# Comparative analysis of existing business models for RES cooperative, aggregators and crowd-funders

Authors: Iban Lizarralde, Michael Hamwi, Audrey Abi Akle, Basma Samir (ESTIA)
Linda Lentzen, Volker Kromrey (LCF)

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This report has been produced within the SocialRES project "Fostering socially innovative and inclusive strategies for empowering citizens in the renewable energy market of the future".

WIP Renewable Energies coordinates the SocialRES project.

Detailed information about the project is available at the website: www.socialres.eu

The consortium involves 13 partners in 9 European Countries. The logos of the partners cooperating in this project are shown below and information about them is available at the project website.

This report has been written by Iban Lizarralde, Michael Hamwi, Audrey Abi Akle, Basma Samir (ESTIA) and Linda Lentzen, Volker Kromrey (LCF).

The authors thankfully acknowledge the valuable contributions from all project partners.

## Disclaimer

## Contacts

### Project coordinator

Silvia Caneva
Sonja Wilhelm
WIP – Renewable Energies
Sylvensteinstrasse 2, Munich, Germany

Email: silvia.caneva@wip-munich.de
Email: sonja.wilhelm@wip-munich.de

### Author(s)

Iban Lizarralde (ESTIA)
Email: i.lizarralde@estia.fr

Volker Kromrey (LCF)
Email: volker.kromrey@bodensee-stiftung.org

### Co-Author(s)

Michael Hamwi, Audrey Abi Akle, Basma Samir (ESTIA)
Linda Lentzen (LCF)

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# Technical references

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# 1. Introduction

The aim of SocialRES is to close non-technological research gaps that impede the widespread uptake of social innovation business and service models in the European energy sector. Social innovation projects address broad social issues, in this case the clean energy transition, while also driving business forward. Several types of businesses and terms are used to cope with social innovations within the energy sector: local renewable projects (Dóci and Vasileiadou, 2015), sustainable energy communities (Romero-Rubio and de Andrés Díaz, 2015), community-owned means of renewable energy production (Walker, 2008).

In the SocialRES project three types of businesses have been considered associated with social innovation in the renewable energy sector: Cooperatives, Aggregators and Crowdfunding platforms. These businesses facilitate an increase in energy democracy by increasing the number of local (decentralised) clean energy projects and allowing the consumer to take a more active role.

Based on a detailed analysis of 9 cases of social innovations implemented by crowdfunding platforms, cooperatives, and aggregators in 7 EU countries, one of the goals is to investigate enabling conditions and barriers for the generation of a portfolio of successful examples of social innovations.

The aim of this report is to identify different business model archetypes existing in the energy sector and how social and environmental standpoints impact these business models.

## 1.1. The business model concept

A literature search for the term 'business model' returns results showing diverse use but a lack of consensus on its definition. The concept of a BM has gained acceptance among academic researchers and practitioners in the field. Research on BMs garnered attention during the dot-com bubble, when the internet enabled start-ups to create value via introducing novel and more efficient BMs (Amit and Zott, 2001).

A common agreement on the basic definition of the BM is its description of how a firm conducts business. Although it does not include all the aspects of the business as a complex social system, it defines the general logic behind the actual processes (Petrovic, Kittl and Teksten, 2001). The early understanding of the BM concept was as a logical tool that

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supported companies to make strategic decisions and manage new technologies (Chesbrough and Rosenbloom, 2002). The BM is seen as a systemic and conceptually rich construct that involves some key components. This view is in agreement with the widely noted BM canvas of Alex Osterwalder, which is a simplified design involving key decisions and activities structured under nine components (Osterwalder, 2004). Realistically, the BM can be considered as a system of interconnected and independent activities (Zott and Amit, 2010). A BM is a role model that detects the shared similarities between firms and the generic types of behaviours that can be outlined to simplify analysis (Baden-Fuller and Morgan, 2010). Therefore, a BM invites innovation through knowledge replication and model imitation (Enkel and Mezger, 2013). A BM can also be seen as an artefact, e.g. a visual template that supports collaboration, creativity, and innovation in teams, and shapes the process of developing new economic logic (Eppler and Hoffmann, 2013). Innovating a BM comprises reconfiguration of the model elements, including changes in content (e.g. product-service, resources, business activities), structure (linkages between involved parties and stakeholders), and governance (who performs the activities) (Zott and Amit, 2010). BMs have different uses and applications and assist in explaining the business, operations, and strategy development (Foss and Saebi, 2017). From a more abstract point of view, BM components are commonly aggregated into three types: value proposition, value creation and delivery, and value capture (Richardson, 2008). The value proposition component considers the value embedded in the product service, refers to the customer segments, and focuses on customer needs. Value creation and delivery covers the key stakeholder roles, such as suppliers and partners, and key activities, including distribution and resource utilization processes. Finally, the value capture component embraces the flow of expenses in terms of costs and corresponding incomes.

Recent research studies have also conceived BMs as the means of transformation to more sustainable economic systems (Wainstein and Bumpus, 2016) and to provide support for integrating sustainability aspects into organisations (Stubbs and Cocklin, 2008). The notion of a sustainable business model (SBM) reflects superior value to the customer and describes how firms can capture economic value while maintaining or generating natural social capital (Boons and Lüdeke-Freund, 2013). Today, the concept of SBM is seen as a method to recognise new business opportunities and create a competitive advantage (Yang *et al.*, 2017). SBMs challenge the status-quo of a BM via development of a triple bottom-line BM, i.e. the integration of environmental, social, and business activities (Evans *et al.*,

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2017). SBMs go beyond delivering economic value and include a consideration of other forms of value for a broader range of stakeholders (Bocken *et al.*, 2014).

The unbundling of energy utilities and liberalisation of energy markets have allowed the emergence of new BMs within the energy sector. Such social and political trends have enabled the study of many interesting research areas (Richter, 2013; Apajalahti, Lovio and Heiskanen, 2015). The concept of a BM has been outlined as an analysis framework for presenting a more sustainable energy utilisation (Richter, 2013; Helms, 2016), introducing new schemes to organise business activities around renewable energy technologies (Huijben and Verbong, 2013; Wainstein and Bumpus, 2016), and drawing comparisons between organisational configurations of renewables (Strupeit and Palm, 2016). Given that disruptive BMs are able to achieve larger system shifts (Johnson and Suskewicz, 2009; Bolton and Hannon, 2016), there is considerable interest in developing a clear and descriptive framework that can guide and support decision makers in innovating BMs, rather than products or processes (Osterwalder, 2004). The BM concept has been useful in describing the evolution of energy service companies (ESCOs) and in analysing the challenges of developing new and innovative EE services (Apajalahti, Lovio and Heiskanen, 2015).

These activities emphasise the BM theory as a method to understand the structures of innovative businesses. For many companies, Demand Response (DR) is a powerful mechanism that can reduce energy costs; however, DR may not be suitable for all businesses. Businesses with low energy needs and small facilities have less capabilities to manipulate electricity loads and generate income. However, organisations that have already adopted EE measures are ideal candidates. Businesses with high electricity loads and smart meters are suitable for the initial DR requirements, since DR can achieve real impact with minimal disruption. This report uses the BM concept to analyse and investigate three different BMs in order to produce insights about possible portfolio of successful examples of social innovations.

## 1.2. Business model framework and attributes

In order to analyse the business models several attributes can be utilised. As explained in the previous section, a well-known tool is usually used to accomplish this analysis: the BM canvas of Alex Osterwalder (Figure 1):

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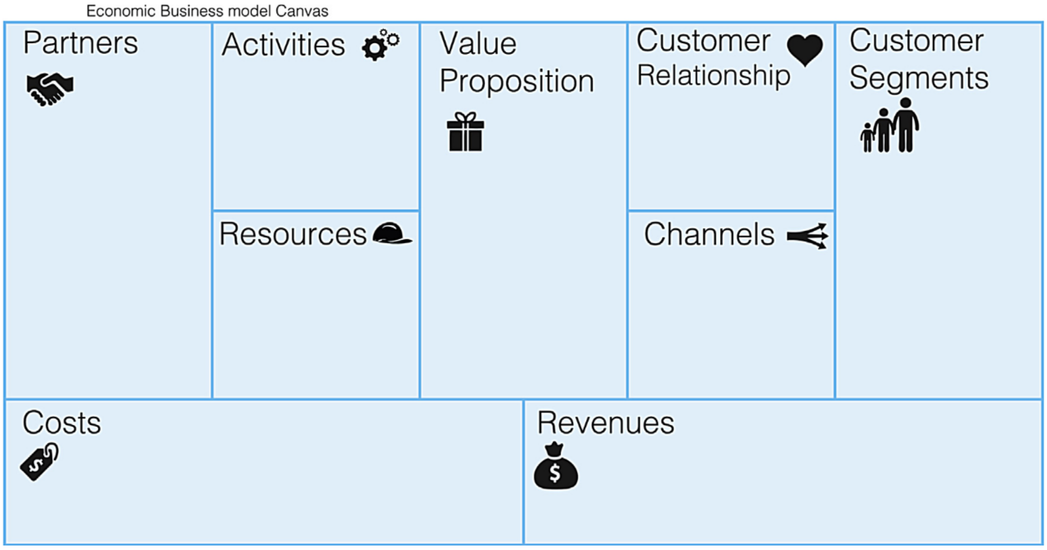


Figure 1 Business model Canvas. Sources: (Osterwalder et al., 2011)

These nine attributes allow the comparison of the main economic attributes that define the business model (Osterwalder, 2004).

Nevertheless, the business models that are analysed in the frame of SocialRES have a strong environmental and social purpose.

From an environmental point of view, it must be remembered that most of the projects related to energy democracy are based on RES. Moreover, the report “Characterisation of driving factors for social innovations” of the SocialRES project already highlights that environment is one of the main motivations for the creation of these kind business models in the energy field.

From a social point of view, this report describes the importance of social aspects when developing some business models mainly based on the accessibility and affordability of energy for every citizen.

Therefore, in order to include environmental and social attributes in the analysis of the following business models, two additional canvas have been considered (Figure 2) and (Figure 3).

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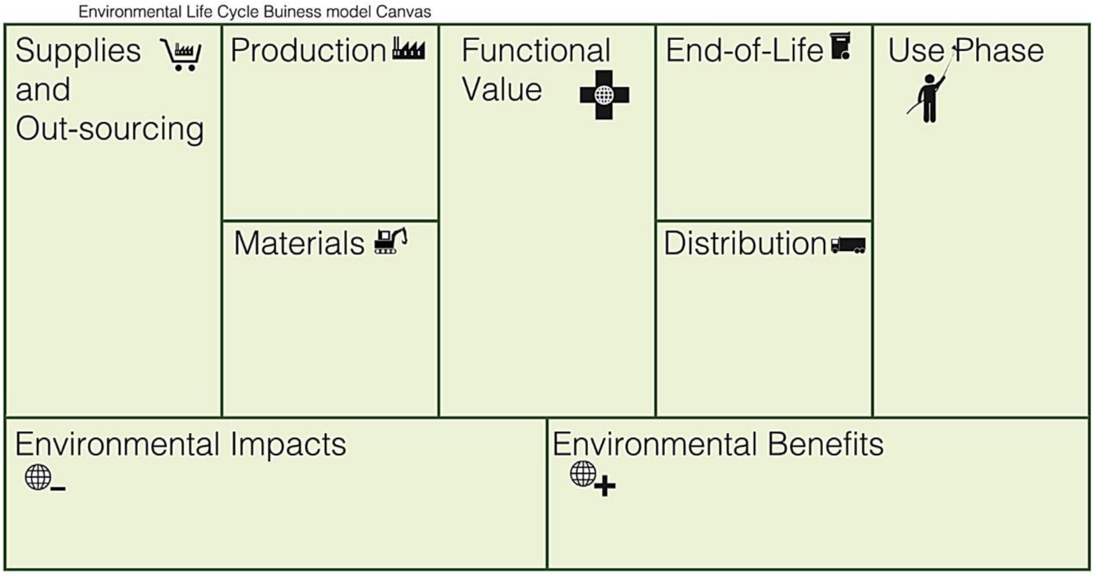


Figure 2 Environmental life cycle business model Canvas. Source:(Joyce and Paquin, 2016)

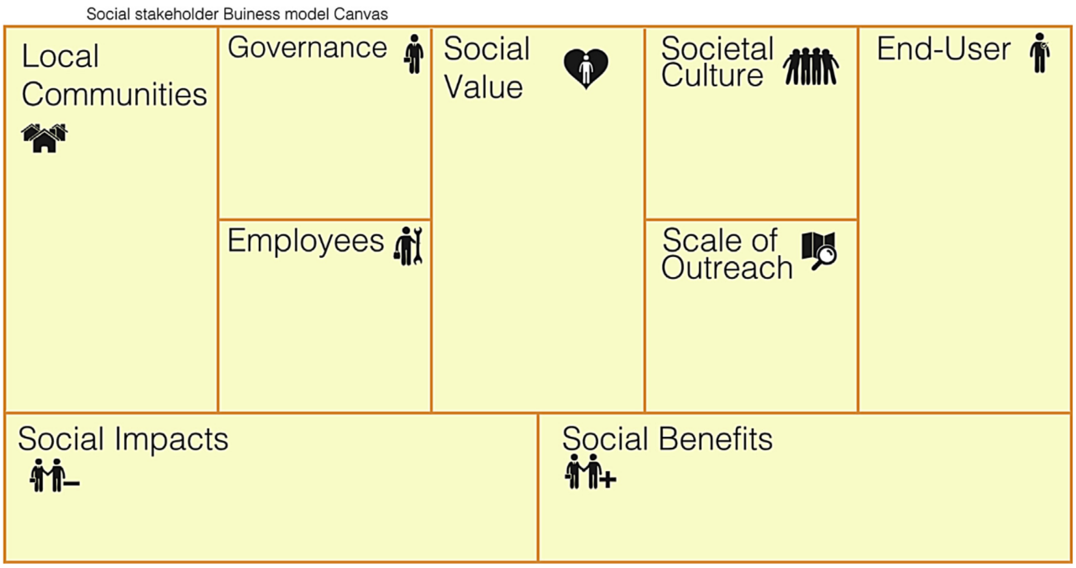


Figure 3 Social stakeholder business model Canvas. Source: (Joyce and Paquin, 2016)

Based on the work of (Joyce and Paquin, 2016), 18 new attributes have been considered in order to complete the main 9 economic attributes.

Additionally, the following attributes have been selected to complete the descriptions of the investigated business models:

- **Servitization intensity**
- **Financing and ownership**
- **Customer's role**
- **Decentralization level**
- **Flexibility degree**
- **Management and control.**
- **Competitiveness and affordability**

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Servitization or service centred business models are providing a service rather than a product. In the energy field, energy service is a concept that often refers to energy efficiency services and associated with Energy Service Companies (ESCOs). Besides ESCOs, this BM is evolving to deliver both renewable energy as a package of services, demand response and energy efficiency. Recent research works have identified that investors prefer this BM rather than BMs focusing on best technology or lowest price (Loock, 2012; Hamwi and Lizarralde, 2017).

Although economic business model considers ongoing business main attributes live the cost structure and the revenue model; the upstream phases are often not considered. Many of the social innovations in the energy sector have developed original business models based on the financing and ownership aspects. This is closely related to the customer's role within this business models, as very often, customers are also investors. These attributes are linked to the governance attribute defined by (Joyce and Paquin, 2016).

Another attribute that does not directly stan in these canvases is the decentralization level. Indeed, RES are directly related to the decentralisation of energy systems and the business models analysed in this report can have different decentralization level depending on the initial choices of the stakeholders.

Flexibility is an important attribute REF

Energy flexibility has become a key factor in power systems. This includes the flexibility of generation systems but also flexibility of the demand side, which is known as demand response. Demand response has great potential for fostering energy flexibility in a cost-efficient and sustainable manner.

Innovation on a managerial position can be a differentiating attribute in some business models. This attribute is closely linked to the governance aspects.

Lastly, one of the priorities for Europe is the competitiveness and affordability of the energy. This attribute has been considered as part of the value proposition and it is related to the social aspects emphasised some business models.

## 1.3. SocialRES Energy Business Model framework

Based on the attributes examined in the scientific literature and aiming an accurate framework to analyse the business models within the energy sector, a specific model is proposed in this chapter (Figure 4).

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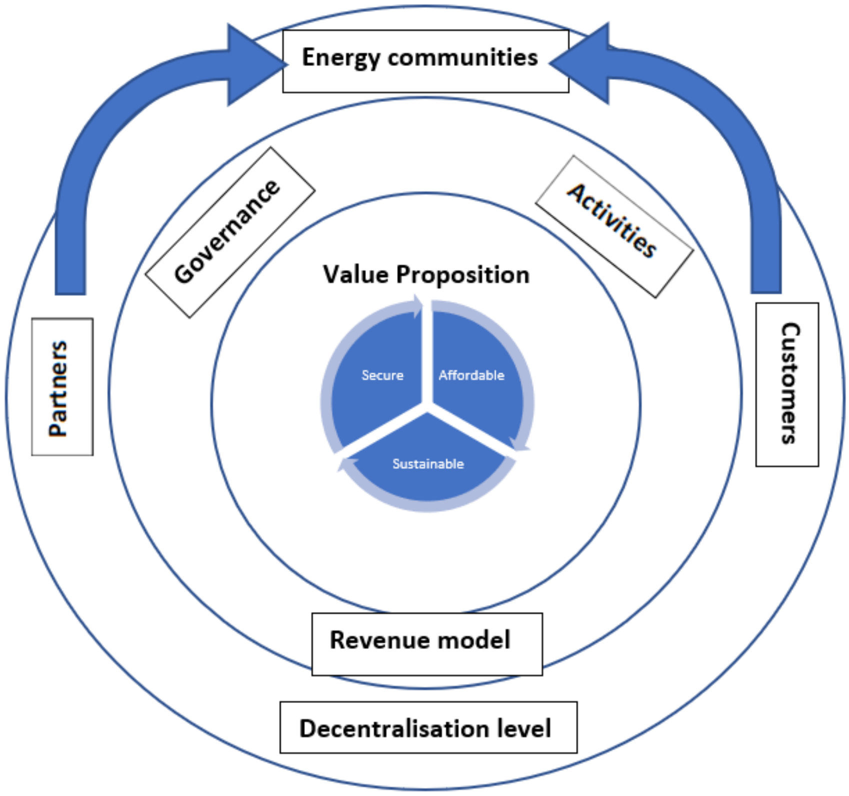


Figure 4 Energy business model framework

This model includes the main attributes that will be used to analyse and compare business models from different organisations.

In the centre of the model, the value proposition of the energy organisation is defined. Based on the priorities for the future European energy system, three main attributes have been considered: Security, affordability and sustainability.

These attributes can be applied either in the supply side or in the demand side. In the supply side, usually generation viewpoint is considered. The more and more, flexible generation means will play an important role in the energy system. Therefore, in order to identify the value propositions related to the supply flexibility, a specific subdivision has been considered. This value propositions can include specific business models as well as special means as storage systems (Table 1).

The demand side is related to the consumption part. Energy can be used to fulfil several functions which are usually classified into heat functions, mobility functions and specific electricity usages. In this case also, a specific subdivision has been considered: The demand flexibility or the Demand Response.

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Table 1 Energy Value chain

| | Secure | Sustainable | Affordable |
|---|---|---|---|
| Supply: Generation | | | |
| Supply Flexibility | | | |
| Demand: Consumption | | | |
| Demand Flexibility | | | |

The second difference is the specific role of the Energy Communities. These communities are created by different partners but mainly by the customers. Indeed, in this model, the role of the customer is highlighted because of the fact that customers can member of the energy community and can realise specific activities that are not usually done in standard companies. From an energy community point of view, the customer can be an active stakeholder of the organisation in the management aspects or finantial aspects (the customer is also an investor).

Lastly, the decentralization level has also a specific role in the model. Indeed, as discused previously, energy communities are directly related to the decentralisation of energy systems and the business models analysed in this report can have different decentralization level depending on the initial choices of the stakeholders.

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# 2. Aggregation

## 2.1. Introduction

Three global trends lead to rapid changes in the electricity sector: decarbonisation, decentralisation and digitalisation. They create new challenges and opportunities for market participants. Decarbonisation pushes the expansion of RES in the power system and energy markets. Decentralisation is led by consumer empowerment and new opportunities on the demand-side. Digitalisation enables the integration of cleaner energy technologies by facilitating connection and coordination among power system elements and stakeholders (Poplavskaya and de Vries, 2020).

Considering current changes in the power systems, aggregation as an innovative solution can stabilise and minimise the risk of failure when energy system is under pressure as well as facilitate the integration of renewable energy technologies. Aggregators can add value by aggregating electrical load (demand) and generation (supply), either separately or in one single portfolio. Aggregation purposes can differ according to the aggregating objects and the customer. Aggregating renewable electricity improves the position in the trading markets. Aggregating load can generate electric flexibility and allow new market actors to join the flexibility market service (De Clercq *et al.*, 2018).

Aggregation is relatively new in the European electricity market and its emergence is associated with the advancement in communication technologies. Traditionally, a single power plant on the supply side or a large industrial consumer is the conventional model for providing flexibility service for power system operators. Recently, a shift in the nature of the used assets are noticed. Aggregation is extended to comprise small generation units as well as small consumers flexibilities (Helms, Loock and Bohnsack, 2016) (Figure 5).

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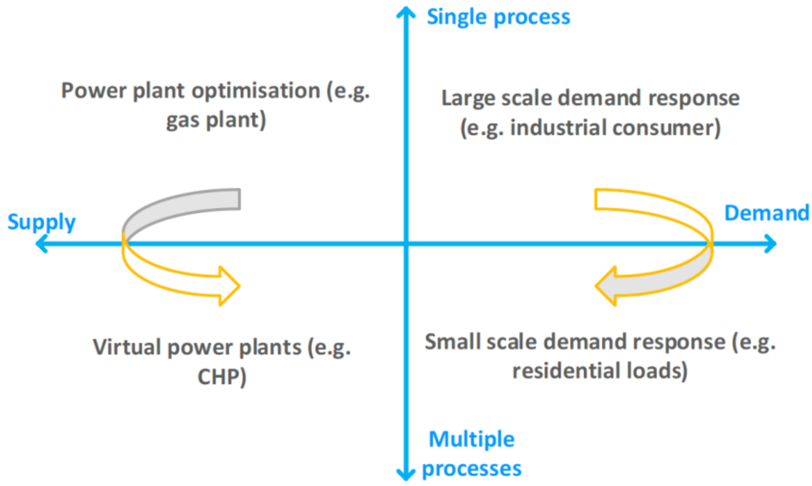


Figure 5 Typology of value creation in the energy industry. Adopted from: (Helms, Loock and Bohnsack, 2016)

Aggregator position as an intermediary is a key enabler for power system decarbonisation. Aggregator create this link between decentralised generation or customer load and the various market actors. In the BestRES project, as illustrated in (Figure 6),two major type of aggregators (combined and independent) and six distinct BMs have been defined (Verhaegen and Dierckxsens, 2016). Combined aggregators are existing market actors that carry out aggregation in addition to their normal operation such as being Balance Responsible Party (BRP) or Distribution System Operators (DSO). Accordingly, an aggregator can have the three BMs: aggregator-supplier, aggregator-BRP and Aggregator-DSO. On the other hand, independent aggregators act independently from the electricity supplier and the BRP. Therefore, three BMs can be identified. Firstly, in ”independent aggregator as a service provider”, aggregators provide service for other market actor but does not sell at own risk to potential buyers. In contrast, in the “Independent delegated aggregator” BM, aggregators sell at own risk. Finally, in “Prosumer as aggregator”, large-scale prosumers choose to adopt the role of aggregator for their own portfolios.

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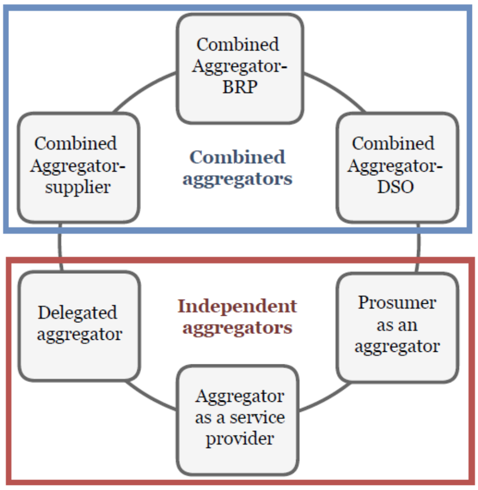


Figure 6 Aggregator business models and roles. Source: (De Clercq *et al.*, 2018)

In the next sections, a theoretical background about the covered topic has been introduced. Following that, the literature review has been divided into two major subsections: aggregation and peer to peer. The result of each subjection is organised following the three main business model dimensions: value proposition, value creation and value capture.

## 2.2. Theoretical background

### 2.2.1. Flexibility

RES power output relies on the availability of primary energy sources. The uncertainty in predicting, even in the short term of theses primary sources (e.g. wind, irradiation) is a major barrier in handling the variability of RES. The resulting technical difficulties increase the need for operational flexibility.

Traditionally, the capacity to be flexible is not usually understood as something that can be bought, sold, and measured in precise units. However, with the introducing of competitiveness into the power system and the emerging of energy market, flexibility notion has been changed. flexibility has been interpreted as the commodified potential to shift the timing of energy-use and energy supply have taken hold.

There are different conceptualisations of flexibility as illustrated in (Figure 7): flexibility as quality of an energy system, flexibility as a commodity, flexibility as a resource of specific instruments such as DSM and storage systems and finally flexibility as the potential for reconfiguring the temporal organisation of social life and the energy demands that follow (Blue, Shove and Forman, 2020).

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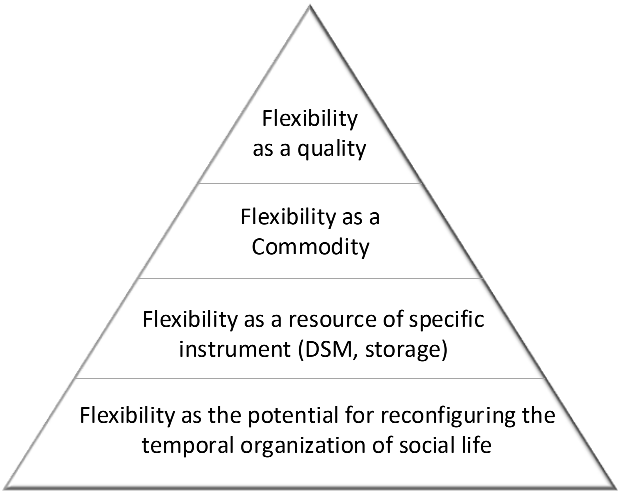


Figure 7 Conceptualisation of flexibility. adopted from: (Blue, Shove and Forman, 2020)

First, Flexibility can be represented as a quality of whole energy systems that can be modified in order to maintain the capacity to meet demand at all times. So that demand could be turned up and down just like sources of energy supply. Second, flexibility is defined as a resource that can be bought and sold. In addition to be a quality of power systems, flexibility includes the cost of balancing input and output in the energy market. The commodification of flexibility is to set a price on the potential to shift specific loads and users of energy from one time and place to another. In this regards, flexibility is defined as the potential of modifying the patterns of generation or/and consumption in response to an external electrical grid signal to contribute to the power system stability, reliability and security in a cost-efficient way (Villar, Bessa and Matos, 2018). In more details, flexibility is the power adjustment maintained at a specific moment for a given duration from a specific location along the electric network (Eid *et al.*, 2016) (Figure 8). Organisations that use or consume flexibility vary in how they combine the attributes of different flexibility ‘products’ and how and when these are mobilised.

Thirdly, flexibility is defined as a resource within the energy system and specific techniques (e.g. DR or storage) might make to the project of enhancing ‘system flexibility’ or of delivering flexibility.

The upper mentioned conceptualisations tend to consider individual activities in isolation and frame them as more-or-less discrete actions, unrelated to linked sequences or complexes of activities or to institutional rhythms, including working hours, school holidays, bus timetable, television programming and so on (Blue, Shove and Forman, 2020).

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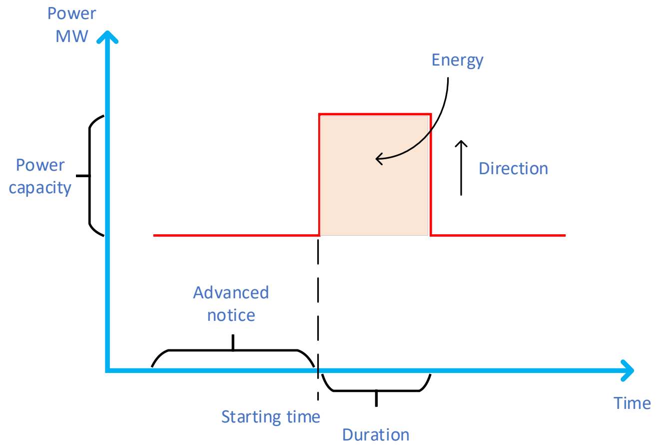


Figure 8 Flexibility and its attributes

Finally, flexibility is not considered as something that can be provisionally fixed, manipulated, bought, and sold, but instead, as something that is made by beings and their relationships, practices and connections. Therefore, it is possible to conceptualise flexibility as an “emergent feature of past and present social-temporal configurations of practices and of related processes of prefiguring and change/stability” (Blue, Shove and Forman, 2020).

### 2.2.2. Aggregation

The market for aggregators develops at different pace in different countries. In some countries aggregators already exist in the balancing market such as France and Netherlands. In other countries such as Austria, aggregators participation in the wholesale market does not noticed yet. Most aggregators of Europe are found in Germany, United Kingdom and France. Nevertheless, these countries have still few aggregators 16,12,10 respectively. Mostly aggregators are acquired or spin-off incumbent utilities. Others are newcomers with a core competence in IT, Energy solution and technology development (Poplavskaya and de Vries, 2020).

Candidate consumers in aggregator pool must be prequalified separately and install an expensive phone line. Independent aggregators need to be contracted with BRP/ supplier. All these barrier lead to a high participation cost and reduction in pool size (Mlecnik *et al.*, 2020). Aggregation in turn is a low-margin business, as it requires scale and volume to profitable. However, advanced automation solution might be a key enabler to extract value from customer flexibility without affecting their comfort level or operations.

The general logic beyond aggregation BM is the capability of aggregator to link the customer’s assets to the market at minimal transaction cost. Aggregation can also improve

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the position of RES such as wind and solar in electricity trading market and take the form of Virtual power plant. Herein, aggregators generate various forecasts for trading and portfolio management purposes (BestRES project, 2017).

## 2.3. Aggregation business model

Business models for energy aggregation has been reviewed. The literature review has been organised based on the three dimension of the business model concept: value proposition, value creation and value capture (Richardson, 2008).

### 2.3.1. Value proposition

The value proposition component considers the value embedded in the product service, refers to the customer segments, and focuses on customer needs. Aggregation has the potential to create different values for different stakeholders and customers including aggregation of RES for production trading and aggregation of load for flexibility valorisation in the electricity markets (Behrangrad, 2015).

Aggregators may assist balance responsible parties by optimizing their portfolios and thereby minimizing imbalances. They can assist transmission system operators (TSOs) to procure balancing services that are more cost-efficient. Aggregator can support distribution system operators (DSOs) to manage their local constraints and obtain a better overview of flexibility at lower voltage levels. Energy utilities (retail companies) may use aggregators' software and virtual power plant (VPP) solutions to tap into their customers' demand response (DR) potential and offer them bundled electricity services. (Poplavskaya and de Vries, 2020).

On the local level, aggregators can provide different types of flexibility products for DSO, BRP and consumers (Olivella-Rosell *et al.*, 2018). A DSO would have interest in having the following products:

- *Congestion management*: avoiding the thermal overload of system component by reducing peak loads where failure dur to overloading may occur.
- *Voltage control*: using load flexibility to ensure the voltage within its limit.
- *Controlled islanding*: to prevent supply interruption in a given grid section when a fault occurs.

A BRP would be interest in purchasing the following products:

- *Portfolio optimisation*: shifting the load from high-price periods to low price to reduce energy cost in both day-ahead and intra-day market.

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- *Self-balancing portfolio optimization*: to reduce imbalance by using the portfolio of flexibility resource and avoiding imbalance penalties.

Consumers and prosumers can benefit from:

- *Time-of-use (TOU) optimisation*: shifting consumption to low price time.
- *Capacity control*: reducing consumption peaks within predefined duration
- *Self*-balancing: to reduce the energy cost consumption by optimising electricity cost from consuming, producing and selling electricity.

### *Customer relationship*

Policies that fight against climate change and encourage consumer-side participating in the energy system increasingly shaping the electricity sector. Consumers who are aware of the energy impact and the value of environmentally sustainable solutions tend to green solutions such as renewable energy. Aggregators assume the following responsibilities towards the customers. First, aggregators examine the customer potential to provide flexibility in order to evaluate the profitability and type of services. This includes for example: customer's preferences, physical characteristics, availability. Aggregators are responsible to provide a response plan that informs customers in advance regarding aggregation future actions. Aggregators should also provide communication infrastructure includes, for example, control devices and smart meters. Finally, customer participation main motivation is economic benefits thus aggregators should provide financial incentives to customer to encourage them to actively participate in DR. These incentives can have the form of discount on the electricity bill or extra compensation (Lu *et al.*, 2020).

On one hand, the cost of customer acquisition and retention is a significant cost as aggregators must find customers with potential flexibilities and should equipped them with an appropriate infrastructure and offer economic incentives. On the other hand, Significant improvements in the customer relationship can generate multiple benefits for the participants. "Automation and control" represents multiple add-ons service to the BM which can lead to reduction in customer's electricity bill and encourage customer engagement (BestRES project, 2017).

### *Customer segments*

Aggregator can have customer on national and local level. They aggregate generation assets as well as small to large load. Their main market segment is the TSO but they also provide service to DSO, BRP, retailers and consumers. Differentiation of market segments

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can be based on the customer need. For example, the need for improving power system reliability, stabilize the market price, reduce operation cost, reduce RES imbalance, increase RES competitivity, reduce retail market risk, etc.

Taking the case of local aggregator, the aggregator acts as a local market operator and supervises flexibility transactions of the local market community. The potential customers are the distribution system operator, the balance responsible party and the end-user themselves. Promoting local flexibility market (LFM) contribute to increase RES local installation, support the trade of end-user flexibility for the benefits of the DSO and its operations and support BRP in the wholesale market (Olivella-Rosell *et al.*, 2018).

Aggregators can manage trading of third-party RES assets and optimize market return. Its role is described as VPP manager. This can be done through collection data from renewable sources and building large unit of installed capacity. Aggregator can also manage third-party load, a customer with an existing electricity supply contract and with another balancing responsible party (BestRES project, 2017).

### 2.3.2. Value creation

Value creation covers the key stakeholder roles, such as suppliers and partners, and key activities, including distribution and resource utilization processes. Aggregators create value by pooling energy resources. As individual small units cannot provide a meaningful system service due to their limited scale, in this can aggregation is indispensable. Aggregation requires both IT knowledge as well as advanced communication infrastructure. Having a balanced portfolio of multiple technologies can firstly overcome each other's technical constraints, secondly exploit the effect of scale and thus reducing the transaction cost and mitigate risk for individual participants. Thirdly, it allows different value streams from multiple objectives (Poplavskaya and de Vries, 2020). Aggregators can innovate in the BM by enabling pooled and controllable RES producers to participate in further flexibility markets such as frequency control and ancillary services (BestRES project, 2017).

Aggregators can exploit different nature of demand-side resources including load and generation (Figure 9). Traditionally, demand has been conceived as fixed variable in the power systems. However, aggregators in energy market can enable energy consumers with elastic consumption to valorise their flexibility through demand response. With the spread of RES, flexible prosumers would not profit just from load flexibility but also from generation flexibility and optimised RES trading (Kubli, Loock and Wüstenhagen, 2018).

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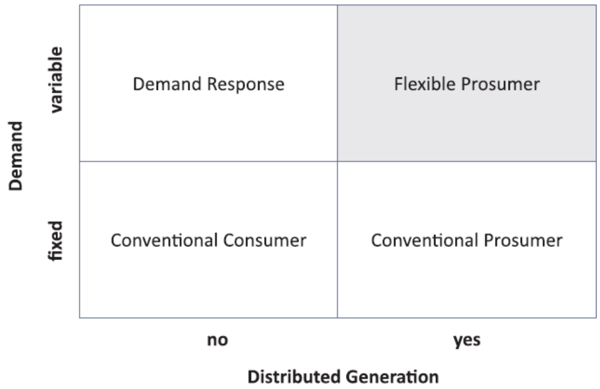


Figure 9 Typology of demand-side resources. Source: (Kubli, Loock and Wüstenhagen, 2018)

The literature on aggregation shows resources can be classified in three major categories: demand, supply and storage (Hamwi, Lizarralde and Legardeur, 2020; Lu *et al.*, 2020). Demand-base are load resources that have a certain elasticity. Aggregation allows these traditionally passive consumers to participate in the energy markets. Supply-based resources are typically distributed generations contains RES (e.g. PV) and traditional generation units (e.g. small hydro). Storage-base are storage systems resources that can compensate demand-base and supply-base resources (e.g. EV).

New energy management tools have opened up opportunities for demand side, allowing prosumer to take part in the energy market activities and create a new market segment. According to World Energy Outlook 2018, between 2014 and 2017 alone, the volume of aggregation in the EU has grown by over 50% from 12 GW to approximately 18 GW (International Energy Agency, 2018). Aggregators, who tend to focus on the product and service innovation, explore new value streams and achieve a competitive advantage from developing new technological solutions such as platform, blockchain and peer-to-peer. In this type of business model (Poplavskaya and de Vries, 2020).

Aggregation BM is multi-stakeholder BM depends on consumers, prosumers, small-scale generators, technology providers and IT companies. The success of aggregator depends on having a smart cooperation across this network of stakeholder's groups.

### 2.3.3. Value capture

Value capture refers to the revenue that the firm generates from providing goods, information and services to the customer (Teece, 2010). Values can be captured from developing new products, addressing a new market opportunity or coming with new transaction mechanisms. In the energy aggregator BM, value capture includes the revenue

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model and costs structure. In this regard, three elements are proposed the "Transaction cost", the "Intervention cost" and the "Revenue model".

Demand response (DR) is one of key revenue model for aggregators. Aggregator can generate revenue by monetizing end-user electricity flexibility. DR revenue has two parts, one belongs to the provider (e.g. Aggregator) and the second is distributed on the customer (e.g. Load).

Aggregator's revenue falls into two categories: "Availability" and "Call". The former is a payment model that is deliver to the aggregator whose customers' load or/and generation in the standby status to be controlled when there is system stress. The latter is a payment model followed by a call from the TSO demanding curtailments during an event (Ikäheimo, Evens and Kärkkäinen, 2010). Significant improvements can be realised in the design of the revenue model. Aggregators can supply customers with time-variable tariffs enabling them to participate in the electricity market. These prices can be forecasted and periodically adapted then communicated to the customers who can benefit from a reduction in the electricity cost (BestRES project, 2017).

Aggregation may create essential value through capitalizing on economies of scale and scope and by managing uncertainty. Regarding the economies of scale, participating in the energy market requires integration with the power system and its functions. These requirements imply a fixed cost. The fixed cost has several components. Firstly, there is the cost of communication infrastructure, secondly the cost of customer acquisition including owners of energy resources and thirdly the cost of complying with existing regulation. Aggregation can be used to reduce this cost by increasing the quantity of services provided. For example, aggregators can reduce searching costs (i.e. transaction costs) for market agents due to their centrality in the marketplace and their economies of scale in managing information (Burger *et al.*, 2017). Economies of scope emerges when the provision of various services or products leverage a common set of business knowledge (e.g. market operations), technologies (e.g. ICTs), or engagement (e.g. customer acquisition) costs. Given the inherent costs of acquiring and engaging a customer, aggregators may realize economies of scope by bundling services and spreading transaction costs across products. Furthermore, service bundling can create synergies and innovative solutions that adapt to consumers' needs (Burger *et al.*, 2017).

Transaction cost is the cost of identifying, activating, connecting and communicating with the aggregated RES or aggregated loads (Helms, Loock and Bohnsack, 2016). Transaction

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cost is correlated with the number of the timing-processes that are required to coordinate and deliver flexibilities, and it increases with the intensification of these timing-processes (e.g. aggregating small-scale residential load). On contrary, it decrease with low number of timing-processes (e.g. aggregating few large-scale industrial load). The intervention cost is the cost of exploring the different, variant and specific consumption patterns, designing their relevant intervention mechanism and remunerating the customers for their behavioural change (Helms, Loock and Bohnsack, 2016).

Finally, changes in the market design have the potential and would enable key improvements in the aggregator BM. Aggregators can explore new possibilities for controllable decentralised units for balancing market where assets flexibility is valued the most (BestRES project, 2017).

In the next subsection, the peer to peer BM is presented as a specific type of aggregation business models.

## 2.4. Peer to peer energy trading

Changes in social structures and process designate considerably the possible conception of energy either as a common, resource and outcome, or a commodity determined by market rules (Giotitsas, Pazaitis and Kostakis, 2015). The former refers to non-commodified space shared by the community and the participation of its members is intensified on local level.

The advancement of information and communication technologies (ICT) have possibly offered the opportunity for a shift of the way energy is generated and distributed. An increasing number of people have been experimenting through a variety of participatory networks allowing them to produce, manage and share in collaborative manner.

As a result of this technological advancement, the concept sharing economy business model has been emerged which is composed of hundreds of online platforms that enable people to turn otherwise unproductive assets into income producing ones. The new value proposition for the production of economic surplus is using software platforms to sell reductions in transaction costs in various business fields such as accommodation, transportation, meals, investment, etc. Many types of platforms BMs have been created: communication, social media, matching, content and review, booking aggregator, retail, payment, crowdsourcing and crowdfunding and development platform, and sharing economy platform.

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In this report, P2P energy platform business models that is inspired by the sharing economy concept have been reviewed and presented. The peer-to-peer markets involve decentralised, more autonomous and flexible P2P networks emerged almost from the bottom up. Prosumers and consumers interact through a P2P platform to bid and directly sell and buy electricity and other services. In the UK for example, the P2P requires a fully licensed supply partner to make sure consumers continue to receive power when the supply from the intermittent generation is low (BestRES project, 2017). The P2P logic of a particular consumer buys electricity from a particular prosumer is only feasible from a market cleaning perspective. At the physical level, however, users of the grid cannot determine which is the source of the consumed electricity (Park and Yong, 2017). The behaviour of the consumers is given as they seek consumption from the cheapest source available at any given time while producers have the ability to put the price.

The purpose of this analysis is to deepen our understanding for energy peer to peer business models including dimensions such as source of value, competitive advantage, the motivation and role of key actors in the ecosystems. The final goal is an attempt to answer the following question: what are P2P business model dimensions that facilitate better understanding and can lead to discover of latent opportunity in previously unknown business models. The result would be useful for potential adopters such as energy retailer, energy cooperatives, energy aggregators and energy users. The result generate insight regarding the implications of P2P business models and possible position in ecosystems. The main contribution is to integrates the extant literature on energy P2P taking a business model approach in delineating their key properties and dimensions.

### 2.4.1. Peer to peer social perspective

Trading P2P BMs would give consumers the opportunity to be active. By sharing underutilised assets P2P would allow individuals to work on self-expression and self-development. The bottom-up approach would emphasize on self-management and increase prosumer's creativity and self-development. Mutual co-creation between P2P network members would increase sense of community work. The communication technology would enable individualistic as well as collective achievements and create a space for connect individuals with the same interest, tastes and goals, etc. Different communities could help individuals to construct identities in purposeful way and preserve sable and constant identity. Resources would be shared within networks on various geographical levels. Networks would guarantee and maintain freedom of choice. In these

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sharing networks, resources might be partly redefined as possessions of the network instead of private property. Other values such as environmental, social, ethical and aesthetic would have preferred to monetary value strengthening solidarity and providing safety net in times of hardship (Ruotsalainen et al., 2016).

### 2.4.2. Literature review analysis

Taking the business model as an analytical framework, the literature review is structured in three dimensions: value proposition, value creation and value capture.

#### 2.4.2.1. Value proposition

The value proposition component considers the value embedded in the product service, refers to the customer segments, and focuses on customer needs. P2P communities give member the feeling of belonging or being connected to a group of like-minded people. Consumers and prosumers can have direct contact enabling sharing electricity surplus which can has a particular story behind it. Consumers also appreciate the independence from conventional energy providers. The co-creation of renewable plants increases RES acceptance (Plewnia and Guenther, 2020). Producing electricity from local resources enables democratisation of electricity. Local market can also improve social cohesion promoting an active attitude towards more efficient energy consumption (Rocha, Villar and Bessa, 2019).

Promoting P2P energy communities supports investment in renewable energy plants. Connection between peers improves energy origin transparency and support local and green consumption. Real-time electricity monitoring can incentivize intelligent and efficient use of available flexibility (Plewnia and Guenther, 2020).

#### 2.4.2.2. Value creation

Value creation covers the key stakeholder roles, such as suppliers and partners, and key activities, including distribution and resource utilization processes. The literature shows that three main P2P market structures are exist: full P2P market, community-based market and hybrid P2P market (Parag and Sovacool, 2016; Sousa et al., 2019). In the Full P2P market, there is no centralised supervision. Consumers can express their preference such as green or local energy allowing prosumers to differentiate their products. Privacy of peers is well protected and are able to fully control their devices. However, this model has less efficiency of coordinated markets as a result of coordinator absence. Additionally,

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the outcome of the P2P energy trading might not predictable or visible for other stakeholders such as DSO or TSO (Zhou et al., 2020).

The Community-based market model is based on group of members who share common interest and gaols such as green energy, location, collaborative manner. The trading activities inside the community are managed by a manger. Based on the information collected from the peers, the manger directly decides the energy import/export of the peers or the operational status of the devices among the peers. This centralised model can maximise the overall social welfare of the P2P community and reduce uncertainty of power production and consumption (Zhou et al., 2020).

Hybrid P2P market: this model combines the previous two models where different trading layers exist and in each layer communities and single peers may interact directly with each other. Herein, the coordinator role is not to control energy export/ import but to send pricing signals (Zhou et al., 2020).

Singh et al., (2017) have studied "mutual energy exchanges" as an alternative for energy trade markets. Mutual energy exchanges are shaped by social relations and cultural values. These exchanges happen in circles. Each circle defines a mutually constituted relational and cultural boundary for energy exchanges. The concept is relational as it centers on and acknowledges the influence of social relations in shaping energy exchanges. That study demonstrates the importance of applying anthropological approaches when designing and evaluating P2P energy trading markets.

### *Ownership perspective*

In P2P BM, there are two forms of ownership. One is related to infrastructure for energy production and second is the energy itself.

Regarding the latter, the possible ownership structures can be divided into different categories by looking at the three key dimensions. First, the "control versus emergent dimension" which emphasizes on the existence of rules or a controller that manage the transactions among the members versus an emerging behaviour from member interactions. Second, the "centralised versus decentralised dimension" refers to how much the members are equivalent among each other versus the presence of few or one member who own, manage and provide services. Third, the "individual versus collective"

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distinguishes between having a pool of members who have common and shared resources, versus privately owned and managed resources (Lovati et al., 2020).

Accordingly, distinct BMs are presented based on different form of ownership. First, in the "Local Energy Provider" the ownership is concentrated around one single provider who owns the totality of production or storage capacity whereas the others are consumers. Second, in the "Local Energy Community" a communal plant is shared among the members equally or according to other criterion such as initial investment. Finally, the "Local Energy Market" is free-form structure where exists multiple producers, consumers and prosumers interacting with each other (Lovati et al., 2020).

***Common value***

Commons-Based Peer Production (CBPP) is a new form of social production enabled by ICT. In which communities are able to create cooperate in order to produce and share common value. Otherwise corporation, communities have flexible organisational structures and their production nor public neither private. In contrary, they are driven by production of use value rather than profit. CBPP models contribute to decommodification of energy and eliminate economic-political power coming from private production and management of centralised plants. Prosumers experience first-hand the energy production increase their awareness of environmental impact. P2P supports building greater resilience and security against collapse, sustainability promotion and diversity of solution for energy production and consumption. P2P models have also some withdraws. It requires high-investment cost especially if there is a storage. It is inefficient in comparison with fuel generation, some green technologies that cannot be implemented in small-scale form would be excluded, they are not appropriate to installed in dense urban space and finally, the absence of supporting regulations and incentives (Giotitsas, Pazaitis and Kostakis, 2015). The advantages and disadvantages of P2P model is illustrated in (Table 2).

Table 2 P2P advantages and disadvantages. Source: (Giotitsas, Pazaitis and Kostakis, 2015)

| Advantage | Disadvantage |
|---|---|
| De-commodifies energy | High-cost investment |
| Diffusion of environmental conscience | Relative inefficiency of production |
| Greater resilience and security | Excluding clean technologies unsuitable in small scale |
| Promote sustainability | Inappropriate in dense urbane space |
| Diverse means of production | Absence of supporting regulations |

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### *Local energy community*

In this community model, the energy is produced and consumed locally. The locality is defined as within the boundaries of low carbon voltage distribution network. Consequently, lower stress in power grid would be as lower net exports of surplus from distributed generation than usual to higher voltage levels. Herein, load patterns are changed in order to absorb the surplus of distribution generation energy within the LV/MV transformer substation and prevent to the maximum the net export of power to the next high voltage level (Pires Klein et al., 2019).

The local energy community (LEC) can have an ownership structure based on communal PV plant. In this regard two models are studied. First, electricity would be given for free for members who participate in the initial investment and operation and maintenance cost, this model is termed “LEC gratis”. In this case, consumers with small consumption would have less benefit than larger consumers. Second, in the model “LEC at price” the electricity from the communal PV is given at production cost and revenues are divided among the members according to each member’s share. The latter distributes the generated benefits among participants in a more equal manner.

The business model for local energy market can be based on the involvement of retailers as P2P market facilitators acting also as aggregators of its customers to trade their net imbalance in the wholesale market. Having a unique entity, such as retailer, can facilitate the settlement of transactions between peers and guarantee the energy flow commitments. Adopting P2P activities would help retailers to integrate the decentralised model of energy production (Rocha, Villar and Bessa, 2019).

### *Supraregional P2P energy community*

Although it is not possible till now to have physical local exchange of electricity, this BM connects electricity consumers and producers on a market and financial level. The electricity is traded on both low and high voltage level, leading to electricity tariff not considerably lower than the utility prices but at the level of green electricity products. Renewable energy electricity is traded with fixed prices provide shelter from future price volatilities (Plewnia and Guenther, 2020).

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#### 2.4.2.3. Value capture

Value capture refers to the revenue that the firm generates from providing goods, information and services to the customer (Teece, 2010). Creating a local community within the low voltage boundaries can be economically feasible. From the consumer's perspective the sales tariff of community shared electricity should be exempted from Network Access Tariffs (NATs) associated with medium and high voltage networks. From the prosumer perspective, there is a larger margin of profit from selling electricity locally than feed-in tariff (Pires Klein et al., 2019).

Singh et al., (2018) have classified the return from energy trading in rural India into three forms: in-cash, in-kind and intangible and acknowledge the dynamics of social relations in P2P energy trading. In-cash returns are monetary. In-cash returns are an integral part of mutual energy trading, a type of energy exchange. In-cash returns are associated with receivers who were 'socially distant' or less connected to givers. In-kind returns defined as a payment made in the form of work or economic value based on equivalent monetary value. In-kinds returns are non-cash but still are monetary. In-kind returns were observed in energy exchanges of the givers with both a 'socially distant' as well as a 'socially close' receiver. Finally, intangible returns have the form of unmeasured and unquantified social gestures and actions, such as goodwill or social support. The notion of profit is absent instead there is mutual energy sharing. Intangible return is associated with "socially intimate" persons where there is a feeling of strong sense of social connection and solidarity (e.g. family, love, friend).

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# 3. Crowdfunding

## 3.1. Introduction

A Crowdfunding system has been defined by (Short et al., 2017) as “a method of pooling often small amounts of capital from a potentially large pool of interested funders”.

This form of finance allows to fund a project by the participation of large number of people usually using web-based platforms (Bourcet and Bovari, 2020).

There are three types of crowdfunding systems: Debt-based crowdfunding (crowdinvesting), equity-based crowdfunding (crowdlending) which includes invoice trading and non-investment models (Crowdfunding without an economic return for investors) which includes reward-based crowdfunding and donation-based crowdfunding (Figure 10).

Even if there were some examples, the crowdfunding platforms become a real financing alternative for innovative projects in general and renewable energies, after the 2008 financial crisis.

As argued in the TEMPO report (Tempo, 2018) “Crowdfunding platforms are not only an alternative source of funding, but also communication and marketing tools, as they are strongly interconnected with social networks and use digital marketing to reach their audience of potential investors or donors. Moreover, publishing crowdfunding campaigns on online platforms allow full transparency and open communication on the projects to be funded and enable potential donors and investors to engage online with the project proponents, get involved and monitor progress over time” (Mollick, 2014; Allegreni, 2017; Bergmann, Burton and Klaes, 2020).

Renewable energy crowdfunding platforms are usually debt-based or equity-based crowdfunding. Generally, debt-based crowdfunding has less risk and investment duration is shorter than equity-based crowdfunding. But the later can have higher returns (Bonzanini, Giudici and Patrucco, 2016; Lam and Law, 2016; De Broeck, 2018).

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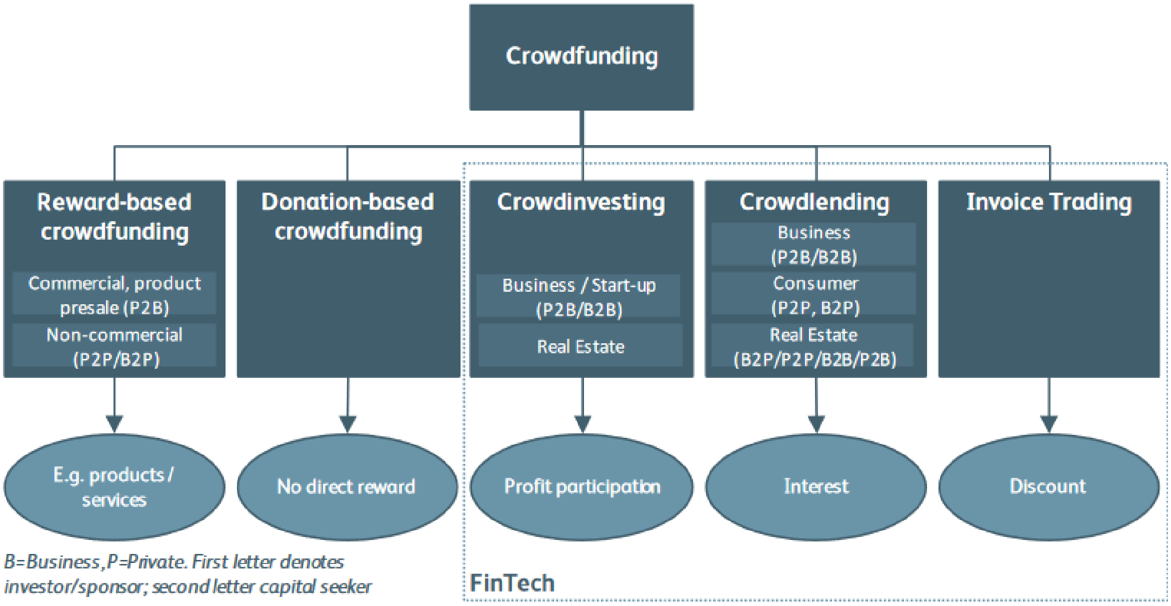


Figure 10 Types of crowdfunding systems. Source: https://blog.hslu.ch

Renewable energy crowdfunding is used to diversify the investors (small) to collect funds for renewable energy projects (McInerney and Bunn, 2019).

Two European H2020 projects have recently analysed the role of crowdfunding platforms in the development of Renewable energy project in Europe:

- **TEMPO Project, Crowdfunding as a novel financial tool for district heating project (https://www.tempo-dhc.eu)**
- **CrowdfundRES Project, Unleashing the potential of Crowdfunding for Financing Renewable Energy Projects (http://www.crowdfundres.eu)**

In the case of Tempo, it is explored the role of European crowdfunding platforms in the context of district heating renewable energy projects.

They highlight their capacity for offering “access to a wider audience of potential investors”.

Crowdfunding platforms for Renewable Energy also augment the acceptance of renewable energy projects among the citizens and increase their engagement. It can also be considered as a strong communication tool for renewable projects to “increase visibility of the project”.

It is convenient to mention the (REF “Crowdfunding for Renewable Energy: Survey Results on Public Perceptions and the Views of Crowdfunding Platforms and Project Developers”) favourable disposition of EU citizens towards renewable energy crowdfunding.

But crowdfunding platforms are mainly an additional source of funding to energy projects, “providing potentially easier and faster access to capital than other institutional sources”.

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This financial mechanism allows a better distribution of renewable energy project revenues within the concerned territories.

The overall viewpoint of EU citizens regarding crowdfunding for renewables has been shown in the CrowdfundRES project to be very favourable (Bergmann *et al.*, 2016).

Within the Crowdfundres project a series of questions have been defined that renewable energy developers should ask themselves and crowdfunding platforms in order to facilitate better understanding and decision-making before engaging in crowdfunding. These questions allow a better definition of the business model of the renewable energy developers.

From a platform operational level, it is necessary to focus on after sales service provided to investors and borrowers, renewable energy developer motivations and the fundraise description.

An important issue of Renewable energy crowdfunding is the fact that developers can use crowdfunding platforms to respect the obligations to engage with the local community concerned by the renewable energy project.

Some core areas of successful crowdfunding platforms include: Platform regulation, Platform technology, Platform investment instrument, Platform developer onboarding and the Investment information provided to investors:

Moreover, developers should consider the level of transparency it will bring to their business and the duration it takes to receive funding from a crowdfund raise (CrowdFundRES, 2016).

## 3.2. Crowdfunding business model

Renewable energy crowdfunding business model can consider the particularities of the renewable energy project or the crowdfunding platform's model itself.

The former can vary considerably depending on the renewable energy domain, the country in which is developed and the public institutions participation. The originalities related to the crowdfunding platform are mainly related to the access to finance and the public engagement.

Several ownership models for the renewable energy facility include full public control, full private control, mixed ownership and management and not-for profit (Stratego Report, 2016).

Based on the business model canvas, the main modification to the renewable energy project's business model is the fact that among the financial partners, there are several

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stakeholders that become partner of the project via a crowdfunding platform. This means that during upstream activities of the renewable energy projects, new activities will be launched related to the crowdfunding platform. These activities can include specific campaigns of communication using social networks in order to engage potential investors but also to present the renewable energy project to be funded in a transparent way. One of the motivations of the investors is the environmental related motivation (Kollmuss and Agyeman, 2002; Li *et al.*, 2019).

Lastly, these campaigns and the potential participation of concerned citizens allow a different relationship with future customers or affected citizens of the renewable energy facility.

From crowdfunding platform's model itself; the value proposition is mainly the access to an extra funding source. Usually, projects with a low expected return on the investment are concerned but with a strong social and environmental commitment.

Lending crowdfunding models are dominant in the renewable energy domain. These platforms often argue that they are a tool for faster access to capital than other institutional sources of finance. Moreover, it can also be seen as a first fundraising that will be use as a guarantee in further fundraising efforts with classical finance institutions. Lastly, a value proposition that is highlighted by crowdfunding platforms is the communication function of the platform. Indeed, renewable energy projects might need a strong participation of citizens or at least the communication should avoid the disagreeing engagement, meaning the organisation of citizens against the renewable energy project.

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# 4. Energy Cooperatives

## 4.1. Introduction

Cooperatives are enterprises that do not follow an equity-based proportion for decision making but the one-member-one-vote principle (Yildiz *et al.*, 2015). Following the definition of the International Cooperative Alliance "A co-operative is an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise". Therefore, cooperatives are neither non-profit organizations nor only economic oriented companies. Indeed, their values go further than only economic aspects. Co-operatives are founded on the "values of self-help, self-responsibility, democracy, equality, equity and solidarity. In the tradition of their founders, co-operative members believe in the ethical values of honesty, openness, social responsibility and caring for others". These values are brought to the practice following 7 principles (Brouder, 2010):

1. voluntary and open membership
2. democratic member control
3. member economic participation
4. autonomy and independence
5. education, training and information
6. co-operation among co-operatives
7. concern for community

Energy cooperatives includes electricity cooperatives and cooperatives that deal with thermal applications, but also cooperatives in the field of electric mobility can be included in this category. In Europe, energy cooperatives can be found since beginning of the 20$^{th}$ century but it is with the liberalization of the electricity and gas markets that most of the current energy cooperatives have emerged.

There are several initiatives of citizens currently working on the renewable energy domain. Most of them work on the generation part and there are also initiatives that have been developed as retailers; lastly, some few initiatives include distribution functions in regions where the legal framework allows.

These initiatives are not always developed within a legal status of cooperative. The REScoop network for example, includes companies defined as Renewable Energy Sources

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Cooperative but which can have other juridical status. Nevertheless, in order to be member of the REScoop network, it is compulsory to accept the principles of the International Cooperative Alliance listed hereabove.

It is therefore important to define the scope when dealing with the term “energy cooperative”.

In order to clarify the scope of different juridical status, it is necessary to compare the energy cooperatives to energy communities (ref, Soeiro) and plus precisely to a label that has recently arisen: the Renewable Energy Community (REC). The REC is a term that have arisen in the Clean Energy Package (CEP) and is contained in Directive (EU) 2018/2001. In the next chapter, RECs principles will be compared to the principles of the International Cooperative Alliance listed hereabove.

## 4.2. Energy cooperatives principles and the Renewable Energy Community (REC) legal entity

In this chapter, the seven principles of the cooperatives are revisited following the definition of the International Cooperative Alliance and comparing with the terms used to define the Renewable Energy Community (REC) in the Directive (EU) 2018/2001 (RED, 2018):

**1) Voluntary and open membership**

Following the International Cooperative Alliance the “Cooperatives are voluntary organisations, open to all persons able to use their services and willing to accept the responsibilities of membership, without gender, social, racial, political or religious discrimination”.

In the Directive (EU) 2018/2001 the Renewable Energy Community (REC) “is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity”.

In both cases the “voluntary participation” is highlighted. Nevertheless, only local cooperatives are able to respect the criteria related to “the proximity of the renewable energy projects”.

**2) Democratic member control**

The RECs are constituted by “the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities”.

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Therefore, it can be noticed that in a Renewable Energy Community, several type of members can be included which can be also the case of a cooperative. Nevertheless, the one-member-one-vote principle is not required within a REC, while for the International Cooperative Alliance the "Cooperatives are democratic organisations controlled by their members, who actively participate in setting their policies and making decisions. Men and women serving as elected representatives are accountable to the membership. In primary cooperatives members have equal voting rights (one member, one vote) and cooperatives at other levels are also organised in a democratic manner".

**3) Member economic participation**

Within this principle, both statuses highlight that member can participate economically. Besides, in both cases community economic benefits, environmental benefits and social community benefits are expected beyond member's financial profits.

In this case the International Cooperative Alliance claim, as in the former principles, the democratic aspect of member participation: "Members contribute equitably to, and democratically control, the capital of their co-operative. At least part of that capital is usually the common property of the co-operative. Members usually receive limited compensation, if any, on capital subscribed as a condition of membership. Members allocate surpluses for any or all of the following purposes: developing their cooperative, possibly by setting up reserves, part of which at least would be indivisible; benefiting members in proportion to their transactions with the cooperative; and supporting other activities approved by the membership".

**4) Autonomy and independence**

Following the International Cooperative Alliance the "Cooperatives are autonomous, self-help organisations controlled by their members. If they enter into agreements with other organisations, including governments, or raise capital from external sources, they do so on terms that ensure democratic control by their members and maintain their cooperative autonomy".

In the Directive (EU) 2018/2001 the Renewable Energy Community (REC) "should be capable of remaining autonomous from individual members and other market actors that participate in the community as members or shareholders, or who cooperate through other means such as investment". Therefore, in both cases the autonomy principle is included.

**5) Education, training and information**

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"Cooperatives provide education and training for their members, elected representatives, managers, and employees so they can contribute effectively to the development of their co-operatives. they inform the general public - particularly young people and opinion leaders - about the nature and benefits of cooperation".

Therefore, one important purpose of energy cooperatives is to provide information about energy and mainly about renewable energy. This is also an objective for RECs.

**6) Co-operation among co-operatives**

This principle is mainly related to cooperatives as they "serve their members most effectively and strengthen the cooperative movement by working together through local, national, regional and international structures".

**7) Concern for community**

A classical company is rarely concerned by the development of the community and the territory where it exercises. Both RECs and cooperatives "work for the sustainable development of their communities through policies approved by their members".

## 4.3. Energy cooperatives business models

Even if cooperatives are companies that can operate in different sectors and with different business models, in the following sections the characteristics that are particular to cooperatives will be highlighted as well as the business models that these characteristics allow. First, updated definitions of the business model concept are presented. Based on these definitions, the particularities of the cooperatives are listed. Lastly, some specific business models' typologies are presented.

### 4.3.1. Specific attributes of the cooperatives from a business model point of view

Energy cooperatives are companies that can operate in different domains of the energy value chain. Cooperatives are mainly active in the generation domain, including electricity production and thermal applications. These generation units are mainly based on renewable energy practices.

Besides, the more and more cooperatives develop an activity as retailers. In both cases, members of the cooperative are at the same time investors and producers or investors and consumers. In some case they can be investors, producers and consumers at the same time.

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Based on this complex role of the cooperative member; the generation units are evaluated following a larger array of criteria compared to classical investors. The result are more sustainable projects and better distributed economic benefits. Besides, it also increases the social acceptance for renewable generation units. From a consumer point of view, the fact of applying transparency on the financial practices, allows a clearness in the energy price policy.

Several energy cooperatives have developed specific energy services linked to energy information and training activities or actions related to energy efficiency.

An interesting domain that some energy cooperatives have recently developpe are the services related to “flexibility” and “Demand Response” domains. Even if there are many companies positioning their business models within this domain, cooperatives can have several advantages as their members are investors and consumers at the same time. Therefore, flexibility actions can be obtained not only based on financial compensations but based on education and trust.

Lastly, the more and more cooperatives develop sharing systems which are directly related to the energy domain. Collective self-consumption generation systems can be included in this area, as well as the electric mobility projects. Indeed, the more and more cooperatives develop original business models that embeds renewable energy, electric mobility and vehicle sharing platforms.

#### 4.3.1.1. Regarding the business model blocks

From a business model point of view this fact modifies the “value proposition” concept. Indeed, cooperatives rarely create one single value proposition and often value propositions are in line with the cooperative principles listed in the former section.

From a “revenue model” point of view, cooperatives do not maximise the internal revenue stream but focus on an economic balance that allow environmental and social gains. Indeed, while classical energy companies are based on selling as much energy as possible, cooperatives support energy reduction through simplicity and efficiency. Moreover, cooperatives will consider the revenue stream of the communities and the economic situation of its members.

A valuable characteristic of cooperatives is the important number of volunteers that participate in the value creation process. Based on this fact, it makes no sense to make a

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difference between “partners” and “customers”. Indeed, while all the members are also investors, some of them go further and offer their skills and their time to the main activities of the cooperative. This voluntary work is also observable within the activities related to the “customer relationship” activities. Looking for new members or ensuring “customer” services are often accomplished by cooperative members in a volunteer manner. This fact modifies substantially the cost model of a cooperative company which can include “value propositions” that other companies cannot afford.

#### 4.3.1.2. Beyond the economic business model canvas

While the economic business model canvas is worldwide used to explain the main characteristics of a company’s business model; the cooperative pattern requests a larger framework to enumerate all its characteristics. With this aim, two additional canvas are presented based on the work of (Joyce and Paquin, 2016).

- Environmental Life Cycle Business Model Canvas

From environmental point of view, energy cooperatives are currently a main actor in the energy transition from uranium and fossil-based energy system to a renewable based system. This has been the main motivation for the creation of numerous cooperatives. Besides, cooperatives usually tend to propose very distributed generation units, reducing the size of the installations and increasing the acceptance of citizens.

Beyond the electricity and thermal applications; environmental criteria are followed closely by the members of the cooperatives who can demand a rigorous environmental assessments of the energy generation systems; for example demanding labelled photovoltaic panels manufactured in Europe. The environmental assessment includes the materials that are used but also productions means used in the manufacturing process.

Environmental benefits can also be found in the downstream area. In the use phase of the energy, cooperative members are more likely to reduce the energy consumption for the same function.  The access to information and training assured by the cooperative, allows the member to modify their behaviours in order to avoid unnecessary energy expenses or to increase the energy efficiency.

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- Social Life Cycle Business Model Canvas

From a social point of view, energy cooperatives main difference is their contribution to the local community. As described in the chapter related to the cooperative principles, the community issue is included in most of the energy cooperative's missions. The link with local communities can be even stronger when the energy cooperative has a geographic restriction. Indeed, some energy cooperatives have defined a restricted geographical scope to perform their activities.

Closely linked to the local community attachment; the energy cooperatives are characterised by a democratic control of its members; which is often materialized by specific governance patterns. Very often, energy cooperatives emerge from groups of citizens that act at a local level and define a management model that allows the participation of all the members. Unlike other companies, cooperatives apply the one-member-one-vote principle for decision taking processes.

Therefore, cooperatives can propose "social value" by enhancing citizen participation and promoting democratic control of energy companies. Moreover, "social value" can also be materialized by the development of specific training activities or mechanisms to reduce energy poverty.

## 4.3.2. Typology and examples of cooperative business models

As explained hereabove, cooperatives are companies that can operate in different sectors and with different business models, in the following section, six typologies of energy cooperatives business models are presented which include features that are specific to energy cooperatives.

### 4.3.2.1. Typology of cooperative business models

Based on document named "Report on Business Models" from the REScoop 20-20-20 project (Rijpens, Riutort and Huybrechts, 2013), in the following section six typologies of business models are presented. As explained in the former chapter, REScoops are not always developed within a legal status of cooperative but it is necessary to agree to the principles of the International Cooperative Alliance.

The following Business Models (BM) are based on the combination of quantitative and qualitative analysis performed in the frame of this REScoop 20-20-20 project:

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***BM1 - Local group of citizens:***

The BM1 REScoop is born from a group of citizens in a bottom-up approach with the motivation to fulfil a need they have identified. The REScoop keeps a small size and develops small local projects, such as solar panels or a watermill. The REScoop mainly functions on volunteering without employees. They have a limited capital and the financial resources mainly come from the members (shares, loans). Typically, a group of citizens who decide to renovate a watermill in their village in order to produce electricity enters in this category.

***BM2 – Regional-national REScoop:***

The BM2 REScoop is either born from a group of citizens that has scaled up or from an external initiative that gathered the relevant actors together. The motivation was either to meet specific needs or to take up opportunities. The objective is to develop a mix of activities and/or to be active on various energy sources. They generally develop different projects at a regional or national level with different production sites. They function with volunteers as well as employees for the operational issues. The financial sources are more diversified and they develop partner relationships on different matters. Typically, a REScoop that develops photovoltaic projects and wind projects at the level of a country enters in this category.

***BM3 – Fully integrated REScoop:***

The BM3 REScoop is a fully integrated business model in terms of services: production, supply, distribution when possible, and other services. This is an advanced model that results from a quite long organizational trajectory. The objective here is to function independently on the different dimension of energy provision. These REScoops function with employees as well as with volunteers. Typically, the grid-owning cooperatives, such as the old Italian energy cooperatives or EWS, enter in this category.

***BM4 – Network of REScoops:***

The BM4 REScoop business model is a network or a group of REScoops. A REScoop developer or incubator puts venture capital in new project and develops autonomous REScoops at the local level on the same business model. The scaling up strategy relies on the replication of a proven and successful organizational scheme in various localities, which permits scales of economies, time and energy in developing the projects. They also

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develop the same types of partnerships, both at the local and meso levels. Typically, this is the Business Model implemented by Energy4All.

***BM5 – Multi-stakeholder governance model:***

The BM5 REScoop is what can be called a multi-stakeholder governance model. The REScoop gathers all the stakeholders who have a role to play in the provision and consumption of renewable energy (consumers, producers, workers, communities, partners) through a complex governance structure. The REScoop governance model can be organized at the local level (with local multiple stakeholders) or at the level of a territory with a pyramidal structure from the local to the territory level. Typically, this is the business model of Enercoop.

***BM6 – Non-energy-focused organization:***

This category includes different types of projects initiated by a local actor whose main focus is not energy production or supply. Typically, existing cooperatives (such as farmer cooperatives), local education institutions or nonprofits developing a citizen-based renewable energy activity as a side project complementary to their activities enter in this category. Community organizations responding to different needs within the community (energy but also housing, mobility, education, etc.) are also typical of this model. The funding is then provided by the host organization, either through its own funds or through a larger contribution of citizens or other stakeholders. The renewable energy project can serve energy saving purposes but it can also be a vehicle for education and awareness-raising (for instance when schools or other local institutions want to concretely showcase how the energy transition they advocate for can become a reality).

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# 5. Levelized Cost of Energy LCOE

## 5.1. The idea of the LCOE approach

The LCOE approach is used as a benchmark to assess and compare energy generation costs of different energy technologies (Hansen, 2019). The LCOE expresses the total cost of building and operating a power plant over an assumed lifetime when generating energy. There are different ways to calculate the LCOE, either by use of the net present value method or the annuity method (Kost *et al.*, 2018). Two examples how to calculate the LCOE are shown in figure 1.

$$LCOE = \frac{I_0 + \sum_{t=1}^{n} \frac{A_t}{(1+i)^t}}{\sum_{t=1}^{n} \frac{M_{t,el}}{(1+i)^t}}$$

| | |
|---|---|
| LCOE | Levelized Cost of Electricity in EUR/kWh |
| $I_0$ | Investment expenditure in EUR |
| $A_t$ | Annual total cost in EUR per year t |
| $M_{t,el}$ | Produced amount of electricity in kWh per year |
| i | Real interest rate in % |
| n | Economic lifetime in years |
| t | Year of lifetime (1, 2, … n) |

Figure 11a

$$LCOE = \frac{\sum_{t=1}^{n} \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E_t}{(1+r)^t}}$$

where:

| | |
|---|---|
| LCOE | = average lifetime levelised electricity generation cost |
| $I_t$ | = investment expenditures in the year *t* |
| $M_t$ | = operational and maintenance expenditures in the year *t* |
| $F_t$ | = fuel expenditures in the year *t*, which is zero for PV electricity |
| $E_t$ | = electricity generation in the year *t* |
| *r* | = discount rate |
| *n* | = financial lifetime of the calculation |

Figure 11b

Figure 11 Examples to calculate the LCOE for new plants. Source: 11a) Kost et al. 2018, 11b) Jäger-Waldau 2019

## 5.2. Literature review: Evaluation of LCOE as an indicator for comparison of power generating technologies

Studies cite LCOE as a "convenient summary measure of the overall competitiveness of different generating technologies" (Ram *et al.*, 2017; Ueckerdt *et al.*, 2017; EIA, 2020). "Internationally recognized" (Kost *et al.*, 2018) and "generally accepted" (Fallmann *et al.*, 2015), the LCOE approach is applied in research as well as in political decision-making processes, for instance in the context of subsidy programs for renewable energy technologies (Hansen, 2019).

Nevertheless, the approach is questioned by many authors and assessed as unsuitable to compare power generating technologies. (Hansen, 2019) analysed critical contributions to the LCOE approach and found, that it mostly relates to "the lack of comparability and transparency for calculating costs due to different assumptions and methods". Further, the approach was evaluated as too static, not considering uncertainties. "Incentives, including state or federal tax credits, also affect the calculation of LCOE. As with any

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projection, these factors are uncertain because their values can vary regionally and temporally as technologies evolve and as fuel prices change”, notes EIA (2020). (Laura Malaguzzi Valeri, 2019) summarizes: “LCOE is not useful to compare the costs of technologies if non-measured costs differ significantly or if the technologies provide different services to the electricity system”. Generally speaking, the factors which are necessary for a comprehensive evaluation and comparison of energy technologies are much more complex than those usually included in the formula determining the LCOE.

These factors which are usually not considered in the determination of the LCOE include “socio-ecological externalities” (Ram et al. 2017). Current studies take the price of $CO_2$ into account (comp. Ram et al. 2017, comp. Kost et al. 2018), but it represents only a fracture of the actual external costs incurred. The insufficient attention to health and ecological risks leads to the fact that for instance nuclear energy scores favourably when compared with other generation techniques by use of LCOE (comp. Hansen 2019, comp. Ram et al. 2017, comp. Fallmann et al. 2015). Further, costs for transfer and distribution of energy are not included in most of the LCOE calculations (comp. Ram et al. 2017). Other missing factors that particularly affect renewable energies are variability and integration costs (comp. Ueckerdt et al. 2013) as well as flexibility and utilisation effects, balancing costs and grid costs (comp. Jäger-Waldau: 2019). The provision of energy at a certain time of day and year is crucial, and it is well known that a “unit of electricity is more valuable if it is produced when demand is high and alternative sources of generation are expensive“ (Malaguzzi Valeri 2019).

In order to improve the LCOE method, several approaches of correction have been suggested, for example by adding a second parameter to be calculated, like the WACC (wighted cost of capital) which is proposed by Jäger-Waldau (2019) or the LACE (levelized avoided costs of electricity), mentioned by IEA (2020). Other authors as Ram et al. (2017) include additional external costs to the LCOE or introduce a specific factor to value RES (comp. Hansen 2019).

In general, LCOE is a measure that breaks down the estimated costs of energy technologies to one single value. On the one hand, the resulting reduction in complexity allows a simple assessment and comparison. On the other hand, the LCOE metric remains a static value, highly limited in the realistic representation of the true costs of electricity systems and “will provide answers that are simplistic rather than simple” (Malaguzzi Valeri 2019). As

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an alternative approach, Malaguzzi Valeri (2019) proposes to more focus on "increasing the transparency of more complex analyses and clearly communicating how systems with different technology mixes fare across the multiple goals of electricity services: affordability, sustainability and reliability."

## 5.3. Why is the LCOE approach not suitable for the comparison of cooperatives, crowdfunders and aggregators throughout Europe?

Within this deliverable, we aimed to survey the competitiveness of our case studies compared to other energy-producing companies. This was meant to be done by comparing recent cooperative-specific LCOE vs. country-specific LCOE, separating different types of renewable energy. According to Kost et al. (2018), the following parameters mainly determine the LCOE of renewable technologies: Specific investment cost, local conditions, operating cost, lifetime of the plant, financing condition.
In the course of the work we noticed that firstly, the complex determination of the LCOE would exceed the project's capacities and secondly, the LCOE will not allow us to distinguish between cooperatives or other energy producers. Due the fact that the LCOE approach does not seem suitable for our purpose, and, as the literature review shows, the method itself is not free from criticism, we decided not to adhere to this survey.

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