump, Solar heat collector, Solar PV system, Heat Storage, Hydro, distribution network)
Renewable generation (or capacity)	-
Description	The energy cluster was formed by signing a civic-legal contract between 20 public and private entities. It is a public-private network of cooperation whose main objectives are the production of electricity and balancing demand. It also includes distribution activities with a distribution network of less than 110 kV.
Objectives	Energy independence of Żywiec, reduce air pollution. Aims include distributing electricity, trading and balancing of energy demand; distribution of thermal energy deploy local renewables in Żywiec region; electro-mobility; energy efficiency in public resources; reducing emissions in housing and public enterprises
Website	http://klasterzywiec.pl/

Słupsk pilot project

Name	Słupsk pilot project
Country	Poland
Year	2018
Members	200 households
Organisation type	Pilot project (Horizon 2020)
Activities	Generation renewable electricity; Energy efficiency
Technology / Energy	Solar
Renewable generation (or capacity)	PV capacity of 0.78 MWp in addition to 0.18 MWp installed on public buildings; savings 73,600 kWh/year (368 kWh * 200 households = 73,600 kWh)
Description	The Polish city of Słupsk in Pomerania with 90,000 inhabitant aspires to

	eliminate energy poverty and become a clean air city. Słupsk is a pilot project of the H2020 SCORE project which facilitates consumer co-ownership.
Objectives	Eliminate energy poverty and become one of the cleanest cities in terms of air quality standards in Poland. Include vulnerable consumers. Increase energy efficiency by refurbishing houses and replacing old, coal-burning stoves with RES heating; invest in public transport and facilitate PV.
Website	https://www.score-h2020.eu/pilot-projects/slupsk/

Spain

Som Energia

Name	Som Energia
Country	Spain
Year	2010
Members	59320
Organisation type	Cooperative
Activities	Generation, supply renewable electricity; Energy efficiency
Technology / Energy	Solar, Biogas, Wind, Hydro
Renewable generation (or capacity)	Annual generation of about 13,56 GWh.
Description	It is the first renewable energy cooperative in Spain. It was created with the aim of promoting sustainable development projects involving citizens' participation. Main activities include electricity commercialisation and renewables generation. It finances its own renewables projects through members' investments.
Objectives	Investments in green power plants. Towards 100% renewables. Provision of green electricity to its members at the generating cost of the power plant.
Website	https://www.somenergia.coop/

Som Mobilitat

Name	Som Mobilitat
Country	Spain
Year	2016
Members	1350
Organisation type	Cooperative of Consumers and Users (SCCL)
Activities	Electro-Mobility
Technology / Energy	Car-, bike-, motorbike - sharing; P2P, car pooling and ride sharing, autonomous vehicles; 25 electric cars (24 cars, 1 van)
Renewable generation (or capacity)	N/A
Description	Som Mobilitat is Spain's first sustainable mobility cooperative. Non-profit consumer cooperative that provides 100% electric and cooperative car sharing. it provides a cooperative answer to corporate and privatised e-mobility models.
Objectives	Transition to a more sustainable mobility. Social model that is a successful alternative to profit-oriented, private and vertical mobility proposals. Accelerate local sustainable mobility and reduce expenses in individual

	mobility.
Website	https://www.sommobilitat.coop/

Sweden

Bostadsrättsföreningen Lyckansberg

Name	Bostadsrättsföreningen Lyckansberg
Country	Sweden
Year	2018
Members	85 tenant-owned apartments
Organisation type	Housing association
Activities	Generation renewable electricity (solar plant); Consumption; Small-scale district heating
Technology / Energy	Solar, biomass
Renewable generation (or capacity)	Solar PV system size of 53 kW; yearly production of 55,000 kWh (PV)
Description	The housing association Lyckansberg's solar cell plant started to produce electricity in 2018. The plant generates electricity for common purposes, such as lighting, laundry cabins, sauna and other functions in the association hall. In case of surplus, PV electricity is sold online. If demand is higher, electricity is bought from the grid. The association also has district heating from Vaxjo Energi AB.
Objectives	Collective energy production. Collective ownership by the community.
Website	https://www.hsb.se/sydost/brf/lyckansberg/miljo/solceller/

Farmarenergi i Eslöv AB

Name	Farmarenergi i Eslöv AB
Country	Sweden
Year	-
Members	9 farmers
Organisation type	Limited Company (corporate enterprise)
Activities	District heating system (small-scale) based on renewable heat; Supply heat; Generation renewable electricity
Technology / Energy	Biomass (wood chips); Heating network; Solar
Renewable generation (or capacity)	Boiler 600 kW; prefurnace 495 kW; production of 2,000 - 2,500 MWh/year from the boiler; 70,000 kWh/year from two solar farms
Description	Joint cooperation by nine farmers to provide small scale local district heating based on renewable energy. The company provides local heating to Eslov municipality through a closed network. Two of the farmers also invested in PV installations. Electricity from solar farms not consumed is sold to Kraft Energie.
Objectives	Strong interest in renewable energy; Independence from global energy costs. Uncertainty in the profitability of farming led to selling heat possibilities.
Website	https://www.lrf.se/foretagande/forskning-och-framtid/innovation-och-

	inspiration/de-tog-steget/framtidsforetag/farmarenergi-i-eslov-ab-skane/

Solbyn Association

Name	Solbyn Association
Country	Sweden
Year	1988
Members	50 households
Organisation type	Housing association (eco-village)
Activities	Energy efficiency: energy savings plan (insulation and heat exchange systems); Renewable heat (solar heating, heat exchange system)
Technology / Energy	Solar heating, insulation
Renewable generation (or capacity)	-
Description	An eco-village that citizens built together through a tenant-owner association with a building company. It was initiated by a well-educated, environmentally-concerned citizen group to create and live in an ecological village. The association is largely self-managing with support from HSB building company. The decisions was to form a tenant owned housing association as a legal representative.
Objectives	Social, ecological and economic sustainability. Self-sufficiency: created and administered as far as possible by residents themselves. Social contacts. Vision of communal living. Resource efficiency
Website	http://solbyn.org/

United Kingdom

Edinburgh Community Solar Limited

Name	Edinburgh Community Solar Limited
Country	The United Kingdom
Year	2013
Members	541
Organisation type	Society for the Benefit of the Community (Solar Cooperative)
Activities	Generation, supply renewable electricity
Technology / Energy	Solar
Renewable generation (or capacity)	2 MW (public buildings, schools, community buildings and leisure centres); 1,107,250 kWh per year or 1.12 GWh/year
Description	Edinburgh Community Solar Cooperative (ECSC) has installed, owns and is now managing solar systems on the roofs of 24 City of Edinburgh Council buildings. This is the largest community-owned rooftop scheme of this kind in the UK. During operation, some or all of the electricity generated is used by the building, depending on internal demand. This electricity is sold to the Council through a Licence Agreement, which is now in place. ECSC also receives income through the Feed in Tariff. Any surplus electricity is exported to the grid for which ECSC also receives an income.
Objectives	Open ownership of renewables for people of Edinburgh. Helps deliver low-carbon initiatives for buildings that host its panels. Helps other community groups that wish to tackle fuel poverty or reduce carbon emissions.
Website	https://www.edinburghsolar.coop/projects/how-the-co-op-works/

Energy4All

Name	Energy4All
Country	The United Kingdom
Year	2002
Members	27 independent renewable-energy cooperatives; Cooperatives have 16,978 individual members.
Organisation type	Private Limited Company (Social enterprise - Facilitation network)
Activities	Network of communities which develops community owned renewable energy projects across the UK with different activities; Financial and management services.
Technology / Energy	Multiple (Solar, wind, hydro, community heat)
Renewable generation (or capacity)	30 MW of electricity capacity
Description	Energy4All is a national cooperative of 27 independent renewable-energy cooperatives. It works with communities that want to develop cooperatively and community owned renewable energy. It raises funds through public shares and bond offers, brings the technical expertise to build projects to time and budget and then manages their continued operation. Once built and operational those new cooperatives become shareholder members of Energy4All and support the development of more community energy projects.
Objectives	Supports new cooperatives in delivering their projects, including raising funds and solving individual operational and financial issues.
Website	https://energy4all.co.uk/

Isle of Eigg

Name	Isle of Eigg
Country	The United Kingdom
Year	2008
Members	96 local residents
Organisation type	Private limited Company Eigg Electric Ltd., a subsidiary of Community Heritage Trust
Activities	Generation, supply renewable energy (wind, hydro, solar); Distribution
Technology / Energy	Wind, hydro, solar; Independent grid management
Renewable generation (or capacity)	357 kW of electricity capacity; individual consumption limited to 5 kW/household
Description	The island, which was not connected to the UK's electricity grid, is the world’s first community to launch an off-grid electric system powered by wind, water and solar.
Objectives	Cost-efficiency. Self-sufficiency (off-grid energy system to meet 24h electricity for a modern life). Sustainability (changing from diesel to electrification)
Website	http://isleofeigg.org/eigg-electric/

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

- at the following standard number: +32 22999696, or

- by electronic mail via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications
You can download or order free and priced EU publications from EU Bookshop at: https://publications.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

KJ-NA-30083-EN-N

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub
ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub - Joint Research Centre

EU Science, Research and Innovation

EU Science Hub

Publications Office of the European Union

doi:10.2760/180576

ISBN 978-92-76-10713-2