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D1.3.2 & D1.3.3 Business Models for Local Energy Communities

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Objective of this deliverable

In order to start an energy community project, secure the necessary funds, and attract more members, a viable business case is important. However, not all pilot projects are easily replicable, as they mostly depend on subsidies to make the project viable and lack a clear business case to encourage others to replicate the project. Developing an innovative business model that is based on the current European regulatory framework for Renewable Energy Communities (RECs) and Citizens Energy Communities (CECs) is necessary.

This deliverable provides information for the development of business models for energy communities. The concept of the business model canvas is first presented, addressing the specificities of energy communities, as opposed to typical commercial entities. Aspects of value proposition, key activities and resources, costs and revenues are discussed through this canvas. An explanation and examples are provided for each of the canvas components to guide interested parties through the development of a business model. Aspects of sustainability from the social and environmental point of view can further be added with the sustainable business model canvas approach. Furthermore, some resources regarding guidance material and templates for the development of a business model and business plan are given.

Additionally, the most prominent and emerging business models for energy community and collective energy actions are presented based on review of the literature and European projects. These cover collective generation and self-consumption of energy coming from renewable energy sources, ownership of energy grids, energy sharing, collective investments in energy projects as well as collective provision of various energy services. Further, to bring these business models into perspective, an assessment is made that provides insights regarding their viability in the current energy landscape. The potential and need for a broader perspective concerning energy community business models is finally highlighted.

Business models and business model canvas

In the business world, the "business model" (BM) is generally understood as the plan of a company to generate revenue or make profit. While there is no widely agreed definition in literature, the interpretation of Osterwalder & Pigneur is commonly used, who state that the business model defines how organizations can create, deliver and capture value (Osterwalder & Pigneur, 2010). A BM needs to address four main issues pertaining to the business or organisation, namely identifying the customers and what is valuable for them, finding a way to generate revenue from the business and providing the value to customers at an appropriate cost level (Reis et al., 2021).

BMs were previously mainly used for private, market-oriented scopes. Therefore, BMs weren't widely used in the past In the energy sector, as utilities often held monopolies and simply offered energy as a commodity to their customers. However, the landscape has been changing since the energy market liberalization and the growth of distributed generation, as smaller players could enter the market and offer innovative services (Reis et al., 2021). Community or collective energy is the new area where BMs expand quickly, especially with the new definitions of RECs and CECs established by the EU Directives. While they share many common aspects with traditional energy BMs, BMs for collective energy may generally have different activities, and most importantly they involve different actors, such as citizens and end-consumers. In the following we focus specifically on BMs for collective energy, abbreviated ECBM, including both Energy Communities and Collective Energy Actions (CEAs).

In order to help design and assess BM concepts in a systematic and more visual way, the **business model canvas (BMC)** was developed by Osterwalder & Pigneur and is used in different variations in practice. The canvas typically includes 9 components, each describing how the organization should address the relevant opportunities and threats. Figure 1 shows a variation of the BMC **specifically designed for energy communities and collective energy actions**, where the structure has been altered to include 8 components more adapted to the purpose (Tuerk et al., 2021). The components of this BMC are the following:

- **Customer segments**: The customers of the business, the persons for which the business model is creating value. For an energy community, customers can include the members and shareholders (such as citizens, SMEs and local authorities), which might be restricted by EU regulations. For other collective energy actions there are no specific limitations as to who can be the customer of the BM. Customers can be segmented based on their different needs and each be offered different value.
- **Value proposition**: The products and services, or more generally the value, that the business has to offer to each customer segment. The value may be tangible or not, quantitative (e.g., return on investment) or qualitative (autarky, security, etc.). Environmental and social benefits for the members or the local community are also relevant value propositions, in particular for energy communities according to the Renewable Energy Directive (European Parliament and Council of the European Union, 2018).
- **Key activities**: The main activities performed by the business in order to deliver the value proposition. For ECBMs, common activities may include local generation, supply, storage, (self) consumption, energy sharing, trading, aggregation, e-mobility, provision of energy services, as well as system administration, collective investments and awareness raising or education. Some restrictions to the activities can apply for energy communities according to the definitions of

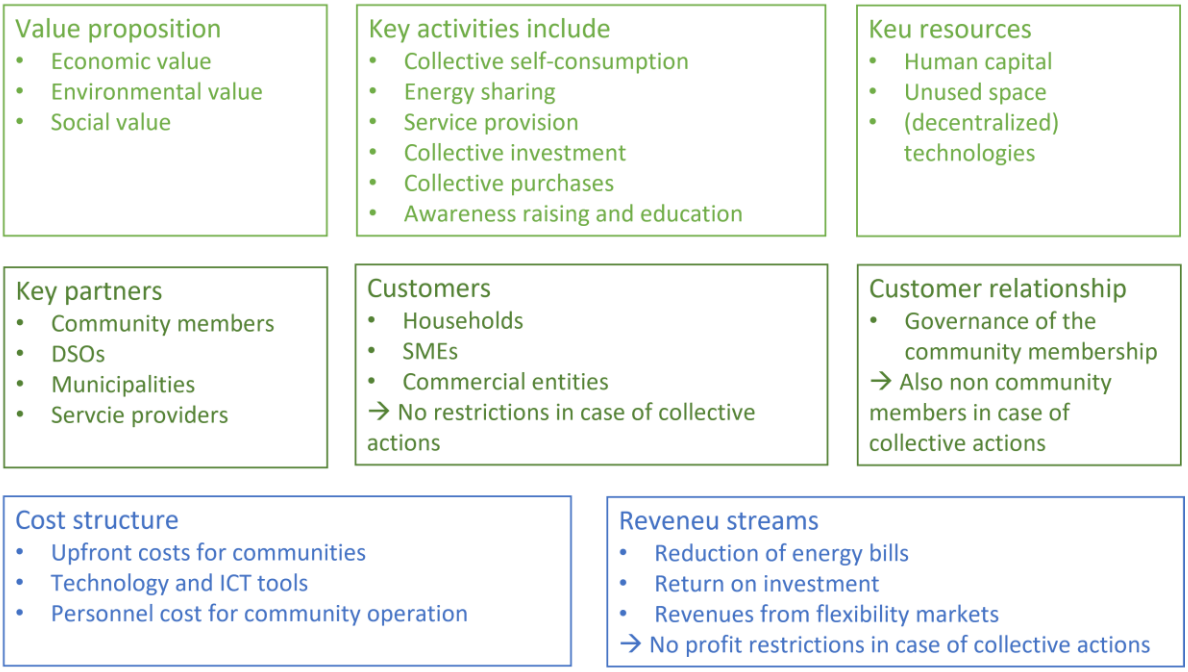

FIGURE 1: BUSINESS MODEL CANVAS FOR ENERGY COMMUNITIES AND COLLECTIVE ENERGY ACTIONS (SOURCE: TUERK ET AL. (2021))

- RECs and CEC in the Renewable Energy Directive and the Electricity Market Directive (European Parliament and Council of the European Union, 2018, 2019).
- **Key resources**: The financial, material, intellectual and human resources necessary to create value. For ECBMs, technology and know-how are key resources, as well as financing resources and availability of subsidies. Human capital, in particular the willingness to participate and invest time or money in the initiative is also important. An appropriate regulatory framework and the availability of space to install the relevant systems are also often considered as key resources for this type of BMs.
- **Key partnerships**: The relationships the business has with other entities that are necessary to make the BM work and reduce risks. Here the members or shareholders of and energy community or collective action are generally not included. Instead, other external stakeholders are considered as partners, such as technology suppliers, energy suppliers, external investors, the DSO, aggregators, energy service providers like ESCOs, municipalities or housing associations.
- **Customer relationships**: The type of relationship between the customer and the value provider. In many energy communities, customers are also members and involved into decision-making, therefore this component can be used to describe the governance structure.
- **(Channels)**: How the business communicates with and reaches the customers to deliver the value proposition. Because of the nature of many ECs and CEAs, the channels are generally based on direct communication, which is why this component is omitted from the adapted BMC of Figure 1.
- **Cost structure**: All costs incurred to operate the BM. For energy projects, these can include capital costs for the required installations, operational costs and salaries, costs for technoeconomic studies, planning and licensing costs, network costs, and others.

- **Revenue streams**: The way the business generates money from each customer segment. This generally include sales of products, subscription fees, licensing etc. For energy communities revenues can come from the sale of participation shares, sale of surplus generation or other energy services and subsidies. For the members' point of view, the revenue may take the form of reduced energy costs and returns on investments.

Another approach to analysing a business model is with the **Lean Canvas** (Maurya, 2016), which focuses more on identifying the market problems and proposing solutions, trying to justify the need for this business. As the focus of this approach lies rather on main purpose and goals, it is more flexible allowing change to the main components of the BMC over time. This approach shares some components with the BMC, but adds some others, particularly regarding **Problem**, **Solution** and **Unfair Advantage**. The Lean Canvas is not further examined in the following but could be interesting for energy communities and CEAs to assess, in order to target their approach towards offering solutions to real problems and thus be more resilient.

Further, recent literature has begun to focus additionally to the economic dimension also on the social and environmental dimensions of a business activity. Cardeal et al. summarise the various literature sources focusing on the development of such a **Sustainable Business Model Canvas** framework (Cardeal et al., 2020). The simple approaches adapt the 9-component BMC of Osterwalder & Pigneur adding the **social and environmental aspects**, either for each of the components, or by adding two more components, the Eco-social costs (negative externalities) and the Eco-social benefits (positive externalities). Environmental aspects build on a life cycle perspective, while the social aspects on a stakeholder management perspective. As the goal of energy communities following the EC directives also aim at social and environmental benefits, it could be useful to integrate the considerations of the Sustainable BMC in the assessment of ECBMs.

Business model & business plan guidance material

The business model canvas is the main tool used to develop and analyse a business model. Only few resources are available to assist interested parties with the development of a BM or business plan specifically for energy communities. Within the E-LAND project, a pattern-based tool was created to build BMs for energy communities. The tool offers some insights about the different BMC components, but it is designed to be applied in a workshop process, guided by the E-LAND team. The inteGRIDy project also developed a pattern-based interactive tool for energy BM development, but it is not specific for energy communities. Hier opgewekt in the Netherlands also provides some general guidance for the business model of local energy initiatives.

Other guidance material and templates are provided for energy community projects under specific contexts. For example, the LECo project developed a template for a business plan for small local energy communities in the Nordic countries. Local Energy Scotland offers various guidance material, including templates, for the development of (community) renewable energy projects. The material is specific for the local regulatory circumstances and financial support.

Finally, business plan templates, examples and guidance may be provided by public institutions for businesses in general, such as in the UK. These are not specific for energy projects nor for energy communities, but they could provide some value also to such initiatives.

TABLE 1: TOOLS, GUIDANCE MATERIAL AND TEMPLATES FOR BUSINESS MODELS AND BUSINESS PLANS.

Tool	Description	Link
E-Land business model innovation tool	The tool is a pattern-based approach to build a business model for energy communities. The framework consists the five core areas: • community value proposition • energy community members • energy value capture • key functions • network effects Provides patterns for each area and examples. Designed to be applied in a workshop process, guided by the E-LAND team.	https://elandh2020.eu/business-model-innovation-tool-for-energy-communities/
InteGRIDy business modelling tool	Interactive business model canvas for the development of energy business model, not specific to energy communities. • library of generic and more specific business model patterns • cash flow analysis • information on similar companies based on database of more than 3000 companies • feasibility and replicability assessment	https://energy.venturely.io/

Hier opgewekt business model guidance	Guidance for setting up a business model for energy cooperatives in the Netherlands, using the business model canvas.	https://www.hieropgewekt.nl/kennisdossiers/opstellen-van-je-bedrijfsmodel
LECo project business plan template	The LECo project supports small energy communities in Finland, Sweden, Norway and Ireland to become self-sufficient. The project developed a template for a Business plan for Local Energy Communities: full structured document with explanation of each element.	https://localenergycommunities.net/business-plan/
Local Energy Scotland CARES toolkit	Local Energy Scotland provides within the CARES toolkit various guidance material for the process of developing a renewable energy project. • Guides for establishing a community group • Guides for business planning • Downloadable templates for project planning, finance models and contractual templates The provided resources are specific for the Scottish Government's Community and Renewable Energy Scheme.	https://localenergy.scot/resources-overview/
Other Business plan templates, examples and guidance, not specific to ECs	Support from the UK government	https://www.gov.uk/write-business-plan
	Support from the Scottish government	https://www.mygov.scot/writing-a-business-plan
	Publicly funded Scottish service providing access to free business support services	https://www.bgateway.com/resources/business-plan-template
	Business plan template and guidance from the National Heritage Fund, UK.	https://www.heritagefund.org.uk/funding/good-practice-guidance/business-plan-template-and-guidance

Business models for local energy communities

Research methodology to define community business models

We based our analysis on a literature review procedure, which aimed at identifying relevant documents. Our research question has been: *Which are the most prominent BM types for energy communities and other collective energy actions (ECBMs)? What are some examples of real applications of those BMs?*

To find the pertinent literature we searched databases such as Google Scholar, Science Direct and IEEE Xplor using search terms as 'business model', 'energy community', 'value proposition', 'review', 'energy sharing', 'case study'. Furthermore, we looked for projects that contained deliverables with some analysis of BMs for energy communities, community energy projects, prosumers, energy sharing, peer-to-peer trading, and collective energy actions. We focused our search primarily to documents that summarised several BMs and/or that provided case studies applying those BMs. Search results that only used the terms without providing information about the BMs, that focused on BMs for very particular cases, or that focused on very technical aspects were not retained.

The collected most relevant documents are summarized in Appendix 1: Summary assessment of most relevant literature, where also the main information and findings are summarised. Specifically, we characterised the documents based on the type of action they cover (energy community, energy sharing, P2P, or other specific application), the geographical range they cover, whether they are using the BMC approach to describe the BMs, and whether they provide examples of existing applications of the BMs. The collected information was then also synthesized to provide the analysis that follows regarding the common ECBMs and their main characteristics.

Most prominent business models for local energy communities

Based on the reviewed literature and projects summarised in Appendix 1: Summary assessment of most relevant literature, we may see that several different approaches are used to classify business models for energy communities and relevant other energy-related actions that involve citizens. The various typologies are reported in Table 2.

Most generic typologies that cover different forms of community energy and other similar collective actions are provided by the DECIDE project, Reis et al. (2021) and the NEWCOMERS project. The other referenced projects or papers focus on a narrower spectrum of community energy, either in terms of the activities or the perspective. The PROSEU project focusses on BMs for prosumers, Karami & Madlener (2022) explore BMs for P2P based on households' beliefs and preferences, the WHY project also takes the household perspective examining BMs for its interaction with the energy system and the BEcoop project provides BMs primarily for bio-energy communities and focusing on the governance perspective. Finally, other sources provide each a separate type of BM, such as for flexibility management, for community storage, for P2P energy trading, for PV using intermediaries specifically in the UK, or for ECs specifically in Sweden.

While all have a different classification, there are some main types that are common. We start from the classification of the DECIDE project (Tuerk et al., 2021), keeping the main components and complementing with additional information from other sources. It is important to note that several BMs may be used by one EC at the same time, as most are not mutually exclusive and might instead be complementary.

TABLE 2: SUMMARY OF PROPOSED BM TYPOLOGIES IN LITERATURE FOR COMMUNITY ENERGY, ENERGY SHARING AND PROSUMERISM.

Types of BMs for ECs & collective energy actions *(DECIDE project)*	**Archetype energy community BMs *(Reis et al. 2021)***	**Emerging energy service BMs in ECs *(NEWCOMERS project)***	**Business Models for Prosumers in Europe *(PROSEU project)***
• Collective generation and trading • Collective residential self-consumption; • Collective commercial self-consumption • Community owned grid • Collective investment in a community project (purchase of technology, building refurbishment) • Collective investment in an independent energy project (cooperative, CEA crowdfunding) • Collective energy services (Mobility communities, Flexibility services, DSM, Energy advice, Energy efficiency services/ESCOs)	• Energy cooperatives • Community prosumerism • Local energy markets • Community collective generation • Third-party-sponsored communities • Community flexibility aggregation • Community ESCO • E-mobility cooperatives	• Local renewable energy generation and supply • Innovative contracting and community-based products (including e-mobility) • Community energy storage services • Peer-to-peer energy trading platforms • Community energy aggregators	• Basic Prosumer • Micro-grid/private wire/internal grid • Communal Self Consumption • Local Energy Tariff/Company • Peer-to-Peer (P2P) Trading • Energy Service Contract/company • Flexibility Aggregator • Vehicle To Grid (V2G) • E-mobility services

Business models for P2P energy trading based on households' beliefs and preferences *(Karami & Madlener 2022)*	**Consumer (household-level) interaction with energy system BMs *(WHY project)***	**(Bio-)energy cooperative BMs, from governance point of view *(BEcoop project)***	**Other BMs from different sources**
<u>BMs for attitudes</u> • High initial costs, lack of funding • Saving and earning money • Power purchase agreement (PPA), auction, and bilateral-based contracts • Free energy up to a certain percentage of the feed-in volume • Self-supplied electricity, and contributing to a virtual battery provider • Sharing energy with friends • Subsidized BM • Donation BM <u>BMs for perceived behavioral control</u> • Affinity with technology • General perceived influence • Specific perceived influence BM for subjective norms	• Conventional Energy Supply Models • Energy as a Service • Peer-to-Peer electricity trading • Aggregators • Community-ownership models • Community-owned assets focused on sharing the economic benefits • Collective self-consumption schemes • Energy Community Models • Pay-as-you-go models	• Local integrated group of citizens • Regional-national RESCoop • Network of RESCoops • Multi-stakeholder governance model	• BM for an EC with Flexibility Management (GOFLEX project) • (Virtual) P2P energy trading (Plewnia & Guenther 2021) • Energy community BM for Sweden (Hartmanis & Lindblom 2021) • Community storage BM (Müller & Welpe 2018) • Community energy BM with intermediaries in the UK (focus on PV). (Nolden 2020)

Hereafter, we provide more details on the following main categories of BMs for energy communities and collective energy actions:

- Collective generation and supply of renewable energy
- Collective self-consumption
- P2P energy trading
- Ownership of the local grid/microgrid
- Collective investment in projects outside the community
- Collective service provision
  - Flexibility services
  - Mobility
  - Energy services

Collective generation and supply of renewable energy

This BM concerns activities such as the installation, operation and management of one or more (collective) (renewable) electricity or heat generation assets, with the purpose of selling (part of) the produced energy or flexibility to energy markets, to a supplier or the DSO. Despite their titles referring to collective generation, the typologies in some literature may actually include the activity of self-consumption (Reis et al., 2021) or assume the existence of a micro-grid (Mlinarič et al., 2019). We present these options as separate BMs here, although they can often be combined.

With this BM, the revenues result from the energy sales or flexibility service provision and can be distributed to the project participants, depending on the established rules, in the form of profits, dividends, or interests. The resources needed by this BM are the technologies used to generate and store electricity and/or heat, typically using renewable energy sources. This may also include a virtual power plant, which virtually aggregates the capacities of several smaller distributed energy production plants.

Energy cooperatives are typical forms of citizen-led initiatives using this type of BM, and they are also the most common form of energy community in Europe (Reis et al., 2021). They may be set up as for-profit companies that compete in the market, but also as local non-profit cooperatives aiming to supply the community and reinvest any surplus revenue in the community (Reis et al., 2021). The various organisational forms usually have in common the voluntary open membership and democratic control and include citizens, local authorities and SMEs as members.

Examples of cases that use and describe this BM include the Hindelang pilot of the DECIDE project (Tuerk et al., 2021) and several of the NEWCOMERS project case studies. As this is a very common BM for energy communities, many real cases are also included in the list of energy community projects provided by Reis et al. (2021).

Collective self-consumption

This BM can also be referred to as collective prosumerism (Reis et al., 2021). In this case, (renewable) electricity production (and storage) is also part of the main activities, but the aim is to consume it primarily within the community. The produced electricity is shared among the members of the community with the objective to balance the demand and production within the community. Surplus production may be sold, in most cases, outside the community generating additional revenue, while remaining electricity needs are covered by external suppliers.

Collective self-consumption is in many countries limited to multi-tenant buildings, where all tenants are covered by one common utility meter. However other countries allow the public electricity distribution grid to be used to connect supply and demand points but impose different restrictions on the location of prosumers. For instance, in Wallonia, all connection points need to be downstream the same medium-to-low voltage transformer (Frieden et al., 2020). In France, the participating prosumers don't need to be located in the same building but within a certain distance (Frieden et al., 2020). In Flanders, no location restriction is put in place.

In general network charges still apply, however in some countries regulations are in place to create "virtual private networks" and exempt prosumers from (some of) these costs. Examples include collective self-consumption in Spain for residents within a 500m radius (Brown et al., 2020). Costs are related to the internal balancing of electricity (or heat), while revenues come from the potential sale to external buyers, but also from the reduction of energy bills.

Collective-self consumption can be enacted with contracts between the participating actors. However, in several countries a legal entity is required. E.g., France, Flanders, and the Brussels Capital Region require participants to be organised as a legal entity.

An important distinction can be made between **residential, public** and **commercial** collective self-consumption. The former concerns generation systems (co-owned) by citizens, SMEs or associations, while the second often relates to involvement or operation by municipalities, and the last one concerns larger facilities owned by commercial entities, or associations.

PV, in particular rooftop PV, is the most common production technology used for (collective) self-consumption. However, other forms of RES are also possible, depending on the scale. Sharing of excess heat from industrial processes can be done in a similar way. Consumption may include different household, commercial or industrial uses, as well as electric vehicles, heat pumps and other controllable loads. Net-metering and ICT-based infrastructures for internal balancing and tracking of energy and money flows may be needed to facilitate the allocation of generated energy and potential revenues from sales (Reis et al., 2021).

Examples of cases that use and describe this BM include pilots of the Compile project (Neumann & Tuerk, 2022), generic cases in Germany, Spain and the Netherlands presented in the PROSEU project (Hall et al., 2020), the Ourpower, TREA and Hindelang pilots of the DECIDE project (Tuerk et al., 2021), as well as several of the NEWCOMERS project case studies.

There are several remarks to be made related to the approach of collective self-consumption. The first one relates to an expected and justified increase of the cost for the part offered by the commercial supplier. The recent article of Abada et al. (2020) dives into this aspect. Energy communities are not likely to reduce system costs; on the contrary. Additionally, the cost of the electricity that is still supplied by the commercial supplier will be increased. This increase is among others related to the higher wholesale prices at the moments the client takes power from the commercial supplier, combined with the increased administration costs. Thirdly, the focus on collective self-consumption is creating a kind of parallel signal as compared to the dynamics of the wholesale market. While the latter is increasingly representing the dynamics of all system-connected renewable energy generation, the mainly PVfocussed self-consumption model might push consumption to moments when its direct use would lead to lower overall emissions.

P2P energy trading

P2P (peer-to-peer) energy sharing allows prosumers to share their excess energy, such as from rooftop PV, without the need for an intermediary. It is possible to realise this via direct power purchase agreements, or using a web-based P2P platform, which acts as an online marketplace between peers (Nacht et al., 2021). Blockchain technology is often used in such platforms to keep track of transactions and guarantee the integrity of the system (Mlinarič et al., 2019). On a P2P platform, prosumers can in principle negotiate the prices between themselves (Mlinarič et al., 2019). A P2P platform only facilitates the creation of value, which is up to the users to achieve. A group of prosumers can use such platform to increase self-consumption, reduce carbon emissions, and save money on their energy bills (Hall et al., 2020). A group of neighbours or an energy community could use 'off the shelf' platforms, which can be purchased for 500 Euro a month (Hall et al., 2020). None of the blockchain based, and other platforms for P2P energy trading as developed and tested in these projects, have not been picked up in a commercial context.

As P2P electricity trading is a novel concept that is still just being introduced in the laws and regulations of European member states, the implementation of this BM strongly depends on the progress in each country (Nacht et al., 2021). The Electricity Market Directive 2019/944 and the Renewable Energy Directive 2018/2001 mandate that P2P and direct electricity selling between prosumers should be integrated in national regulations.

The Flemish project Logigrid, investigated P2P sharing of electricity between companies in business parks to assess the optimal solutions regarding installation of RES production from PV panels. The P2P sharing of electricity allows for a company with excess roof space for PV panels to install a larger capacity while selling the excess energy produced at a higher rate than when sold back to the supplier. For the company that purchases the energy from a peer, the price will be lower than when they buy it from the energy supplier. During this process, it is important to match companies with the appropriate consumption profiles. Complementary usage profiles increase the rentability of installing renewable energy production and adds an incentive to use energy flexibly when the producing partner has excess electricity. Therefore business parks with a variation of businesses are suitable for these types of BMs.

Ownership of the local grid / microgrid

With this BM, the EC itself owns and operates the local electricity or heat distribution grid. For example, in Portugal, grid concession contracts allow energy cooperatives to manage the low-voltage grids (Reis et al., 2021). The Elektrizitätswerke Schönau eG in Germany is an example of a community energy cooperative that took over the town's power grid and energy supply management (Peeters, Protopapadaki, et al., 2021). Another case may concern isolated places, such as islands or remote areas that naturally have an isolated grid.

Typically, this BM is combined with one of the above BMs, where the same community also owns RES production facilities on the same network forming a *microgrid*. In this case, a private network within a building or compound connects individual prosumers "behind the meter" (Brown et al., 2020).

Microgrids aim to be self-sufficient, typically with high penetration of RES, although they might be still connected to the national grid (Mlinarič et al., 2019).

Costs as well as revenues from owning the local grid are related to the internal balancing of electricity and/or heat, as well as remuneration of grid relief and/or emergency management of the system (Tuerk et al., 2021). With the management and operation of the grid it is possible to incentivize self-consumption through time-of-use tariffs or provide exemptions to members from network tariffs (Mlinarič et al., 2019; Reis et al., 2021).

There are several remarks to make related to the operation of (a part of) the public grid. Firstly, grid costs are socialized and concern long term investment (depreciation times of 20 to 50 years for most assets). Hence, taking over a specific part to reduce costs will imply a cost increase for the remainder of society. Secondly, the standards related to grid operation are rather high with regards to reliability. It is unlikely that a private undertaking will be able to deliver this service at a lower cost. For example, the Brussels University hospital operates on such a microgrid, though there are no cost savings related to that (on the contrary). The reason for this set-up is a full operation of the hospital in case of a major issue in the Belgian capital. Finally, the privatisation of the grids would most likely concentrate in areas with higher socio-economic class which enforces the Matthew effect (linked to the first argument).

Collective investment in projects outside the community

This BM involves the collective investment by members of a community in an independent project with no relation to the community. The investors primarily aim to gain financial benefits from their investments, even though they might also want to contribute to climate-related or environmental goals in general. Examples of such projects include investments in a PV plant for a public school, social housing or condominium (Neumann & Tuerk, 2022). This is also a typical third-party investment of a cooperative, such as for instance the installation of PV on the police station by Licht Leuven. In this case, members of the cooperative do a financial investment and get a guaranteed financial return.

Ways of investment in a collective project can be for example the purchase of cooperative shares in the project, or crowdfunding. The main types of crowdfunding, other than donations, are equity (shares in the project) and debt (in the form of a loan) crowdfunding. There are several platforms present in Europe for crowdfunding green-energy projects.[1]

Typical governance forms to perform such activities are cooperatives and associations. For example, the Green Energy Cooperative helps with crowdfunding of RES projects as well as collective purchases in Croatia (Peeters, Tuerk, et al., 2021). In Flanders, Belgium, the Flemish Energy Company signed a framework contract with local cooperatives for installing solar panels with citizen participation in public administrations, schools and other public services.[2] Citizens can buy shares to the projects through the cooperatives, who manage and operate the projects.

An important remark to make is whether the third-party investment of an energy community in PV on a public building is the best approach from a societal point of view. In reality, a selected number of

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[1] https://thecrowdspace.com/platforms/green-energy

[2] https://www.ecopower.be/nieuws/burgercooperaties-plaatsen-zonnepanelen-via-raamcontract-vlaams-energiebedrijf-veb

people who have the financial means to become member of such community will benefit, while the public building will pay this benefit. Only in the case where the public building had no other means to have the PV plant installed, this is indeed a solution that fits the requirement of the cost efficiency in the operation of the public institution.

Collective service provision

Service provision is another type of BM that may cover a wide range of activities. In general the service may be provided by the community itself or by a third party. The following are some categories of such service provision.

Flexibility services

One of possible services concerns the provision of flexibility services to the markets and the DSO (Tuerk et al., 2021). A community aggregator pools together the flexibility offered by a group of consumers or prosumers in order to reach the thresholds required to enter markets such as the wholesale electricity market, primary, secondary and tertiary power control (Nacht et al., 2021). Assets managed by the aggregator are monitored, and their use is directly controlled and optimised using appropriate information technology that processes power supply and consumption data, weather forecast and electricity prices (Nacht et al., 2021). A price-based approach is also possible, where the customers receive dynamic pricing signals and respond to it themselves, by changing their consumption. This is more common for large consumers that can more easily control their loads. Generally, the consumers participating in this BM have separate contracts with an energy supplier and the aggregator (Reis et al., 2021).

Aggregation is more commonly targeting larger industrial and commercial customers in Europe, but also residential applications are expected to increase as the European directives recognise their potential and encourage it (Reis et al., 2021). Examples of residential flexibility aggregation include TIKO, ThermoVault and domX. TIKO started years ago with controlling residential heat pumps in Switzerland. Thermovault in Belgium (now partially owned by Italian Ariston) aggregates small scale flexibility through the storage capabilities of electrical water heaters, accumulation heaters, and heat pumps (Tuerk et al., 2021). Also, domX, a Greek SME, works on this small-scale flexibility, though focussing on gas condensing boilers and the local congestion of the gas distribution system.

Due to the very technical nature of these activities, these BMs are typically started by the aggregators who also make the largest financial investment. Members that choose to participate in this type of collective energy action are often joining because of interest, and their involvement in the decision-making is limited to the definition of preferences and boundaries written in the contracts (Reis et al., 2021). In fact, these aggregation models can be offered to anyone, whether or not part of an energy community. However, we see more and more models arising where the financial benefit for the end-consumer contributes to a better business case for the asset (e.g., DCBel).

Mobility

ECBMs about mobility may include the provision of electric car sharing services or electric charger sharing. For example, an energy community may purchase and manage electric vehicles and/or charging infrastructure and offer these services to its members or other customers (often at a different price) in return for a service fee or share of the EC, such as for the cooperatives Partago in Belgium and Som Mobilitat in Spain. Other options can be to serve as a platform for car-pooling or offering fleet management services. Mobicoop is a cooperative in France proposing these services. In this case users of the services are not necessarily members of the cooperative. These mobility cooperatives generate revenue from the participation shares or fees of the cooperants and by service fees they collect from their users, while costs are linked to the investments in infrastructure, maintenance and operation costs to run the services.

As electric vehicles represent large loads but also significant electricity storage capabilities, ECs may as well employ them as such in combination with other BMs. For example, self-consumption can be increased when optimizing the charging patterns of electric vehicles to absorb peaks of renewable electricity production or act as storage (Hall et al., 2020). Furthermore, the vehicles can be used as flexibility resources, exploiting vehicle-to-grid and grid-to-vehicle modes. The flexibility could be pooled by aggregators to deliver flexibility services to the markets and DSO and generate revenues from it. This BM then becomes similar to the one focusing on flexibility services specifically. However, there are still regulatory, technical or economic barriers that may need to be overcome to make vehicle-to-grid BMs feasible (Reis et al., 2021). Additionally, the involvement of the DSO, energy suppliers and EV technology providers is usually necessary to allow for this highly technical model to work. There aren't many examples of operating vehicle-to-grid BMs. In London in the UK, bus-to-grid flexibility services are trialled using an aggregation platform (Hall et al., 2020).

Such mobility models require sufficiently large scale to be break-even. The Belgian Cambio is a commercially exploited model, which has a viable business model. This viability is mainly linked to its size, enabling members to pick up a car in nearly every Belgian city. Several smaller scale cooperative models show increasing losses, e.g., the more locally active Partago. The latter largely depend on subsidies, and it is questionable whether this is replicable.

Energy services

An emerging BM is the provision of energy services. Instead of purchasing energy commodities or technology, the customer pays to obtain a result, such as a reliable electricity supply, thermal comfort, hot water, lighting etc. (Hall et al., 2020). These can be provided by Energy Service Companies (ESCOs) via an energy service contract. Energy communities can work with external companies to establish a community ESCO that provides services related to renewable energy supply or energy efficiency services (Reis et al., 2021).

Renewable energy services can typically be solar-as-a-service, where the ESCO owns and manages the solar panels installed at and used by a customer, and comfort- or heat-as-a-service, where the ESCO operates a district heating system offering specific comfort to the customers (Hall et al., 2020). Energy efficiency services are related to reducing the energy use, achieved by building renovations and insulation, improving the efficiency of energy systems, using energy management technology to monitor and optimise energy use, etc. Further savings on the energy bills may include switching between providers to take advantage of the best tariffs, in which case the ESCO does the screening and handles the administrative (Nacht et al., 2021).

An ESCO is typically remunerated based on the delivered performance, such as the achieved energy savings. One way is for the ESCO to guarantee certain savings in advance, or to agree with the customer on a predetermined sharing of the achieved savings (Reis et al., 2021).

A community ESCO can be a means for customers to become prosumers or save energy, as they do not need to do the investment at once, but instead pay for it through e.g., a monthly fee (Nacht et al., 2021).

With this BM, community members can have a saying on the types of projects that are suitable, however the decision powers remain with the investing companies that hold the assets (Reis et al., 2021).

This type of BM is used by ThermoVault and DomX DECIDE pilots (Tuerk et al., 2021). The Chase Community Solar project in the UK, is an example of a community ESCO (Reis et al., 2021). Also the Energiesprong initiative uses this form of BM for deep home retrofits program, with ESCOs guaranteeing the performance of the building for a 30-year period (Hall et al., 2020).

Similar as for the mobility services, these more generic services again do not require the users to be members of the energy community. Similar examples are the energy audit and one-stop shop services for renovation, such as under Carbon Co-op, Tipperary cooperative and Klimaatpunt. They all allow anyone, member or not, to benefit from the offered service against payment. While the energy expert work is done by Klimaatpunt directly, both Carbon Co-op and Tipperary cooperative hire external consultants to provide the expert service.

Assessment of Business Models

In order to start an energy community project, secure the necessary funds, and attract more members, a viable business case is important. However, not all pilot projects are easily replicable, as they mostly depend on subsidies to make the project viable and lack a clear business case to encourage others to replicate the project (Kacperski et al., 2020). Developing an innovative business model that is based on the current European regulatory framework for Renewable Energy Communities (RECs) and Citizens Energy Communities (CECs) is necessary. The above assessment shows the variation of business models that could be rolled out.

Independent of the organisational form, the lack of effective cost saving services to participate in through an energy community is affecting the business case. Several of the energy regulators interviewed by the Bridge taskforce LEC indicated the lack of effective added value to be the main reason preventing the justification of a reduction on tariffs for energy communities (Peeters, Tuerk, et al., 2021). Energy communities, as well as aggregators of small-scale flexibility and even individual consumers could all deliver services for grid management at distribution level, or team up to provide services to the transmission level. There are two important remarks on the potential remuneration for such services. First is the lack of distribution-level markets in most member states, and second is the often-substantial overestimation of the value of services for the distribution grid (Felice et al., 2021). In most EU member states, the current congestion challenges at DSO level could still be resolved with a cable with higher capacity. The cost of such cable replacement is to be distributed over the typical depreciation time of 50 years and over all connections on the cable. A typical annual "saving" could then be imagined to value around 10€ to 20€ per connection, in the assumption that the provided services would be overcoming all congestion issues. It is not impossible, just challenging, to provide measurement and automation as well as a line-level control for the stated value per connection per year.

The elaborate research on business models in most European funded projects has limited reflection of and on reality: the business models are assessed from a rather unilateral point of view. More specifically, the provided models look at the energy community and not at its impact on the operational cost of the other connected stakeholders, such as mainly suppliers and DSOs (and consequently also . These stakeholders will consequently have to recuperate the induced costs, either over all their clients or over the group that asks for the new services.

The concept of an energy community as such does not change the way energy flows. The redistribution of the injected energy already happens due to the physic of the system and the balancing responsibility of the supplier. What energy communities are creating on top is a data model that virtually connects two or more meters. The implementation of this data model is challenging and costly. There is a risk for unintended models to appear: e.g., models that are not favoured by the suppliers and hence are presented with unattractive conditions, or models that are violating basic principles such as the free choice of supplier.

The data model requires to include the information of the sharing ratios between members of the community, the injected amount and the linked (part) of the consumption that could be covered with this injected amount. This must be considered in the accounting of the consumed and injected commercial volumes, which could be spread over several commercial suppliers. The adjustment must happen in the calculation of the balancing volumes of each supplier, as well as in the invoice of each connected consumer. The IT-adaptations are substantial. For DSOs this cost is reimbursed by the (adapted) grid component in the tariff. Though, for suppliers the model is much less attractive. Firstly, they are requested to adapt their IT and prepare their helpdesk to handle the energy sharing concept. If the DSO managed to immediately integrate the shared volumes in the existing dataflow system, these adaptations on supplier side have to be done only once. In case the DSO is not ready and comes with an intermediate solution (such as e.g., in Flanders), suppliers will have to adapt processes twice. Secondly, several member states expect the supplier to collect the charges and levies on the shared volumes. This implies that a consumer that does not pay the bill, now has an even more negative impact. Furthermore, there is less volume of energy on each invoice to allocate these risks to. And finally, the consumption of the community member is now more directed to moments with generally higher prices on the energy wholesale market. Consequently, the supplier has an increased investment, an increased risk, and less margin on such a consumer. The supplier can choose to spread these costs over all clients or allocate it to the ones that want to use the energy sharing concept.

Because of this complexity, other models appear. For example, the Ourpower energy cooperative requires its customers to become clients with a fixed pre-selected supplier. This limits the member with regards to exercising the right to freedom of energy supplier. Additionally, it is the commercial supplier who sets the rules. Similarly, the Greek energy supplier Heron enables its clients to co-invest in the PV installation of someone else. But both must be client with Heron, and a "virtual" installation is used to estimate the production. The Slovenian DSO Elektro Gorenjska applied a different scheme to enable joint investments. They require the PV plant to be connected to a separate meter. The DSO then calculates the production going to each of the owners. Though, annual net metering substantially simplifies the case here.

Wierling et al. (2018) assessed the viability of energy communities by collecting and analysing data on a large number of initiatives covering Germany, Denmark, Austria and the UK. They concluded, among others, that several waves of community energy projects exist, caused either because of deflecting against the establishment, or because of specific financial stimulations. The formed links to international crises such as the oil crisis and the financial crises. With regards to the latter, most initiatives also disappeared when the exceptional conditions were no longer continued. The scale and professionalism in operation linked to the scale are determining factors for longer term success of community energy projects. The size further hints to the operational costs of managing the community energy project. Such scale can be successful, as for example with the Belgian Ecopower and Wase Wind, or limit effective energy democracy, such as in the case of the fast grown Schönau.

The potential of broader focus

As elaborated above, viable business models for energy communities in the strict sense are hard to find. Though, some interesting concepts have been developed recently, tailored to the specifics of a more dynamic and more decentralized energy system. Three of these examples are briefly discussed below: Sonnen, Shiphol Trade Park, and Thermovault.

None of them fit in the narrow definition of CEC or REC, but can be considered energy community initiatives that clearly contribute to the goals of enabling more renewable energy, providing the consumer with the means to take up a more active role in the energy market, and ensuring the consumer has a benefit from participation.

Sonnen

Sonnen started years ago with selling home batteries. Today they act as a supplier in Germany, combining the PV-battery systems of their clients with wind energy. Only when it is absolutely needed, they will buy energy on the wholesale market.

The sonnen Virtual Power Plant connects home batteries digitally to form a large solar energy resource to create a virtual power plant. This stabilises fluctuations in the electricity grid and places a downward pressure on energy prices. Only by connecting many decentralised solar batteries into one virtual power plant, this model is able to take the place of traditional intensive power plants.

Depending on the demand, electricity can be temporarily stored in the storage system or released back into the grid. Members of sonnenConnect are rewarded for sharing their home solar battery power with the sonnenCommunity, in addition to receiving their solar feed in tariff. The sonnenBatteries can hence make an important contribution to the clean energy transition in times of need. A recent independent study estimated a total of 67 GW of such decentralized storage systems to be needed in Germany.

The Sonnen community works in a commercial setting in Germany, and does not need specific data or provisions by the DSO. A strong point is that they offer multiple models: a client can join just for the Sonnen battery with increased self-consumption, or can join for being an active part of the community.

Schiphol Trade Park

Schiphol Trade Park is an industrial zone near Schiphol in the Netherlands. Spectral, a company making innovative software for new energy systems, developed a virtual market enabling the exchange of unused capacity among the connected companies on a local grid. Specifically, if a company has a contract for X kW of power supply, but only uses 90% of that during a period of time, it makes this 10% of X kW available in the virtual grid. Consequently, another company can “buy” this capacity. There is no impact on the local grid, nor on the income of the DSO. However, it does allow the companies to expand, encourages flexibility and collaboration.

Thermovault

Thermovault offers smart control on existing hot water boilers, electrical heaters (accumulation heating), and heat pumps. The offer starts with a focus on energy efficiency first. The advanced algorithm enables savings of about 20% for the sanitary hot water boilers. Consequently, the boilers are used to provide flexibility services to the electricity market (currently FCR, in the future also aFRR). The community building is based on B2B, mainly targeting social housing companies and large project developers. Their model does not require user interaction. They currently offer over 2 MW of flexibility in Belgium.

Conclusion

The new opportunities provided through the 2018 and 2019 renewable energy and energy market directives include a range of opportunities for end consumers to take up a more active role in the energy system. This active role is not just a role of individual or collective presumption, but should bring added value for an increased share of renewable energy in the system.

There has been a substantial focus on energy communities in the form of CEC and REC, with less attention to many other opportunities provided by the respective European directives. Research has shown that energy communities as such do not deliver system benefits, and hence cannot claim to deliver savings that they should be remunerated for. It is that system view, combined with the (directly and indirectly linked) impact of the action on non-participating citizens, that is generally not considered in the business model templates. The dependency on financial benefits through subsidies or exemptions, as shown by assessment of historic data on community energy projects, does not lead to lasting operations.

It is clear that the typical business model canvas approach should be combined with a system-canvas that assesses the impact of a large uptake of the proposed community concept on the operational, capital, and energy costs for both participants and non-participants.

Furthermore, as shown through various examples, moving out of the boundaries of the strict concepts of CEC and REC proves to create viable concepts that align well with the needs of the future decentralized and renewable energy system. The most viable business cases further combine multiple services, or focus on delivering a value that is not based on "expecting a return" from the common infrastructure.

Viable business models all look for a win-win-win from different point of views, creating added value for all stakeholders in the energy system.

Appendix 1: Summary assessment of most relevant literature

Source	Type of EC or action	Geographic scope	Using BM canvas for analysis	Providing existing BM examples	Important findings
BEcoop project becoop-project.eu	Cooperative BMs for (Bio-) energy Communities	EU	Yes, sustainable BMC used to present 4 business model types	Table with RESCoop successful cases collected, reporting main focus areas, final products, financial resources and governance model. (many in GR and SP, also others)	(Bio-)energy cooperative BMs, from governance point of view (D2.9): • Local integrated group of citizens • Regional-national RESCoop • Network of RESCoops • Multi-stakeholder governance model

Compile project
 	
compile-project.eu
	Energy communities	Pilots in Croatia, Greece, Portugal, Slovenia, Spain	Yes	Project has 5 pilot projects. BMs are qualitatively described and there is a quantitative value analysis.
				
				Deliverable 7.1
					They use DECIDE BM types to describe their cases, covering:
					
					• Collective self-consumption
					• Reduction of curtailment
					• Collective investment
					• Collective service provision to the grid and markets
					  o Provision of balancing services
					  o Provision of network management services
					  o Demand side management
					
					Business Model Value Analysis tool for supporting the decision for consumers and community managers for starting, joining or enhancing the energy community. The Value Analysis module calculates the value of new services energy community bring compared to business-as-usual case. (Deliverable 6.2)

DECIDE project decide4energy.eu	ECs and Collective Actions	Pilots in GR, BE, ET, DE, AT	Yes	Yes, 6 DECIDE pilot projects	Types of BMs for ECs (D3.2): • Collective generation and trading; • Collective residential self-consumption; • Collective commercial self-consumption; • Community owned grid; • Collective investment in a community project; • Collective investment in an independent energy project; • Collective energy services.

Source	Type of EC or action	Geographic scope	Using BM canvas for analysis	Providing existing BM examples	Important findings
GOFLEX project goflex-project.eu	LEC providing flexibility services	Demonstration sites in GE, CY, CH	Yes, describes BMC exactly	BM design for 3 demonstration sites is given in detail (see Demonstration results for lessons learned). GOFLEX Deliverables)	Proposal of a BM for an EC with GOFLEX Flexibility Management in "D10.6 Best Practice Implementation Opportunities of the GOFLEX solution outside the Project and beyond the Project's Time". The project develops technologies for use, provision or trading flexibility as a service.
NEWCOMERS project newcomersh2020.eu/	Innovative clean energy community: intersection of "community energy" and "emerging energy services BMs"	Case studies in NL, SE, UK, IT, SL, DE	Value proposition, value creation & delivery, value capture. For case studies, more descriptive.	10 EC case studies focusing on the emergence and operation, showing how they create and deliver value as a business model. Case study reports in Materials and Deliverables	Emerging energy service BMs in ECs (D2.2): • Local renewable energy generation and supply (including micro-grid) • Innovative contracting and community-based products (including e-mobility) • Community energy storage services • Peer-to-peer energy trading platforms • Community energy aggregators
PROSEU project proseu.eu	Prosumer perspective, BM to enable RES generation and self-consumption	EU, with focus on and examples from countries: UK, DE, SP, NL, PT, HR, BE, FR, IT	Reference to components, but more general description	Reference to actual cases given. D4.1 Business Models for Prosumers in Europe	Business Models for Prosumers in Europe (D4.1, D4.2): • Micro-grid/private wire/internal grid • Communal Self Consumption • Local Energy Tariff/Company • Peer-to-Peer (P2P) Trading • Energy Service Contract/company • Flexibility Aggregator • Vehicle To Grid (V2G) • E-mobility services EU regulations for these BMs: D4.2 Policies for Prosumer Business Models in the EU
WHY project why-h2020.eu	options to interact with the energy system available to households	General EU	No, general idea description	Not in relation to BM. Use cases: Goiener, an EC in general. WHY D1.3	Consumer (household-level) interaction with energy system BMs (D1.2) • Energy as a Service • Peer-to-Peer electricity Trading • Aggregators • Community-ownership models (Co-operatives, Partnerships, Non-profit organisations, Community trusts) • Community-owned assets focused on sharing the economic benefits • Collective self-consumption schemes • Energy Community Models • Pay-as-you-go models • Conventional Energy Supply Models

Source	Type of EC or action	Geographic scope	Using BM canvas for analysis	Providing existing BM examples	Important findings
Hartmanis & Lindblom 2021 (Master's thesis)	Energy communities in general	Sweden	Yes, analysis of BMC for ECs based on literature and proposed BM example.	No. They propose BM based on result of interviews.	They propose BM based on result of 11 interviews. Results of interview show important aspects of BMC.
Horvath 2018	PV business models	General, literature review not limited geographically	Yes, BMC, Lean Canvas, Value Proposition, Creation, Delivery, Capture	No, theoretical. Refers to other papers.	Basic PV BMs: • Host-owned • Third-party-owned • Community-shared They look at the canvas from the customer side and the infrastructure side.

Karami & Madlener 2022	Peer-to-peer (P2P) energy trading platform
	
	BMs from point of view of households
		Germany	Mainly descriptive, mention of Value proposition and revenue streams.	15 projects and platforms in DE. Only look which type of BM they have, not much detail available for the cases.
				
				Survey of 1600 households.
					They propose 11 BMs based on the attitudes and norms of the surveyed households, and analyse which BMs the case studies have adopted.
					
					Business models for attitudes
					• High initial costs, lack of funding
					• Saving and earning money
					  ○ Power purchase agreement (PPA), auction, and bilateral-based contracts
					  ○ Free energy up to a certain percentage of the feed-in volume
					  ○ Self-supplied electricity, and contributing to a virtual battery provider
					  ○ Sharing energy with friends
					  ○ Subsidized business model
					  ○ Donation business model
					Business models for perceived behavioral control
					• Affinity with technology
					• General perceived influence
					• Specific perceived influence
					Business model for subjective norms

Source	**Type of EC or action**	**Geographic scope**	**Using BM canvas for analysis**	**Providing existing BM examples**	**Important findings**
Müller & Welpe 2018	Community storage	Germany, Western Australia	Yes, main components addressed for all cases together	Yes, 8 demonstration projects. Some details given, not full BM description. Interviews with experts.	Main revenues from R&D grants for all. Analysis of barriers and best practices. Proposal of new BM without public funding.
Nolden 2020	Community energy, focus on PV	UK	No, general description	No. They do give examples of intermediaries (in the UK)	Very nice overview of how support schemes have shaped the creation of PV ECs, and where to go from here: BM with intermediaries.
Plewnia & Guenther 2021	Virtual P2P ECs (EC n:n and P2P 1:n)	Germany	Value proposition, value creation, and value capture	Seven German companies offering P2P services used for interviews, but not presented as case studies.	Due to current legislation, organizations in Germany mostly facilitate virtual, supraregional P2P energy communities. BMs offer "system transition value" (contribution to the transition towards a sustainable system)
Reis 2021	Energy communities / community energy	EU	Yes	Annex EC projects in different EU countries. Details on: Motivations, governance, ownership and operation (and links)	Distinction between customer-side BMs and third-party-side BMs. Archetype energy community BMs: • Energy cooperatives • Community prosumerism • Local energy markets • Community collective generation • Third-party-sponsored communities • Community flexibility aggregation • Community ESCO • E-mobility cooperatives

Abbreviations

BM	Business Model
BMC	Business Model Canvas
CEA	Collective Energy Actions
CEC	Citizens Energy Community
DER	Distributed Energy Resources
DR	Demand Response
DSO	Distribution Systems Operator
EC	Energy Community
ECBM	Energy Community Business Model
EMD	Electricity Market Directive
LEC	Local Energy Community
RED	Renewable Energy Directive
REC	Renewable Energy Community

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