newcomers
EXPLORING NEW ENERGY COMMUNITIES

New Clean Energy Communities in a Changing European Energy System (NEWCOMERS)

Deliverable 2.2.

Typology of new clean energy communities

Version: 1.0

WP2: Theoretical framework, typology and case study guidance

Author(s): Maša Mlinarič, Nina Kovač, Jacob Barnes, Nancy Bocken

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Document information

Delivery Type	Report
Deliverable Number	D2.2
Deliverable Title	Typology of new clean energy communities
Due Date	31 December 2019
Submission Date	31 December 2019
WP/Task related	T2.2
Work package leader	Nicolien van der Grijp (VUA)
Author(s)	Mlinarič, M. et al.
Name (Partner organisation)	GEN-I d.o.o.
Reviewer(s)	Sarah Darby (UOXF), Jenny Palm (LU)
Keywords	Typology, business models, emerging energy services, energy communities
Dissemination level	Public
Project coordinator	Julia Blasch (VUA)
Project manager	Ruud van Ooijen (VUA)
Contact details	Ruud van Ooijen r.van.ooijen@vu.nl
Cite as	Mlinarič, M. et al. (2019). Typology of new clean energy communities. Deliverable D2.2 developed as part of the NEWCOMERS project, funded under EU H2020 grant agreement 837752, December 2019.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Revisions

Version	Date	Author	Status
0.1	12.09.2019	Maša Mlinarič, Nina Kovač	First draft
0.2	11.11.2019	Maša Mlinarič, Nina Kovač	Second draft
0.3	15.12.2019	Nina Kovač	Third draft
1.0	20.12.2019	Maša Mlinarič	Final

Reviews

Version	Date	Reviewer	Review Title
0.3	18.12.2019	Sarah Darby	Review 1
0.3	17.12.2019	Jenny Palm	Review 2

Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

Disclaimer

This deliverable reflects only the authors' views and the European Union is not responsible or liable for any use that might be made of information contained therein.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Summary of NEWCOMERS

In its most recent Energy Union package, the European Union puts citizens at the core of the clean energy transitions. Beyond policy, disruptive innovations in energy sectors are challenging the traditional business model of large energy utilities. One such disruptive, social innovation is the emergence of new clean energy communities ("newcomers"). The possible benefits of these "newcomers" for their members and for society at large are still emerging and their potential to support the goals of the Energy Union is unclear. Using a highly innovative holistic approach – drawing on cutting edge theories and methods from a broad range of social sciences coupled with strong technical knowledge and industry insight – the NEWCOMERS consortium will analyse European energy communities from various angles. By taking an interdisciplinary approach and through employing co-creation strategies, in which research participants are actively involved in the design and implementation of the research, the NEWCOMERS project will deliver practical recommendations about how the European Union as well as national and local governments can support new clean energy communities to help them flourish and unfold their potential benefits for citizens and the Energy Union.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Summary of NEWCOMERS's Objectives

As subsidiary objectives, the NEWCOMERS project aims to

- provide **a novel theoretical framework based on polycentric governance theory**, combined with elements from social practice theory, innovation theory and value theory, in which the emergence and diffusion of new clean energy communities can be analysed and opportunities for learning in different national and local polycentric settings can be explored;

- develop a **typology of new clean energy community business models** which allows to assess the different types of value creation of "newcomers" as well as their economic viability and potential to be scaled up under various conditions;

- identify the **types of clean energy communities that perform best along a variety of dimensions**, such as citizen engagement, value creation, and learning, and their potential to address energy poverty, while being based on sustainable business models;

- investigate the **regulatory, institutional and social conditions**, at the national and local level which are favourable for the emergence, operation and further diffusion of new clean energy communities and enable them to unfold their benefits in the best possible way;

- explore **how new clean energy communities are co-designed with their members' (i.e. citizens' and consumers') needs**, in particular whether new clean energy communities have the potential to increase the affordability of energy, their members' energy literacy and efficiency in the use of energy, as well as their members' and society's participation in clean energy transition in Europe;

- deliver **practical recommendations based on stakeholder dialogue** how the EU as well as national and local governments can support new clean energy communities to make them flourish and unfold their benefits in the best possible way;

- offer citizens and members of new clean energy communities **a new online platform 'Our-energy.eu'** on which new clean energy communities can connect and share best practices and interested citizens can learn about the concept of energy communities and find opportunities to join an energy community in their vicinity.

Find out more about NEWCOMERS at: https://www.newcomersh2020.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

NEWCOMERS Consortium Partners

Logo	Organisation	Type	Country
	Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam (VUA)	University	The Netherlands
	International Institute for Industrial Environmental Economics (IIIEE) at Lund University (LU)	University	Sweden
	Environmental Change Institute (ECI), University of Oxford (UOXF)	University	United Kingdom
	Institute of Social Sciences, University of Ljubljana (UL)	University	Slovenia
	Institute for Advanced Energy Technologies “Nicola Giordano” (ITAE), National Research Council (CNR)	Research organisation	Italy
	Leibniz Institute for Economic Research (RWI)	Research organisation	Germany
	Consensus Communications (CONS)	Private for Profit (SME)	Slovenia
	GEN-I	Private for Profit (Large company)	Slovenia

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 837752.

TABLE OF CONTENTS

SUMMARY FOR POLICY MAKERS

- The NEWCOMERS project focuses on energy communities that have adopted innovative business models.
- These communities all aim to gain value from distributed renewable energy resources, in line with the EU Clean Energy Package. There are both local and virtual communities.
- Innovation is defined broadly to include new forms of economic, social and environmental value creation.
- This deliverable provides an overview of new types of clean energy communities for the consideration of project colleagues, policymakers and practitioners.
- Business models for sustainability describe how an organization creates, delivers and captures value for its stakeholders in a just way.
- Sustainable business models have potential to act as drivers for innovation for sustainability.
- We identify five business model types that have been adopted by new clean energy communities, namely
    - Local renewable energy generation and supply
    - Innovative contracting and community-based products (including e-mobility)
    - Community energy storage
    - Peer-to-peer energy trading platforms
    - Community energy aggregator business models.
- Each is described in terms that highlight the significance of actors/stakeholders as integral parts of an energy system.
- We emphasise the significance of pioneering new energy communities as sites for learning and identify potential for learning for all stakeholders, from the individual energy user to the high-level policymaker.
- The new energy community business models represent a potential for new ways of incorporating distributed renewable energy resources into existing (energy) communities and empower the citizens to become prosumers.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

1 EXECUTIVE SUMMARY

Regulatory changes in the European energy markets as well as the emergence of new technologies for Distributed energy resources (DERs)[1], storage and demand response, have brought about the emergence of new energy services business models. These developments also heavily influence the development of services, which energy communities offer to their members. Some examples for new business models that influenced the business models of energy communities, mostly for electricity generation and storage, are those for peer-to-peer electricity trading systems, micro-grids and grid-connected energy storage. Decentralised or distributed generation represent one of the main advantages of new energy community business models, which also offer potential for innovative energy services (Moroni et al., 2019a; Moroni et al., 2019b; Pichler et al., 2019; Adu-Kankam and Camarinha-Matos, 2019; Nardelli et al., 2019; Scheller et al., 2018; Li et al., 2018).

In the NEWCOMERS project, the research focus lies on energy communities that have adopted innovative business models, with innovation being defined broadly to include new forms of economic, social and environmental value creation.

Business models for sustainability describe how an organization creates, delivers and captures value for its stakeholders in a way that supports a safe and just operating space for humanity and all living entities to flourish (Kennedy & Bocken, forthcoming). They have the potential to act as drivers for further innovation for sustainability in business by taking a holistic view on how business is done (Stubbs and Cocklin, 2008). Clean energy business models can be categorized as a type of sustainable business model, which brings together social, economic, and environmental benefits to the stakeholders involved.

In this paper, we set out five emerging business model types adopted by clean energy communities, namely:

- community micro-grids,
- innovative contracting and community products,
- community energy storage,
- peer-to-peer energy trading platforms
- community energy aggregator business models.

For each of these business models, the *value proposition*, *value creation and delivery* and *value capture* are described, combined with an assessment of *the learning potential* and *the potential for wider impact in the community*.

The new energy business models represent a potential for new ways of incorporating distributed renewable energy resources into existing (energy) communities and empower citizens to become prosumers, active in their energy production and distribution, and to contribute to system stability and sustainability through demand response and conservation. We note the significance of different human actors/stakeholders in each business model.

[1] Distributed energy resources' (DERs) is commonly used to cover both conventional and renewable energy resources used for power generation that is connected to medium- or low-voltage distribution networks, as well as demand and storage socio-technical configurations that may be utilised to balance electrical supply and demand in real time.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

These new business models have the potential to create economic, environmental, technological, political and social benefits for the community that adopts them. Value is therefore assessed in social and environmental terms as well as in economic terms.

Finally, this paper assesses each type of business model in terms of its potential for learning, within the energy communities themselves and for utilities, policymakers and wider society. Through careful analysis, this project aims to capture and disseminate some of this learning from a range of new clean energy communities.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

2 INTRODUCTION

2.1 Background

Innovative forms of energy communities and their underlying new business models are at the heart of the NEWCOMERS project.

The project promises to contribute to national policy making in line with the EU's Clean Energy for All Europeans legislative package. As distributed energy resources (DER) are occupying a more and more prominent role in the energy sector and regulatory frameworks were changed accordingly, traditional energy service providers, but also traditional energy communities, were confronted with the need to develop new business models. The new energy services sector is facing a growing energy demand and has to adapt to the needs of consumers who are taking a more active role in energy consumption, generation and storage. In the light of these developments, a more thorough understanding of emerging energy business models is needed.

2.2 Role of this deliverable in the project

The aim of this deliverable is to set out, explore and develop a typology of emerging business models that are adopted by energy communities. The typology was developed on the basis of the three pillars of business model design, namely *value proposition*, *value creation and delivery*, and *value capture*. The potential for wider impact of new energy community business models was also assessed.

We envisage three sets of users for this deliverable:

a) The typology resulting from the analysis carried out in this deliverable will serve as an underlying framework for *NEWCOMERS colleagues* to use in producing future deliverables and will be beneficial for a better understanding of the new business models that are emerging in a changing energy sector. It will encourage a better understanding, overview and structure of the variety of activities that energy communities across Europe currently undertake.

b) The typology will benefit policy-makers in providing background for the development of policy instruments and could serve as guidance in the process of structuring regulations / laws in order to push the development of the most effective energy community business models. It could also be used as a tool do detect and incentivise successful business models of energy communities from the governmental and European standpoint.

c) The developed typology should benefit practitioners in facilitating a shift to more effective business models for energy communities, provide them with guidance and help them to link the theoretical concept of business models to the practical transformation mechanisms that are emerging for new clean energy communities, such as skill development, technology selection and regulations. Energy communities can use one or a selection of business model types for shaping their own transformations, which are envisaged to provide assistance in exploring new ways to create and deliver sustainable value, and to develop business model structure by providing guidance to realise new opportunities.

There is a great deal of uncertainty about processes and outcomes of energy transition, but this typology is offered as an analytical tool that can be used in conditions of uncertainty to assist with analysis and policy development.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

2.3 Approach

The typology is based on a literature review that focuses on understanding of different energy communities' business models and their characteristics.

Previous work has combined literature and business practice review using an iterative approach to develop sustainable business model archetypes (Bocken et al. 2014) and business models for distributed energy resources (Burger and Luke, 2017).

2.4 Structure of the document

The deliverable is structured in three distinct parts. In the first part, we define and describe the theoretical framework underlying business models of clean energy communities and what their main characteristics are. In the second part, the methodology used for the construction of the typology is presented and the criteria for the typology are defined. In the third part, we present some developed types of emerging business models in energy communities.

3 BUSINESS MODELS OF NEW CLEAN ENERGY COMMUNITIES

To understand the emergence and benefits of innovative clean energy communities, it is important to understand which key characteristics distinguish them from more traditional energy communities, what trends underlie the emergence of these key characteristics, and how these enable new value creation. The distinguishing characteristics can be identified by carving out their similarities, differences, and by establishing broader groups of distinct types. Such a structuring and classification is important in order to have an overview of the energy community business models that can currently be observed and to have the possibility of studying and incentivising the types that are efficient, sustainable and have the potential to yield long-term positive results.

In this chapter, we will describe the business models by energy communities, their drivers, and sustainable innovation. In the next chapter, we aim to find overarching types that combine single cases into distinct types of emerging energy service business models. This will lay the ground for the research that is carried out in the work packages dedicated to the case study research (WP4, WP5 and WP6).

WP4 will mainly focus on the new business models developed by energy communities that will, with a series of in-depth case studies, analyse their emergence, operation and future potential. WP5 will then take a deeper look into one or two of these case study communities to empirically examine whether membership affects daily electricity use and which types of pricing, information or engagement are promising to stimulate energy conservation or demand response. Finally, the work in WP6 will examine the potential of energy communities to meet consumer needs and their values, to tackle energy poverty and increase energy literacy. In doing so the WP6 will address potential opportunities and barriers to the diffusion of energy communities from the perspective of energy community members.

To carry out the above research with the case study communities efficiently, it is worth to take a step back and analyse the business models currently adopted by energy communities. This allows developing a deeper understanding of their features, which can then be incorporated in a framework that enables accurate assessment of profitability and value creation. New clean energy communities ("newcomers") are forms that diverge from traditional energy communities in at least one of the following respects: scope, purpose, technologies, origin, actors and mode of operation.

Clean energy communities within the NEWCOMERS project are defined as *"Associations of actors engaged in energy system transformation for reduced environmental impact, through collective, participatory, and engaging processes and seeking collective outcomes"*.

In this same context, new energy community business models can be considered as *"All types of emerging business models that provide a service and therefore value (broadly defined) to energy users, energy companies, energy systems and/or wider society"*. As pointed out in Deliverable D2.1 (Theoretical framework focusing on learning in polycentric settings), they are *"initiatives that combine the characteristics of community energy initiatives and new energy service business models, and could be characterized by a greater diversity of participating actors, leading to different types of partnerships and coalitions between citizens, industry and municipalities. Furthermore, they often involve the use of innovative and smart technologies and aim to create new values for their members and society that go beyond the joint production of renewable energy"* (Grant Agreement, p.8). They can often be considered to lie at the intersection of community energy projects and new energy service business models.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

3.1 Emerging energy service business models by clean energy communities

A variety of new business models can be identified and categorised by the services they provide, the customer segments they target, and the revenue streams that they leverage. They are emerging in response to societal mega-trends (decarbonisation, decentralisation and deregulation, also known as 3D of the energy transition) and EU-level policies. Consumers' economic and social roles have fundamentally changed as a result of globalisation, demographic shifts, technological developments and regulatory reforms. For instance, in 2016 the European Commission recognized for the first time, in a proposed legislative measure of the Clean Energy Package, the role of community-based energy projects in the energy transition. With regard to self-consumption the Internal Electricity Market Directive (IEMD) states that citizen's energy communities shall be treated like active customers. With the availability of cheaper technology and the rise of digital markets, consumers can actively participate in markets and also offer their own services or self-/co-produce products and services (Cseres, 2018). Active consumers are fundamental building blocks of the European Union's goal to achieve smart, sustainable and inclusive growth in Europe[2].

The classical energy system business model involves the reliable and universal sale of energy at reasonable prices by utilities to consumers. Information flows (billing information from utilities to consumers) and revenue flows (from consumers to utilities) are usually unidirectional and in that sense the consumer plays a predominantly passive role. This kind of market is described as the "Utility business model" (Lynch et al., 2016). However, through the current development in the energy sector and the new, more active role of the consumers, these business models are rapidly changing. The corporate national utility business model makes little space for growth of small to medium scale generators, disincentives local demand side services and is poorly matched with delivering households' and SME's energy efficiency goals. The large utilities constitute the bulk of generation and supply, and endeavour to match their generation profiles with their forecast demand, topping up from or selling into the wholesale market to tune their supply positions (Hall and Roelich, 2016). These new business models involve the use of innovative and smart technologies, a greater diversity of participating actors, new partnerships and coalitions, as well as new relationships between producers, consumers, networks and infrastructure.

The traditional energy industry business models are centralised and the consumers pays for the energy consumed and the usage and the services of the grid (Bellekom et al., 2016). A shift to the new clean energy community models will see a strengthened role of communities, cities and municipalities. This will require the shift of energy supply from mass production to mass customization, aiming to produce goods and services to better meet the individual customer's needs within the broader context of overall industry outcomes. This development is supported by smarter network infrastructure that connects smaller and dispersed generation plants to create more open and cleaner energy communities (Gui and MacGill, 2018). Along the same lines, also the role of the consumer changes. The conceptual shift from the traditional consumer to the concept of prosumers, which have an active role in the process of generating, storing and using energy, will build the foundation for new revenue streams for companies (Lynch et al., 2016). The switch from the passive consumer to a prosumer requires consumers to understand why they need to engage, where to engage and how they can engage in the process of energy supply and use (Massey et al., 2019). The consumer becomes a prosumer when they are able to offer flexible load and/or generation resources

[2] Communication from the Commission, "EUROPE 2020 A Strategy for smart, sustainable and inclusive growth" (03.03.2010) COM(2010) 2020 final, para. 3.1; Communication from the Commission, "Single Market Act Twelve levers to boost growth and strengthen confidence 'Working together to create new growth'" (13.04.2011) COM(2011) 206 final, para. 2.4; "Boosting confidence and growth by putting consumers at the heart of the Single Market" 22 May 2012, COM(2012) 225 final.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

to the system (Hayes et al., forthcoming). This clearly shows a movement from a passive recipient of energy to a somewhat more empowered and integral value chain participant offering flexibility (Lynch et al., 2016; Brown et al., 2019).

New energy community business models could be defined as all emerging business models that provide a service and therefore value to energy users, energy companies, energy systems and/or wider society. Fell (2017) defines "energy services as those functions performed using energy which are means to obtain or facilitate desired end services or states" (Fell, 2017, p. 137). A definition might encompass start-up companies developing peer to peer energy trading platforms, the move from Distribution Network Operators (DNOs) to Distribution System Operators (DSOs), commercial firms managing distributed storage facilities and competing in national power system balancing markets, and similar. These new business models are being developed by existing energy companies, start-ups, spin-off companies, engineers, entrepreneurs and municipalities as well communities. Based on the reviewed literature, the energy services that these energy communities provide can be split into three distinct groups (Moroni et al., 2019a): a) Purchasing energy as a collective group, b) managing demand and supply, and c) generating energy.

The differences in the emerging energy services can be described on continuums from large-scale to small-scale production, local versus centralised, integrated versus autonomous, bottom-up to top-down, grid-integrated to off-grid, single-purpose versus multi-purpose, place-based versus non-place based/virtual, etc. Energy services can create value with the use of smart and innovative technologies or through social and commercial objectives. Decentralised systems thus multiply the possibilities for citizens and small-scale participation in the energy transition (Brown et al., 2019).

3.1.1 A typology that emphasises learning, to build up the knowledge base

Hicks and Ison (2018) have focused on identifying motivations underlying community energy projects, distinguishing between political, social, economic, environmental, and technological factors. We propose a typology building on the previous ones, but with the specific aim of linking the characteristics of new energy communities with different types of *learning*. Learning within and between energy communities is an important focus of the NEWCOMERS project. More specifically, it is aimed to link the characteristics of new clean energy communities and their settings with various types of learning. Various types of learning are expected, notably

- cognitive learning (the acquisition of new factual information), which is important in environmental governance for bringing advocacy and understanding feedback systems (Haug et al., 2011; McFadgen, 2019);
- normative learning (a change in priorities assigned to certain norms and values), which results in changes of perspectives, goals, or priorities, important for the development of common interests and goals, resulting in political consensuses and collective-action (Haug et al., 2011; Gerlak et al., 2019)
- relational learning (a change in levels of trust and understanding between actors), which results in changes in trust, ability to cooperate, and understanding of other stakeholders' ideas and values (Haug et al. 2011).

Bauwens (2017) argues that community-based energy initiatives foster the conditions for experimentation and creativity, exhibit informational benefits by encouraging the use of local knowledge, enable feedback on the performance of rules, enhance the conditions for cooperation and reciprocity between participants, and lower enforcement costs by strengthening local perceptions of the legitimacy of rules.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

The value creation of energy communities can be defined as the way, the energy communities are creating value for their customer and stakeholders. The important part on energy communities are the other aspects that create value and can broaden the traditional only economical value. Value creation or motivation driving renewable energy projects can be split into five distinct fields, namely (Hicks and Ison, 2018):

- Economic value creation that represents the classical view on value creation with the monetary benefits for customers and shareholders, optimization of processes in order to lower the production or storage cost, creating local jobs and contracts, community and shareholder income etc.
- Environmental value creation that is mainly concerned with the sustainability, lowering the carbon footprint, use of green technologies and sources of energy and local environmental benefits.
- Social value creation that can be defined by the learning and awareness raising on this topics as well as empowerment of participants in the energy communities. It represents the active participation and social entrepreneurship of the members in the energy communities, community building and local ownership and decision-making.
- Technological value creation that represents the value created with the use of technology that helps the members to lower their carbon footprint, trade the produced electricity and empower them to be more active in their energy use and production. It also enhances the renewable energy industry development, energy self-sufficiency and increased energy efficiency.
- Political value creation that is connected mainly with the new policies that arise as a response to new energy communities and the energy services they provide. In that view the political value creation is the least tangible but can be of uttermost importance in order to create an environment, where new clean energy communities can flourish and be successful. It is a way of political mobilisation that can influence the support in the society and reduce the opposition in the society.

The NEWCOMERS project explores and evaluates new types of clean energy communities as social innovations that perform along dimensions, such as citizen engagement, value creation, and learning, while being based on sustainable business models that are attractive and accessible for a broader group of EU citizens and have the potential to be scaled-up.

Our aim is to contribute to the knowledge base to underpin the formulation and implementation of policies in order to empower the average EU citizen to actively participate in the clean energy transitions. We will do this by identifying those new clean energy community business models that combine the benefits of community energy with the benefits of self-sustained, revenue-generating business models that have the potential to be scaled up. We will identify new clean energy communities that are, on the one hand, organized in a democratic and participatory way, and hence have the potential to mobilize and engage the consumers and citizens for the clean energy transitions. On the other hand being based on sustainable, revenue-generating business models that offer value propositions that attract and enable a broader target group of citizen to participate in the clean energy transitions.

3.2 Drivers for clean energy communities and new energy services

The increasing use of unconventional energy sources is changing the blueprint of the world's energy resources (Malek and Nathwani, 2017). Technology advancement and a fast level of innovation, the application of a systems perspective, the introduction of innovative approaches to collaboration (across industry boundaries and non-industry actors) and the need for education and awareness

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

raising to facilitate adoption of new business models are topics that are emerging in the development of sustainable business models (Bocken et al., 2014).

However, community-led action on energy is not new. It has a long history dating back at least to 1970's, when alternative technologies and 'soft energy paths' were pursued (Lovins, 1979). Community-led energy activity has flourished since the turn of the century as energy systems have faced multiple external pressures such as decarbonisation, digitalisation and decentralisation. These pressures have motivated community action and opened up new opportunities for community participation in energy systems (Thiel, 2016).

Community energy encompasses a highly diverse field of activity. It includes energy generation activities (typically from renewable energy sources like wind, water and solar), energy conservation and management activities (such as draught proofing, retrofitting as well as advice programmes and support with switching), and energy awareness activities (such as programmes to increase the energy literacy of citizens). Community energy activity is typically instigated by a range of civil society groups but may also be fostered through the actions of local or national governments or through the support of businesses. Community action is typically supported through partnerships with local governments, social enterprises, charities, local businesses or energy companies (Interreg Europe, 2018).

The emergence of new clean energy communities reflects the individual community energy needs, their desires and engagement in addressing social, environmental, and economic opportunities and challenges in local energy production and use, often as a response to regulatory incentives, inadequacy of the products or services offered on the market, or deficiencies in the current electricity market (Gui and MacGill, 2018). Community initiatives lead to different outcomes and hence benefits, depending on the structures employed, processes followed, and activities pursued. The term community energy is used in a flexible way by practitioners, researchers, and policy-makers alike, to identify a broad range of energy activity, involving a diverse array of actors with multiple outcomes and benefits. This field is substantial and yet it remains a minor niche when viewed as part of existing energy system ecologies.

For most researchers, what differentiates community action from business or government action on energy, is the degree of community involvement or participation and the extent of local and/or collective outcomes or benefits. As noted above, the NEWCOMERS project defines clean energy communities as "'associations of actors engaged in energy system transformation for reduced environmental impact, through collective, participatory, and engaging processes and seeking collective outcomes.". In the literature, there are also definitions that go further. For example, clean energy communities have been defined as "social and organisational structures formed to achieve specific goals of its members primarily in the cleaner energy production, consumption, supply and distribution, although they may extend to water, waste, transportation, and other local resources" (Gui and MacGill, 2018, p.2). Concern about water or waste issues might thus also be a driver behind the development of a clean energy community.

In the NEWCOMERS project, the research focus lies on energy communities that have adopted innovative business models, with innovation being defined broadly to include new forms of economic, social and environmental value creation. Defining what we mean by business models and by different forms of value is an important early task in the project.

3.3 Definition of business models

A business model is a conceptual tool to help understand how a firm does business and can be used for analysis, comparison and performance assessment, management, communication, and innovation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

(Osterwalder and Pigneur, 2005). In the NEWCOMERS project, we define a business model in its simplest form as "sets of propositions about how actors produce and distribute value". A business model contains the information about how a company defines its competitive strategy through the design of the product or service it offers on the market, how it charges the company's costs for the production, how it differentiates itself from other companies based on the value proposition and how the company integrates its value chain with other actors in the same value network (Rasmussen, 2007).

According to Fielt (2014), a business model is defined as a representation of the value logic of an organization in terms of how it creates and captures customer value. The Cambridge Dictionary (2018) refers to business models as a description of the different parts of a business or organization showing how they will work together successfully to make money. Business models can thus be more generally defined as the elements of a business that create customer value, and hence revenues.

Bocken et al. (2014) based on Teece (2010) and Richardson (2008) define a business model by three main elements:

- *Value proposition*, which is typically concerned with the product and service offered to generate economic return. In sustainable business models, the value proposition would provide measurable ecological and/or social value in combination with economic value.
- *Value creation and delivery*, which defines how the business creates value and delivers it to its customers, which is at the heart of any business model.
- *Value capture,* which represents the consideration of the companies how to earn revenues from the provision of goods, services or information to users and customers by seizing new business opportunities, markets and revenue streams.

This definition of business models was used for the definition of energy service business models for the development of the typology.

3.3.1 Extending the concept of value

In market economies, revenue generation is often the primary, if not exclusive, value of interest. The focus in nearly all of the business model literature often fails to consider the wider societal values that the business can produce, the most basic value of which is fulfilling a societal demand (established or perceived). Historically, community action on energy has not been solely driven by revenue generation motives. Some community energy activities have purposely stayed clear of market economies and instead relied on volunteer time and effort to deliver desired outcomes. Therefore business models pursued by some community energy initiatives were not viable or attractive for private actors due to the ways of their value creation. Grants and awards have also been used to underpin a vast array of community activity on energy (Seyfang et al., 2013). Energy communities place value on more than just revenue generated from their activities, therefore environmental, social and political value, such as preference for green/local, autonomy, democratisation and social capital creation, are foregrounded over economic value (Giulietti, 2019[3]).

More recently, community action has been developing models that are financially self-sustaining. This in turn has also led to a professionalization of community activity on energy, with the majority of activity focussed on developing business models to support the management and operation of renewable generation projects rather than demand-side energy efficiency projects (Braunholtz-

[3] https://www.cerre.eu/sites/cerre/files/business_model_innovation_giulietti.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Speight et al., 2018). Revenue generation is being pushed on community energy activity. Nevertheless, an important characteristic of energy communities is also the non-monetary value. The outcomes associated with community energy as well as the benefits and therefore value of community energy is equally diverse, such as increasing social acceptance of technologies, improving the environment, strengthening the local community, building trust, creating local jobs etc. The value of energy communities goes beyond economic and financial values, and includes wider social impact, support and investment in social projects (Hicks and Ison, 2018). One of the positive impacts of energy communities is as well learning between and within the communities and the knowledge sharing on new emerging technologies and their use, energy-efficiency improvements, business insights and practical aspects of running a business and value creation through new energy services (Cameron et al., 2018). In conclusion, in the wider literature on community energy (European Commission, 2015; European Commission, 2016; IRENA Coalition 2018; Bauwens and Devine-Wright 2018; Bauwens 2017; Seyfang et al., 2013; Roberts et al. 2014; Berka and Creamer, 2018), wide varieties of benefits have been identified, including:

- Economic benefits, such as income generation, income retention, saving money on fuel bills, tackling fuel poverty, supporting the local economy, local job creation etc.
- Environmental benefits, such as reduction of carbon emissions and air pollutants, local environmental improvements etc.
- Social benefits, including increasing social cohesion, increasing trust, improvement of community wellbeing, health and education, social inclusion, changes in practices and behaviours, creating volunteering opportunities, alleviation of energy poverty, enhancement of citizens' energy literacy etc.
- Political benefits, such as greater public engagement, awareness raising, community empowerment, influence on sustainability and energy policies, community leadership etc.

3.3.2 Extending the concept of innovation

Clean energy communities are typically set up with sustainability as a goal. Sustainable development is a narrative that needs to be approached holistically. It has to be looked at as a combination and interrelated balance of social, economic and environmental aspects, which present the three pillars of sustainability, defined as the Triple-Bottom-Line in business context (the economic, environmental and social pillar) (Bocken et al., 2014). The emergence of new business models is important for sustainable development, since through eco-design and improved efficiency the intensity of energy and resources used, as well as level of emissions and waste per unit of production, can be reduced (Bocken et al., 2014). Sustainable business models can therefore serve as a tool to coordinate technological and social innovation with system-level sustainability. They consider the environment and society as stakeholders with whom they align their interests. One of the key challenges is to design business models in such a way that enables the company to capture economic value for itself through delivering social and environmental benefits (Bocken et al., 2014).

The EU project TEPSIE defines social innovation as "new solutions (products, services, models, processes, etc.) that simultaneously meet social needs and lead to new or improved capabilities and relationships and/or better use of assets and resources" (The Young Foundation 2012: 18). Hoppe and de Vries (2019) state that in the context of energy transition, social innovation can be defined as innovation that is social in its means and which contributes to low carbon energy transition, civic empowerment and social goals pertaining to the general wellbeing of communities. Social innovations are both good for society and enhance society`s capacity to act (The Young Foundation, 2012).

The need for new solutions in the social domain can be met through collaborative innovation, which includes experimenting and facilitating the exchange of ideas, mutual learning and joint action. This

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

can be achieved through replication, partnerships, and network strategies, in particular through networking among public, private and social organisation, and through open-source strategy among community actors to self-organise the sharing activities (Sørensen and Torfing, 2011). Whilst not focused on community activity per se new opportunities are emerging at local scales for new market entrants where community-based approaches may have a particular role to play in customer engagement (Brown, 2018). Also the partnership between technology actors, including utilities, and community actors however, is crucial, as the combination of technological sophistication and social innovations can create greater window of opportunity for the partnership to destabilize the existing regime and lead to a potential transformation pathway (Gui and MacGill, 2018). Systems of local and sustainable energy provision have a peculiar form being open (large) technical systems into which local technical components, business cases, skills and community goals are configured (De Vries et al. 2016). A study of De Vries et al. (2016) also shows that the innovation dynamics in sustainable energy communities are deeply connected with learning processes at the community level, whereby an evolving technical identity and community building activities provide a network of resources, which serves as a context for user innovation.

3.3.3 Business model innovation for sustainability

Business model innovation is a change in the way organisations do business rather than change in their business activity (what they do). Thus, Richter (2013) defines business model innovation as the "development of new organizational forms for the creation, delivery, and capture of value" (Richter, 2013, p.1228). The opportunities and barriers of business model innovation are of vital importance for the clean energy industry, due to the extensive presence of disruptive innovations and organizational ambidexterity (Malek and Nathwani, 2017). Business model innovation for sustainability may not be economically viable from the beginning but may become so in the future due to regulatory or other changes (Bocken et al., 2014).

Sustainable business model innovation is the "conceptualisation and implementation of sustainable business models. This can comprise the development of entirely new business models, the diversification into additional business models, the acquisition of new business models, or the transformation from one business model to another "(Geissdoerfer et al., 2018, p.407).

Bocken et al. (2014) studied various sustainable business model archetypes and found that they had the potential to *embed* sustainability into business purpose and processes. Moreover, these archetypes are suited to increase a company's ambition for innovations, to accelerate the introduction of innovations and to reduce risks of implementation through learning from practical experience.

Brocken and colleagues developed and introduced eight archetypes of sustainable business model, presented in Figure 2 (below). They aim to categorise and explain business model innovations for sustainability and to develop a common language that can be used to accelerate their development in research and practice. In the energy context, specifically, Burger and Luke (2017) also propose archetypes. They emphasize that regulators and policy makers, who play a key role in shaping models, must move towards frameworks that consider the implications of their policies for business model structure and long-term business model sustainability.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

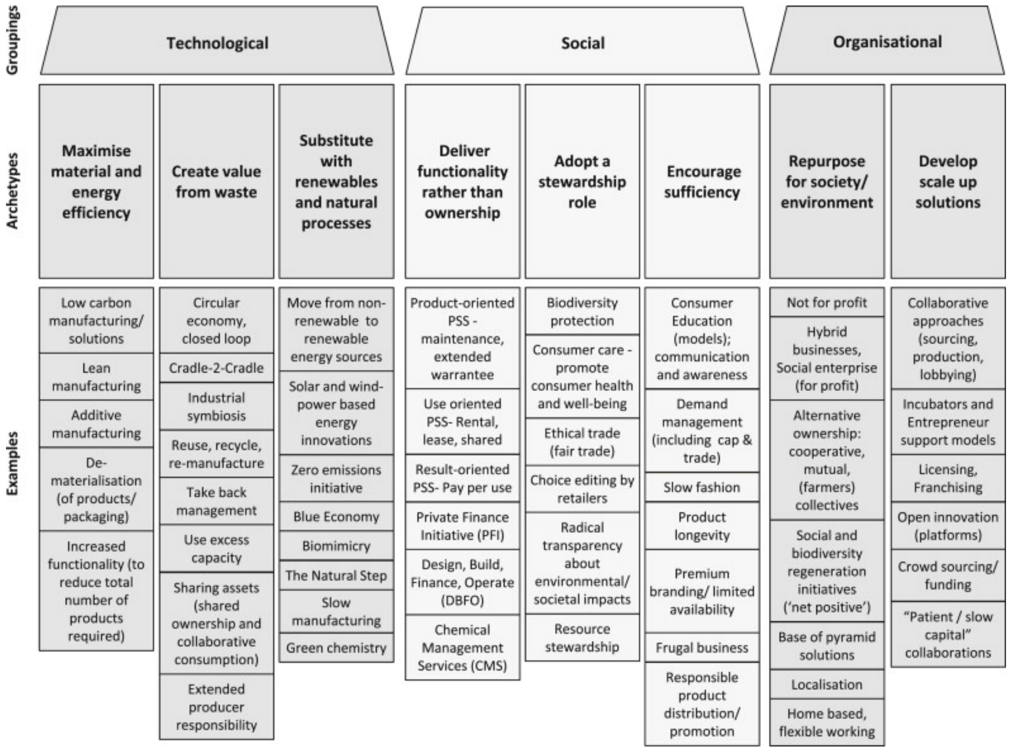

Figure 1: The sustainable business model archetypes (Bocken et al. 2014)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

4 CONSTRUCTING A TYPOLOGY OF EMERGING ENERGY SERVICE BUSINESS MODELS

In order to reduce complexity and have an overview, a typology will be constructed using the following terminology and definitions:

- *Clean energy communities,* associations of actors engaged in energy system transformation for reduced environmental impact, through collective, participatory, and engaging processes and seeking collective outcomes
- *Business models,* sets of assumptions about how actors produce and distribute value
- *Energy service business models,* any type of emerging business models that provide a service and therefore value (broadly defined) to energy users, energy companies, energy systems and/or wider society.

We propose the emerging energy community business models will include a change of scope, diverse actors and change in purpose and operation. We are interested in where these business models are compatible with, or draw on the strengths associated with, community energy. This gives us a focus at the intersection of the two spheres between community energy and emerging energy services business models.

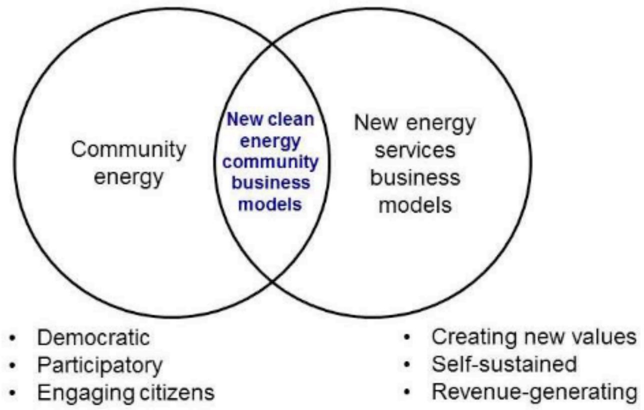

Figure 2: Visualization of the new clean energy community business models that are in the focus of the NEWCOMERS project.

4.1 Approach to typology construction

The typology draws on the existing literature on energy communities, their business models and where those business models overlap. These overlapping characteristics present the backbone of our typology.

The typology construction started with a literature search to identify the relevant articles in the scientific database and the selection into the sample. We identified the business models themes and relevant categorisations from the academic literature, and described the energy service business models through the business model framework that focuses on value proposition, value creation and delivery, and value capture (similar as the research of Bocken et al., 2014). We then focused on the emerging energy services they provide to their customers and their key activities in order to define the overarching categories of the emerging energy services business models. Based on these results, the types of business models were set out.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

4.1.1 Selection criteria

In order to find the relevant literature, selection criteria were defined. We used the Scopus search database. The keywords for the search were *energy community* and *business models* in order to have a broad range of articles to review. A query for articles from 2015 onwards returned 54 articles for review listed in Appendix I

4.1.2 Literature review

The literature was reviewed in light of the business model framework proposed by Bocken et al. (2014). We focused on the three pillars of business model design:

- *Value proposition, which* should answer the question of what value consists of and to whom it is provided. It relies on the definition of products/services, customer segments and their relationships in order to estimate the value offered to customers, other stakeholders and the environment.
- *Value creation and delivery, which* tries to answer the question about *how* value is provided, and focuses on the key activities, resources (materials, infrastructure, human and financial), partners, technology and product features.
- *Value capture*, which addresses the way in which a business makes money and captures other forms of value. It focuses mainly on cost structure and revenue streams, the value capture for environment and society, and growth strategies for the future.

Each of the articles in the final selection was reviewed based on these three pillars of business model design. If the article did not include descriptions of the business models, it was labelled as not applicable. If it included more than one business model description, each of them was labelled separately. The final sample consisted of 46 business model descriptions that were reviewed and clustered based on similarity.

As we examined emerging energy community business models, the development of the typology focused mainly on the aspect of value proposition dealing with products/services, and with the aspect of value creation and delivery describing the key activities. We focused on those two characteristics to find distinguishing differences between the described business models. All of the products/services provided and activities were analysed and clustered into groups of similar products/services/activities. This led us to the development of five business model types based on the products/services they provide and the activities they focus on. Based on these, other pillars of business model design were examined and added to the typology.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

5 TYPES OF EMERGING ENERGY SERVICE BUSINESS MODELS IN ENERGY COMMUNITIES AND THEIR LEARNING POTENTIAL

This section explains the emerging energy service business models in energy communities developed in this study. We defined five types :

1. Local renewable energy generation and supply
2. Innovative contracting and community-based products (including e-mobility)
3. Community energy storage services
4. Peer-to-peer energy trading platforms
5. Community energy aggregators

All of the emerging energy community business models in energy communities propose an active role for consumers – the role of prosumers.

In the following paragraphs, the emerging business models are described. First, there is a short description of the energy services they provide, and then we describe the models in light of the value proposition, value creation and delivery, and value capture. The learning potential and the potential for wider impact are also assessed.

5.1 Local renewable energy generation and supply

This can take a number of forms, including heat networks, individual PV or battery owners taking part in a virtual community in order to trade their generation or storage, or anaerobic digestion plants. Perhaps the most familiar form of renewable generation and supply, though, is a locally based micro-grid. Micro-grids are "a self-contained and self-sufficient local electricity supply systems, either standalone or connected to a centralized grid of regional or national scale, comprising residential and other electric loads, and can be supported by high penetrations of local distributed renewables, other distributed energy, and demand-side resources" (Gui et al., 2017, p.3). Micro-grids are private wire arrangements that have long been a solution to electricity provisions in remote areas, where the cost of the grid connection is expensive. The early examples used diesel generators, but are now tending to convert to small-scale hydro, wind and PV sources; modern micro-grids have been characterised as a combination of renewable energy resources generation, storage devices and consuming devices (Xie et al., 2019).

In these micro-grid business models, the local private network operator owns the low-voltage distribution network rather than the statutory Distribution Network Operator (DNO). The entities may also form virtual energy communities that are responsible for billing customers for the consumed energy within the private network. These models promote consumption 'behind the meter', and their aim is to share any distributed generation between the prosumers and others within the private network area. Community micro-grids can offer an improved export tariff and a lower import tariff, and can incentivise optimal consumption behaviour through time-of-use tariffs during high generation periods. They may also negotiate an improved supply tariff with a licensed supplier who takes on the responsibility for balancing and settlement (Brown et al., 2019). Balancing generation and demand at a local level can also make an important contribution to balancing at the national scale, although their priorities do not always match. It is important to connect the generation and demand at the local level when implementing demand-side measures (Hall and Roelich, 2016). Like this, homeowners and businesses are enabled to offer energy generated on-site (for example with PV or cogeneration units) to other citizens and organisations directly, without using the public grid. The product consists of this self-produced energy plus the delivery of the residual load. Its value proposition for tenants includes convenient access to locally produced and

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

community-based energy and independence from utilities. For housing companies, the model generates additional revenue and supports an eco-friendly image (Löbbe and Hackbarth, 2017).

The participants in a micro-grid system are obliged to participate and should be located in close proximity in order to be connected to the grid (Fina et al., 2019). In remote areas that are lacking grid connectivity, micro-grids offer the possibility to supply energy to the members of the community and present a way of lowering the cost of energy. Also, they minimise the life-cycle cost of energy generation (Tikka et al., 2019). The prosumers are benefiting from free electricity, provided they can self-consume at the moment of generation (Brown et al., 2019). Key motivations for community smart-grids are energy autonomy and self-sufficiency, promotion of cleaner and more sustainable electricity, more reliability and retained economic benefits in the community (Gui and MacGill, 2018).

Mini- and micro-grids, if connected to the transmission network, can inject excess power into the grid and therefore receive revenue through feed-in-tariffs (Adu-Kankam and Camarinha-Matos, 2019). In community micro-grids the resources for production and supply are owned by the community, which can derive value from these tariffs. They micro-grid owners can share renewable energy facilities and establish small-scale generating companies, which can result in the empowerment of the community participants and general community development (Adu-Kankam and Camarinha-Matos, 2019).

In general, community micro-grids are characterised as independent from the main grid although, as described above, they may still have a connection with it. In the pure form, though, prosumers are generating electricity for their own use and supplying it to other members of the community. This business model can as well connect with other business models described, in the way that it can offer additional services to the prosumers and consumers connected to the micro-grid, such as energy storage services and peer-to-peer energy trading platforms. In this business model, the energy communities play the role of the asset managers and local distribution grid managers. This represents a major change in the configuration and management of electricity systems. We should perhaps not forget that the earliest electricity systems were micro-grids!

Local renewable energy generation and supply overview

Value proposition	• Community-based energy • Some degree of independence from utilities. • Affordable self-production of electricity.
Value creation and delivery	• Renewable energy generation by the prosumers. • Supply to the members of the micro-grid. • Supplying ancillary services to the grid (peak reduction, balancing etc.) • Emergency and backup services to critical infrastructure within the community during power outages. • Renewables production, heat pumps, storage devices, energy management, smart home devices, participation in a virtual power plant to optimize self-supply.
Value capture	• Revenue streams are inside the community; boosts local economy. • Generation from non-polluting sources • Social cohesion from operating as a community
Actors involved	• All participants of the micro-grid (prosumers and consumers) • Distribution System Operators (DSOs)
Citizen engagement and benefits	• Empowerment of the members of the community • Community development • Use of smart technologies

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

	• Knowledge of local power production and supply
Learning potential	• Knowledge of local electricity production and distribution • Awareness-raising on energy production, demand and supply • Development of skills related to financing, developing and maintaining the community system • a sense of community, with members more willing to learn from each other
Potential for wider impact	The empowerment of local actors can offer a viable way of power production from renewables, which enhances knowledge on power generation and raises awareness that can reduce costs and environmental impacts in a community.

Table 1: Local renewable energy generation and supply

5.2 Innovative contracting and community products (including e-mobility)

The business model of innovative contracting and community products proposes a way of promoting sustainable energy with the involvement of the consumers on a contractual basis. Contractors are able to gain loyal customers and support regional value creation and the products for energy delivery and contracting that are adapted to new customer demands and to the regulatory framework. This is further supported by future technological opportunities, such as blockchain technology (Löbbe and Hackbarth, 2017). PV leasing and contracting means that the homeowners provide their roof surface to the contractor who installs and operates a PV unit on the rented space. This reduces the effort for the customer regarding installation and operation and corresponds to the customers' desire of being energy self-sufficient (Löbbe and Hackbarth, 2017).

Willingness to pay for flat rates tends to be higher, compared to pay-per-use tariffs, so that expected margins are higher as well. The share of fixed costs of electricity prices rises with increasing production from renewable energies. Consequently, costs are becoming more projectable, so that fixed prices can be guaranteed for longer time spans. This yields a considerable number of new products and business models. These new offers relaunch contracting products and unlock new target groups; e.g. "established conservatives" and "liberal intellectuals" seem promising due to their high homeownership rate and interest in eco-friendly, easy-to-use, and care-free solutions (Löbbe and Hackbarth, 2017) which can in turn provide more probabilities for innovative contracting and community products as a response to emerging energy services.

Innovation in smart contracting and community products is as well the incorporation of e-mobility with the diffusion of renewable energies and flexibility potential of electrical vehicles (EVs). The main challenge here lies not in the increased volume of consumed electricity but in changing shape of the load curve i.e. in the possible increase in evening demand peaks as users charge their EVs overnight. Local increases in demand peaks can require significant grid investments; hence the need for enabling technologies providing shiftable load, and a regulatory framework valuing their flexibility for the grid through so-called Vehicle-to-Grid (V2G) and smart charging solutions (https://fsr.eui.eu/electro-mobility/). Transport prosumption models are also emerging in tandem with the diffusion of EVs. These models allow prosumers to charge EVs using locally generated electricity.

Innovative contracting and community products business model overview

Value proposition	• Contracting of technology designed for self-sufficiency (lease of solar PVs, storage, cogeneration, local energy etc.). • Providing e-mobility services. • Companies are providing contractual energy services that enhance the local production and lower the cost of energy production.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Value creation and delivery	• PV, storage, cogeneration contracting • Rental of space for PVs • Sale, service and maintenance of contracts • Contracting of EVs
Value capture	• Contractual relationships (for battery, solar PV and storage leasing) with the prosumers. • Membership in the community based on the contractual relationship. • Sale of the energy systems, installation and maintenance fees for smart meters and batteries, membership fees and energy delivery.
Actors involved	• Residential and commercial customers • Prosumers • Third-party companies/providers
Citizen engagement and benefits	• Citizens and the members of the community can rent their Citizens and the members of the community can rent their spaces to generate energy from renewable resources without their direct involvement (with the involvement of a third-party company).
Learning potential	• Knowledge on the benefits of renewables production and use • Energy efficiency knowledge and awareness • Empowerment for the use of new innovative products
Potential for wider impact	Potential to offer additional services via e.g. smart home services new products and business models.

Table 2: Innovative contracting and community products business model overview

5.3 Community energy storage services

Distributed energy resources are not only supply-side resources: the term also covers demand and storage socio-technical configurations that may be utilised to balance electrical supply and demand in real time. Electric vehicles, battery storage at grid/network level, and distributed chemical and thermal storage can thus all become resources for energy systems. In this section, we concentrate on batteries but it is important to note that they are not the only form of storage available to communities.

Community energy storage is a system that is *located* within a community with defined boundaries and/or it *serves* a community. The term *community battery* often refers to an aggregation of individually owned-batteries that are managed through a central system, as opposed to one single technical system that is shared amongst residents (Fina et al., 2019).

Energy storage services can broadly be classified into five types: bulk energy, renewables integration, ancillary, transmission and distribution, and customer energy management. All these services, either alone or combined, are design elements for flexibility options that are valuable to the European energy system (Ugarte et al., 2015).

Community energy storage (CES) in the form of batteries is expected to contribute towards energy transition while accommodating the needs and expectations of citizens and local communities (Koirala et al., 2018). It refers to the means that capture or store the produced electricity for future use. Batteries do not produce new power (and incur efficiency losses) but may inject previously generated power in the grid later on, to smooth out the negative impact of peak loads. The stored energy may be utilized for local consumption, or injected into the grid to be used by others. As a form of flexible demand, energy storage systems can adapt their charging and discharging patterns to provide ancillary services, supporting DSOs and TSOs in the operation of the.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Malashenko et al. (2013) have broadly defined community storage as storage connected at the distribution feeder level, associated with a cluster of customer load. The services these types of systems could provide include capacity for excess generation from distributed energy resources, integration of higher penetrations of intermittent renewable resources (through, e.g., power quality regulation and "smoothing"), or backup power during outages. The community storage has the following use cases, namely the provision of distribution reliability (with the connection directly to the utility distribution grid), provision of customer bill management or local distribution grid services, and provision of services to local customers.

The growing popularity of community solar may also contribute to the increased tendency to tout distributed storage projects as community storage (Malashenko et al., 2013). CES is expected to provide numerous benefits in many possible combinations. It can serve as a robust, fast-responding and flexible alternative to generation. It can store low priced energy and release it when the price is high. It can also be used to provide most types of ancillary services that are needed to keep the electrical grid stable and reliable. Depending on the location, CES may reduce the need for transmission and distribution capacity because CES provides power locally, so less transmission and distribution equipment is needed to serve the local peak demand. CES can also improve the local electric service reliability and power quality.

Of particular interest is CES used to maintain a stable voltage in the distribution system (Energy storage Association[4]). Energy storage can help integrate local renewable generation; optimum aggregation level of storage deployment next to the consumption centres (Barbour et al., 2018). Storage of excess energy generated by individual prosumers in a central electrical storage bridge the temporal and quantitative gap of renewable electricity supply and energy demand (Scheller et al., 2018).

Communities do not always own storage resources themselves. For example, consumers can store their generated but unconsumed power virtually in a centralized battery, owned by cooperative utility, and consume it later; they pay a regular fee for utilizing this virtual cloud service (Löbbe and Hackbarth, 2017). Such an arrangement entails use of a flexible, standardized, modular utility-owned solution to important challenges faced by utilities in the new electricity marketplace. It is enabled by and can enhance the value and effectiveness of the expanding suite of elements of the Smart Grid.

As discussed in the study of Koirala et al. (2018), based on current developments, three configurations of community energy storage can be identified:

- shared residential,
- shared local and
- shared virtual.

Shared residential and shared local configurations are local forms of storage services, whereas a shared virtual configuration has no specific location. The further development of these configurations depends on local conditions, policy frameworks, and the system of regulations as well as market conditions.

[4] https://energystorage.org/community-energy-storage/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Community energy storage services business model overview

Value proposition	• Storage connected at the distribution feeder level, associated with a cluster of customer load (shared residential, shared local and shared virtual CES). • The stored energy may be utilized for local consumption, or it may be injected in the grid to be used by others. • Storage "behind the meter" and EV batteries in consumer premises. • Reduction of the mismatch between local supply and demand. • Increased local renewables self-consumption. • Improved grid services through battery storage systems. • Improved prospects for sustainability and autonomy.
Value creation and delivery	• Capacity for excess generation from distributed energy resources, integration of higher penetrations of intermittent renewable, local balancing, peak shaving, seasonal storage, emergency services or backup power resources during outages. • Higher self-consumption and integration of variable DERs. • Economic incentives (avoid peak prices, regulated costs, surcharges and taxes) • Improved reliability of supply. • More competitive energy prices and investment returns. • Greater cooperation among neighbours.
Value capture	• Low priced energy can be stored and used when energy price is high. • Local benefits include backup power, flicker mitigation and renewable integration. • Grid benefits are the load levelling at substation, power factor correction and ancillary services.
Actors involved	• Communities and individuals + organisations within them. • Practitioners involved in installation and maintenance of equipment. • Lawyers and accountants who draw up and enforce agreements for storage arrangements. • Traditional system actors – energy suppliers, DNOs. • Local authorities.
Citizen engagement and benefits	• Prosumers can store their generated but unconsumed power virtually in a centralized battery and consume it later. • Non-prosuming community members can have access to stored power at favourable prices. • Everyone gains from improved network stability.
Learning potential	• Knowledge and awareness of storage technology and energy supply and demand. • Development of skills in setting up, managing and regulating storage. • Energy consumption awareness. • Communal use of CES systems has potential to enhance communal responsibility.
Potential for wider impact	CES systems could adapt charging and discharging patterns to provide a wider range of ancillary services to the system and support DSOs and TSOs in the operation of the system. Further development of these configurations depends on local conditions, policy framework, and system of regulations as well as market conditions.

Table 3: Community energy storage services business model overview

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

5.4 Peer-to-peer energy trading platforms

Peer-to-peer (P2P) trading of renewable energy is defined in the Renewable Energy Directive (REDII, 2018[5]) as "the sale of renewable energy between market participants by means of a contract with pre-determined conditions governing the automated execution and settlement of the transaction, either directly between market participants or indirectly through a certified third-party market participant, such as an aggregator".

Two focuses of P2P trading are the P2P exchange of energy *surplus*, where prosumers can exchange their surplus with their neighbours, and through *provision/matching*, where prosumers can directly choose local renewable generation, for example through their established supplier (Sousa et al., 2019).

A P2P energy trading platform business model is a software platform enabled by smart electricity infrastructure that matches renewable energy purchasing customers with local suppliers (Engerati, 2016). This is predicted to remove the need for energy suppliers as an intermediary in the trading of distributed electricity generation, such models are theoretically based on the use of a third-party platform where prosumers can trade energy with each other with minimal involvement from suppliers. Prices can be negotiated directly with other prosumers, allowing them to select the provenance of their electricity (Brown et al., 2019; Hall and Roelich, 2016).

P2P platforms can be local balancing units that do not have to be bound by geography, but are traded on the virtual platform exchange (Hall and Roelich, 2016). The base case of a peer-to-peer energy network involves transactions between individual users on an online platform, which is getting a more prominent role with the development of the blockchain technology. Blockchain is a cryptographically secured distributed database system operated by a peer-to-peer network. Its main purpose is to keep track of transactions between the peers in the network while guaranteeing the integrity of the single transactions and the whole system at the same time: the lack of the central authority opens up manifold possibilities to accomplish these transactions and no intermediary is needed (Löbbe and Hackbarth, 2017). In theory, blockchains allow prosumers to negotiate fairer prices for their generation rather than being forced to accept whatever price a supplier is prepared to offer. They could also incentivise prosumers to produce and consume energy at times when electricity is generated locally by their peers. But there is still a need for a licensed supplier that balances the system and the use of the public network that maintains the physical balance of the grid (Brown et al., 2019).

In blockchain-based P2P energy networks, the provider offers an online platform, while a decentralized network handles the transactions without an intermediary. So-called smart contracts, which are to be arranged between peers directly and verified by the blockchain, take over the role of the central authority. It is a virtual marketplace where peers are able to trade their energy products reaching from individualised offers to regular supply agreements on a bilateral basis based on digitalisation, prosumage and the appreciation of customers (Löbbe and Hackbarth, 2017). Smart contracts could, for instance, include the energy quantity, date of delivery, and price. As a consequence, the system could gain in flexibility, pace, and accuracy because tasks are to be increasingly automated or even substituted by smart contracting. Additionally, costs could be reduced. Thus, implementing blockchain technology could be a key success factor of decentralized energy applications (Sieverding, 2016; Hayes et al., forthcoming).

[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Peer-to-peer energy trading platform business model overview

Value proposition	• Sale of renewable energy between market participants by means of a contract governing the automated execution and settlement of the transaction, either directly between market participants or indirectly through a certified third-party market participant. • Independence from incumbents for the prosumers. • P2P exchange of energy surplus between peers. • Prosumers can directly choose local renewable generation and can share their energy production with others.
Value creation and delivery	• A virtual marketplace (virtual energy exchange) where peers are able to trade their energy products. • The provider offers an online platform, while a decentralized network based on blockchain handles the transactions without an intermediary (smart contracts). • Use of renewable energy technology, innovative technology, Innovative software services (platforms), blockchain, smart contracts.
Value capture	• Consumers are offered 'green', distributed power of known origin. • Producers receive a price premium compared to the standard feed-in tariff or can realize additional revenues. • Optimizing the generated and consumed energy in the network; improved system efficiency. • Lower unit energy prices
Actors involved	• Prosumers • Intermediaries in the form of third-party software platform providers • Software designers • Legal and regulatory practitioners
Citizen engagement and benefits	• Consumer empowerment and active engagement in energy demand-supply on the local energy market. • Prosumers can negotiate the prices with other prosumers, or agree to an automated arrangement.
Learning potential	• Energy demand and supply awareness and knowledge • Knowledge and understanding on energy trading • Understanding energy production and consumption • New engagement mechanisms such as gamification could reduce/optimise energy use to increase revenue stream opportunities.
Potential for wider impact	Energy system could gain in flexibility, pace, and accuracy because tasks are to be increasingly automated or even substituted by smart contracting. However, increased complexity brings with it the risk of new forms of malfunction. There is not yet much empirical evidence of P2P viability; most schemes are still in the trial stages. Implementing blockchain technology could be a key success factor of decentralized energy applications, opening the way to wider adoption.

Table 4: Peer-to-peer energy trading platforms

5.5 Community energy aggregators

Many community organisations are integrating generation and demand response at a local scale, using skills they have gained in IT and local network balancing. In such community organisations anyone who uses or generates electricity, can join a local community aggregator company. Usually community energy aggregators have gained people's trust due to being well known in their localities

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

and having proven their technical competence and ethical standards. Therefore people are keen to provide them with their data and let them manage their appliances (Braunholtz-Speight et al., 2019).

An aggregator is a new type of energy service provider that can increase or moderate the electricity consumption of a group of users according to the status of the grid or distribution network. An aggregator can also operate on behalf of a group of consumers producing their own electricity by selling the excess electricity they produce (BEUC[6]). Aggregators are relatively new entities in electricity systems that possess the ability to influence a number of grid-connected units via a suitable communication interface. A centralized optimization algorithm usually coordinates the units, in order to fulfil a certain control goal. Aggregators may operate in different parts of the electricity network and utilize the units in their portfolio for trading in electricity wholesale and ancillary service markets. Note that, depending on the market design, an aggregator can also be understood as an entity that coordinates the units in a certain area of the network in the sense of a micro-grid or like a virtual power plant (Koch and Andersson, 2015).

Aggregators are likely to play an important role as enablers for decentralised market actors like consumers, prosumers, active customers and energy communities. With the help of aggregation, it will be possible to reduce prices on control reserves and wholesale markets by combining several different units and optimising their demand and supply behaviours. For consumers and prosumers participating in aggregation services, it will have the potential to lower balancing costs and decrease the energy bill. The aggregator can take the role of the intermediary between decentralised actors and the market and can help small actors like renewable self-consumers, active customers, or small businesses to participate in the electricity market (BEUC). Aggregation entails grouping the energy consumption or generation of several consumers. When it comes to consumers, aggregators can set up an agreement with several consumers, based on which they can temporarily *reduce* their electricity consumption when there is high demand. An aggregator could also be operating the reverse action and could *increase* the demand of a consumer when electricity prices are favourable. Aggregators can also operate on behalf of a group of consumers engaging in self-generation by *selling their excess* electricity (BEUC). The flexibility from this aggregated demand and supply is then sold.

Aggregation can be carried out by traditional electricity retailers and DNOs, or by new entrants such as independent aggregators. Independent aggregators are, thus, electricity service providers. In practice, when consumers engage with them, they have one contract with the supplier and a separate one with the aggregator.

The increasing amount of installed distributed renewable generation is a challenge to system managers. It requires the demand side to become more active, emphasizing increased engagement of consumers who need to be more flexible in adjusting their energy consumption, giving rise to demand-response mechanisms (Pichler et al., 2019). The proper management of available flexibility, both in generation and demand side, can help to compensate the lack of certainty of new renewable sources (i.e., apart from large-scale hydro) (Olivella-Rosell et al., 2018). The high penetration of distributed energy resources introduces new flexibility services like prosumer or community self-balancing, congestion management and time-of-use optimization (Nieta et al., 2018).

Aggregators initially focused on larger commercial/industrial consumers/prosumers, but have more recently started to aggregate demand and supply from much smaller customers, for example diverting excess generation into domestic storage rather than being curtailed. Such trials open up the way for more comprehensive flexibility platforms where assets such as PV, heat pumps, battery and

[6] https://www.beuc.eu/publications/beuc-x-2018-010_electricity_aggregators_starting_off_on_the_right_foot_with_consumers.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

heat storage and EV batteries are controlled remotely as a 'virtual power plant' (Brown et al., 2019). These raise the question of how much prosumers are involved, and how (Darby et al., 2018). Virtual power plants (VPP) are cloud-based distributed power plants that aggregate the capacities of heterogeneous distributed energy resources. VPPs not only allow aggregating an immense number of electricity producers, consumers and storage units, by controlling feed-in and consumption. Their power and flexibility can be valorised on different markets (Darby et al., 2018, Boait et al. 2019).

Demand response can operate at many scales, from absolute demand reduction (long term) to fast frequency response for grid stability (Darby and McKenna 2012). From the customer standpoint, it is based on users' responses to dynamic pricing or other signals, or on direct/automated load control, or some mix of the two. Demand response can offer value to individuals, organisations, communities and the electricity system, through

- making the distribution network and/or transmission grid work more effectively and efficiently;
- offering financial or other benefits to end-users and building up useful knowledge and skills for system management and maintenance (in the short to medium term);
- strengthening resilience to physical or social disruption (medium to long term); and
- reducing the environmental impact of energy services.

Energy aggregators can offer a better deal to consumers in general but may in particular be of use to people who find it hard to manage smart technologies themselves, or do not have the money and resources to engage on their own behalf. Community members may also benefit from an aggregator acting as a legal shield, taking on the contractual risk of engaging in the wider energy market on their behalf. According to Kumar (2019), by aggregating domestic energy assets and providing ancillary services to grid operators, they can generate new revenue to benefit local communities.

Energy communities can themselves take the role of an aggregator. The aggregation of demand and shifting of demand patterns can allow community members to consume when spot markets offer lower prices, if they have access to market price signals. Alternatively, initiatives aim at reducing their grid costs, either by consuming less energy from the grid or by reducing their (collective) connection capacity.

Many new clean energy communities are based on the use of smart and innovative technologies, platform-based mechanism including virtual platforms, virtual power plants (VPP) and virtual private networks, and can through such digital channels have easier access to user experiences feed backs and exchange of information, with focus on learning, customer insights, data analytics and connectivity. Virtual private networks can be a great way for knowledge and information interchange: interaction can range from relatively 'simple' communities/blogs where project stakeholders and other interested parties find space for communicating on specific events or issues and through which they can disseminate news, tools and ideas to more interactive communities (https://www.programmemed.eu/fileadmin/PROG_MED/capitalisation/smart_med_regions.pdf).

Technological innovation in smart metering offers new ways of aggregating customers with small demand by undertaking community level engagement to deliver flexibility, (Hall and Roelich, 2016)through some mix of demand side response and dispatchable generation and storage, with a range of incentives to improve the network operation and efficiency (Brown et al., 2019). The smart meter itself is a tool to enable dynamic pricing, direct load control and two-way communication of data and energy.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Community energy aggregator business model overview

Value proposition	• Providing a mix of flexible demand-response and dispatchable generation and storage. • Convenience of engagement in demand-response programs. • Ease of transactions (joining the platform, negotiate a contract, sign a contract, etc.). • Transparency and fair remuneration terms and agreements. • Selling excess locally-generation electricity through the aggregator.
Value creation and delivery	• Reducing the energy consumption in times of high demand through flexibility services, which in turn leads to lower costs. • PVs, heat pumps, battery and heat storage and EVs are controlled remotely as a virtual power plant. • IT systems for monitoring energy flows and managing platforms. • Shifting of demand patterns. • Providing a communication interface to the consumers.
Value capture	• Aggregator models allow prosumers to provide a range of services to the electricity wholesale markets, grid and network operators, customers and third-party stakeholders, through the optimisation of processes. • Environmental value through the integration of distributed renewable resources and greater system efficiency. • Social value through participation in energy transition as part of a community.
Actors involved	• Prosumers • Consumers • Energy communities • Network operators (TSO, DSO) • Aggregators • Legal and regulatory practitioners • Installers, software engineers, maintenance engineers etc.
Citizen engagement and benefits	• Price signals and community messaging to incentivise the desired response. • Potential reductions in unit cost of energy services. • Changes in citizens' demand and supply behaviours.
Learning potential	• Customer insights and learnings from practising demand response / aggregating distributed supply. • Utility/industry insights, learning from customer feedback • Data analytics • Connectivity: which pieces of equipment work with each other, and with different types of software? • Knowledge on energy conservation and efficiency
Potential for wider impact	The proper management of available flexibility, both in generation and demand side, can help to compensate the variable availability of generation from new renewable sources. Virtual private networks also offer an opportunity for knowledge and information interchange between community members.

Table 5: Community energy aggregator business model

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Overview table summarising the value propositions, value creation and delivery, and value capture					
Business model overview	**Local renewable energy generation and supply**	**Innovative contracting and community products**	**Community energy storage services**	**Peer-to-peer energy trading platform**	**Community energy aggregator**
Value proposition	• Community-based energy • Some degree of independence from utilities. • Affordable self-production of electricity.	• Contracting of technology designed for self-sufficiency (lease of solar PVs, storage, cogeneration, local energy etc.). • Providing e-mobility services. • Companies are providing contractual energy services that enhance the local production and lower the cost of energy production.	• Storage connected at the distribution feeder level, associated with a cluster of customer load (shared residential, shared local and shared virtual CES). • The stored energy may be utilized for local consumption, or it may be injected in the grid to be used by others. • Storage "behind the meter" and EV batteries in consumer premises. • Reduction of the mismatch between local supply and demand. • Increased local renewables self-consumption. • Improved grid services through battery storage systems. • Improved prospects for sustainability and autonomy.	• Sale of renewable energy between market participants by means of a contract governing the automated execution and settlement of the transaction, either directly between market participants or indirectly through a certified third-party market participant. • Independence from incumbents for the prosumers. • P2P exchange of energy surplus between peers. • Prosumers can directly choose local renewable generation and can share their energy production with others.	• Providing a mix of flexible demand-response and dispatchable generation and storage. • Convenience of engagement in demand-response programs. • Ease of transactions (joining the platform, negotiate a contract, sign a contract, etc.). • Transparency and fair remuneration terms and agreements. • Selling excess locally-generation electricity through the aggregator.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Value creation and delivery	• Renewable energy generation by the prosumers. • Supply to the members of the micro-grid. • Supplying ancillary services to the grid (peak reduction, balancing etc.) • Emergency and backup services to critical infrastructure within the community during power outages. • Renewables production, heat pumps, storage devices, energy management, smart home devices, participation in a virtual power plant to optimize self-supply.	• PV, storage, cogeneration contracting • Rental of space for PVs • Sale, service and maintenance of contracts • Contracting of EVs	• Capacity for excess generation from distributed energy resources, integration of higher penetrations of intermittent renewable, local balancing, peak shaving, seasonal storage, emergency services or backup power resources during outages. • Higher self-consumption and integration of variable DERs. • Economic incentives (avoid peak prices, regulated costs, surcharges and taxes) • Improved reliability of supply. • More competitive energy prices and investment returns. • Greater cooperation among neighbours.	• A virtual marketplace (virtual energy exchange) where peers are able to trade their energy products. • The provider offers an online platform, while a decentralized network based on blockchain handles the transactions without an intermediary (smart contracts). • Use of renewable energy technology, innovative technology, Innovative software services (platforms), blockchain, smart contracts.	• Reducing the energy consumption in times of high demand through flexibility services, which in turn leads to lower costs. • PVs, heat pumps, battery and heat storage and EVs are controlled remotely as a virtual power plant. • IT systems for monitoring energy flows and managing platforms. • Shifting of demand patterns. • Providing a communication interface to the consumers.
Value capture	• Revenue streams are inside the community; boosts local economy. • Generation from non-polluting sources	• Contractual relationships (for battery, solar PV and storage leasing) with the prosumers.	• Low priced energy can be stored and used when energy price is high. • Local benefits include backup power, flicker	• Consumers are offered 'green', distributed power of known origin. • Producers receive a price premium	• Aggregator models allow prosumers to provide a range of services to the electricity wholesale markets, grid and

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

	• Social cohesion from operating as a community	• Membership in the community based on the contractual relationship. • Sale of the energy systems, installation and maintenance fees for smart meters and batteries, membership fees and energy delivery.	mitigation and renewable integration. • Grid benefits are the load levelling at substation, power factor correction and ancillary services.	compared to the standard feed-in tariff or can realize additional revenues. • Optimizing the generated and consumed energy in the network; improved system efficiency. • Lower unit energy prices	network operators, customers and third-party stakeholders, through the optimisation of processes. • Environmental value through the integration of distributed renewable resources and greater system efficiency. • Social value through participation in energy transition as part of a community.
Actors involved	• All participants of the micro-grid (prosumers and consumers) • Distribution System Operators (DSOs)	• Residential and commercial customers • Prosumers • Third-party companies/providers	• Communities and individuals + organisations within them. • Practitioners involved in installation and maintenance of equipment. • Lawyers and accountants who draw up and enforce agreements for storage arrangements. • Traditional system actors – energy suppliers, DNOs. • Local authorities.	• Prosumers • Intermediary in the form of third party software platform providers • Software designers • Legal and regulatory practitioners	• Prosumers • Consumers • Energy communities • Network operators (TSO, DSO) • Aggregators • Legal and regulatory practitioners • Installers, software engineers, maintenance engineers etc.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Citizens engagement and benefits	• Empowerment of the members of the community • Community development • Use of smart technologies • Knowledge of local power production and supply	Citizens and the members of the community can rent their Citizens and the members of the community can rent their spaces to generate energy from renewable resources without their direct involvement (with the involvement of a third-party company).	• Prosumers can store their generated but unconsumed power virtually in a centralized battery and consume it later. • Non-prosuming community members can have access to stored power at favourable prices. • Everyone gains from improved network stability.	• Consumer empowerment and active engagement in energy demand-supply on the local energy market. • Prosumers can negotiate the prices with other prosumers, or agree to an automated arrangement.	• Price signals and community messaging to incentivise the desired response. • Potential reductions in unit cost of energy services. • Changes in citizens' demand and supply behaviours.
Learning potential	• Knowledge of local electricity production and distribution • Awareness-raising on energy production, demand and supply • Development of skills related to financing, developing and maintaining the community system • a sense of community, with members more willing to learn from each other	• Knowledge on the benefits of renewables production and use • Energy efficiency knowledge and awareness • Empowerment for the use of new innovative products	• Knowledge and awareness of storage technology and energy supply and demand. • Development of skills in setting up, managing and regulating storage. • Energy consumption awareness. • Communal use of CES systems has potential to enhance communal responsibility.	• Energy demand and supply awareness and knowledge • Knowledge and understanding on energy trading • Understanding energy production and consumption • New engagement mechanisms such as gamification could reduce/optimise energy use to increase revenue stream opportunities.	• Customer insights and learnings from practising demand response / aggregating distributed supply. • Utility/industry insights, learning from customer feedback • Data analytics • Connectivity: which pieces of equipment work with each other, and with different types of software? • Knowledge on energy conservation and efficiency

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Potential for wider impact	The empowerment of local actors can offer a viable way of power production from renewables, which enhances knowledge on power generation and raises awareness that can reduce costs and environmental impacts in a community.	Potential to offer additional services via e.g. smart home services new products and business models.	CES systems could adapt charging and discharging patterns to provide a wider range of ancillary services to the system and support DSOs and TSOs in the operation of the system. Further development of these configurations depends on local conditions, policy framework, and system of regulations as well as market conditions.	Energy system could gain in flexibility, pace, and accuracy because tasks are to be increasingly automated or even substituted by smart contracting. However, increased complexity brings with it the risk of new forms of malfunction. There is not yet much empirical evidence of P2P viability; most schemes are still in the trial stages. Implementing blockchain technology could be a key success factor of decentralized energy applications, opening the way to wider adoption.	The proper management of available flexibility, both in generation and demand side, can help to compensate the variable availability of generation from new renewable sources. Virtual private networks also offer an opportunity for knowledge and information interchange between community members.

Table 6: Overview table summarising the value propositions, value creation and delivery, and value capture

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

6 CONCLUSION

The research carried out in the NEWCOMERS project has the potential to open up new areas of research and inspiration for practice on how to translate social and environmental value creation through new clean energy communities into economic profit and competitive advantage.

The presented typology of community energy business models gives examples of five main types of innovative energy community business models identified by the literature. These are emerging as a response to the changing energy sector landscape and present novel ways of incorporating distributed energy resources into energy communities.

The typology covers the main energy services and describes the types that are emerging, and in the same time, tries to assess the potential for wider impact as well as future learning potential. It emphasises the significance of social processes, as people learn to use both traditional and new technologies in innovative ways. The limitations of our approach lie in the characteristics of a field that is currently in a phase of exponential development. New energy communities are shaping themselves in response to the new energy sector landscape and at the same time, they are helping to shape that landscape by demonstrating what is possible and how it can be achieved.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

7 DISCUSSION

In this deliverable, we developed a typology of new business models by clean energy communities. The typology contains five types of business models being developed by new clean energy communities. In the following, we discuss the methodological approach adopted, its weaknesses and potential for adaptation and reflect on the results, with a particular focus on the typology's use in the NEWCOMERS project.

The typology was constructed based on a scientific literature review before business models (described within the articles) were clustered on the basis similarity (Section 5). In taking this approach a variety of methodological choices were made, for pragmatic and analytical reasons – about what search terms to use, which databases to search and over what time period - each with the potential to influence the results.

- *Search terms* ('energy community' and 'business models') were selected based on our research interest. Both terms are widely used and both can be interpreted flexibly. However, we also recognise how many similar terms are currently employed to describe energy communities. Equally, whilst the term business model is widely used and understood, we suspect innovative projects that are more 'community-orientated' are being investigated by researchers who do not employ the term. As a result, the inclusion of synonyms or additional search terms has the potential to enhance the work undertaken here, potentially widening the pool of academic papers and associated business models identified.
- To collect academic papers one database was used. Scopus presents one authoritative and widely used database but is not the only possibility. To further widen the search additional database could be employed, such as Google Scholar or Science Direct.
- Because of our focus on new or emerging business models, we searched only the most recent academic literature, from 2015 onwards. It remains to be seen if going back further in time would result in more diverse business models being identified.
- Our search was also limited to English language papers.

Our approach returned 54 articles. This represents a relatively low number of articles, given our existing knowledge of the field, but also provided sufficient diversity to search for similarities and differences in business models adopted. Beyond a broadening of the search terms, databases employed or time horizon, we suggest future work on the diversity and types of emerging business models by energy communities could be advanced by expanding the literature review to include 'grey' materials (i.e. non-peer reviewed publications) and by complementing the approach with stakeholder interviews. To pursue either path requires additional resources. They also have the potential to present new methodological challenges, such as how to identify grey materials systematically. Moreover, the extent to which a literature search can capture the innovation and diversity of a dynamic and rapidly evolving field is always going to be a challenge.

This leads us to reflect on the work undertaken.

First, we observe how some of the energy communities we will investigate as case studies do not appear to fit easily within the developed typology. The process of identifying, selecting and recruiting case studies was largely undertaken before the project began and was based on our existing knowledge of the field and what we suspected was innovative. For some of our case studies we suspect their innovativeness lies in the unconventional alliances of actors. For others we suspect their novelty lies in the creation of wider social or environmental values. These two aspects are not currently foregrounded in the typology. Despite this, we can say that business activities pursued by our case studies will mostly fit within the current typology.

Second, we observe how the typology appears to capture more fully, traditional profit-orientated business models over community-orientated business models. This may be a result of the search terms used. Equally, it may be a result of the extent to which research focussed on the development and participation of communities in energy systems has been less interested in 'business models' to date.

Third, we observe how the literature we reviewed focused more on technological advancements and profit-orientated business models than on social changes entailed or the creation of environmental or social value. The current academic literature still largely leans on the traditional economic value the members get from participating in energy communities and in large part still fails to recognise the social and environmental value. This suggests a gap in the literature, which NEWCOMERS can contribute to. The literature also appears to have little to say about the soft-skills that underlie energy communities' purpose, such as various types of learning, empowerment potential and awareness raising that can evolve as a consequence of joining an energy community.

Collectively, these points underline how the typology is an outcome of the analytical framework employed, methods adopted and articles review. Building off the existing business model literature – with its emphasis on (financial) value creation and retention directed us to foreground business activities and financial models over other aspects, such as the (innovative or not) arrangement of actors involved or the diversity of social and/or environmental values pursued. This does not mean these attributes are unimportant or ignored in the typology, but that they are in the background at present. Regarding social values, the typology reflects how the literature is currently focused on the assessment of cost savings and energy-use optimisation as a response to the new smart technologies emerging, such as block-chain, smart contracts and cloud computing. This, in turn, suggests that by examining social and environmental values alongside financial values, and by exploring different attributes of business models the NEWCOMERS project can add to existing business model literatures. Meanwhile, the extent to which our case studies neatly fall within the five types outlined above can only be ascertained through their further investigation.

This Deliverable shows the progress of the development of a typology of new clean energy communities for the NEWCOMERS project by Month 7. Overall the work entailed by this is running according to timetable and it operates satisfactorily.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

8 LITERATURE

Bauwens, T. (2017). Polycentric governance approaches for a low-carbon transition: The roles of community-based energy initiatives in enhancing the resilience of future energy systems. In T. Bauwens, Green Energy and Technology (pp. 119-145). Springer Verlag.

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

Boait, P., Snape, J.R., Hamilton, J., Morris, R. and Darby, S. (2019) The Practice and Potential of Renewable Energy Localisation: Results from a UK Field Trial. Sustainability 11

Bocken, N.M.P., Short, S.W., Rana, P. and Evans, S. (2014) A Literature and Practice Review to Develop Sustainable Business Model Archetypes. Journal of Cleaner Production, 65, 42-56. http://dx.doi.org/10.1016/j.jclepro.2013.11.039

Braunholtz-Speight, T., Mander, S., Hannon, M., Hardy, J., McLachlan, C., Maderson, E and Sharimina, M. (2018) - The Evolution of Community Energy in the UK

Braunholtz-Speight, T., Mclachlan, C., Mander, S., Cairns, I., Hannon, M., Hardy, J.,(2019). Visions for the Future of Community Energy in the UK: realising the potential. UK Energy Research Centre (1) pp. 4-43.

Brown, D., 2018. Business models for residential retrofit in the United Kingdom; a critical assessment of 5 key archetypes. Energy Effic. 2, 1–26. https://doi.org/10.1007/s12053-018-9629-5

Brown, D., Hall, S., and Davis M. E. (2019). Prosumers in the post subsidy era: an exploration of new prosumer business models in the UK. *Energy Policy, 135*.

Burger, Scott P., and Max Luke. 2017. "Business Models for Distributed Energy Resources: A Review and Empirical Analysis." Energy Policy.

CORDIS / European Union (2019). New Clean Energy Communities in a Changing European Union landscape [Online]. Retrieved from: https://cordis.europa.eu/project/rcn/221779/factsheet/en.

Cseres, K. (2018). The Active Energy Consumer in EU Law. European Journal of Risk Regulation, 9(2), 227–244. doi:10.1017/err.2018.7

Dóci, G., Vasileiadou, E., Petersen. 2015. Let's Do It Ourselves' Individual Motivations for Investing in Renewables at Community Level. Renewable and Sustainable Energy Reviews 49(October): 41–50.

Engerati, Good Energy Is Deploying Open Utility's Piclo Renewable Energy Marketplace for UK Business Consumers, (2016) https://www.engerati.com/Governing Climate Change edited by Andrew Jordan. (n.d.).

Fell, M.J., Energy services: A conceptual review. Energy research & social science, 2017. 27: p. 129-140.

Fielt, E. 2014, 'Conceptualising Business Models: Definitions, Frameworks and Classifications', Journal of Business Models, Vol. 1, No. 1, pp. 85-105

Gerlak, A., Heikkila, T., Smolinski, S.L., Armitage, D., Huitema, D., and Moore, B. (2019). It is time to learn about learning: where should the environment and natural resource governance go next? Society and Natural Resources, 32, 1056-1064

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Grunewald, Philipp, Jo Hamilton, Ruth Mayne, and Beaudry Kock. 2014. How Communities Generate and Distribute Value - an Analytical Business Model Framework for Energy Initiatives.

Gui E.M., Diesendorf M., MacGill I., Distributed energy infrastructure paradigm: community micorgrids in a new institutional economics context, Renew. Sustain. Energy Rev. 72 (2017) 1355–1365.

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

Hall, S. and Roelich, K. (2016). Business model innovation in electricity supply markets: The role of complex value in the United Kingdom. *Energy Policy, 92*, 286-298.

Haug, G., Huitema, D., and Wenzler, I. (2011). Learning through games? Evaluating the learning effect of a policy exercise on European climate policy. IVM (Institute for Environmental Studies).

Hewitt, R., Bradley, N., Compagnucci, A., Barlagne, C., Ceglarz, A., Cremades, R., Slee, B. (2019). Social innovation in community energy in Europe: A review of the evidence. Frontiers in Energy Research, 7(APR). Frontiers Media S.A.

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

International Renewable Energy Agency (IRENA). 2018. Remap 2030 Renewable Energy Prospects for the European Union. Retrieved from - https://www.irena.org/benefits

Interreg Europe (2018). Renewable Energy Communities; A policy brief from the policy of learning platform on low carbon economy European Union. [Online] Retrieved from: https://www.interregeurope.eu/fileadmin/user_upload/plp_uploads/policy_briefs/2018-08-30_Policy_brief_Renewable_Energy_Communities_PB_TO4_final.pdf.

Kalkbrenner, B., & Roosen, J. (2016, 3 1). Citizens' willingness to participate in local renewable energy projects: The role of community and trust in Germany. Energy Research and Social Science, 13, 60-70.

Keeling, M. (2019). emPowering the People Understanding energy communities Title: emPowering the People: Understanding energy communities.

Kennedy, S., Bocken, N. (2019). Innovating business models for sustainability: an essential practice for responsible managers. In: Laasch, O., Jamali, D., Freeman, E., & Suddaby, R. (2019, forthcoming). The Research Handbook of Responsible Management. Cheltenham: Edward Elgar.

Kluge, S. (2000). Empirically Grounded Construction of Types and Typologies in Qualitative Social Research. Forum Qualitative Social Research 1(1), Art. 14. http://www.qualitative-research.net/index.php/fqs/article/view/1124/2499

Koch, S. and Andersson, G. (2012). Assessment of revenue potentials of ancillary service provision by flexible unit portfolios. 2012 IEEE Power and Energy Society General Meeting, 22-26 July 2012.

Koirala, B., Koliou, E., Friege, J., Hakvoort, R., & Herder, P. (2016, 4 1). Energetic communities for community energy: A review of key issues and trends shaping integrated community energy systems. Renewable and Sustainable Energy Reviews, 56, 722-744. Elsevier Ltd.

Lovins, A. B. (1979). Soft Energy Paths: Toward a Durable Peace. San Francisco, California: Harper Collins Publishers.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Lüdeke-Freund, F., Freudenreich, B., Schaltegger, S., Saviuc, I., & Stock, M. (2017). Sustainability-Oriented Business Model Assessment—A Conceptual Foundation. In F. Lüdeke-Freund, B. Freudenreich, S. Schaltegger, I. Saviuc, & M. Stock, Analytics, Innovation, and Excellence-Driven Enterprise Sustainability (pp. 169-206). Palgrave Macmillan US.

Lüdeke-Freund, Florian. 2013. "Business Models for Sustainable Innovation: State-of-the-Art and Steps towards a Research Agenda." Journal of Cleaner Production 45: 9–19.

Malek, K., & Nathwani, J. (2017). Typology of business models for adopting grid-scale emerging storage technologies. PICMET 2017 - Portland International Conference on Management of Engineering and Technology: Technology Management for the Interconnected World, Proceedings. 2017-January, pp. 1-6. Institute of Electrical and Electronics Engineers Inc.

Malek, K., Nathwani, J. (2017). Typology of Business Models for Adopting Grid-Scale Emerging Storage Technologies. Portland International Conference on Management of Engineering and Technology (PICMET) Management of Engineering and Technology (PICMET)

McFadgen, B. (2019). Connecting policy change, experimentation, and entrepreneurs: advancing conceptual and empirical insights. *Ecology and Society* 24 (1), 30.

Moroni, Antoniucci, & Bisello. (2019, 6 25). Local Energy Communities and Distributed Generation: Contrasting Perspectives, and Inevitable Policy Trade-Offs, beyond the Apparent Global Consensus. Sustainability, 11(12), 3493.

Osterwalder, Alexander; Pigneur, Yves; and Tucci, Christopher L. (2005) "Clarifying Business Models: Origins, Present, and Future of the Concept," Communications of the Association for Information Systems: Vol. 16 , Article 1.

Rasmussen, B. (2007) Business Models and the Theory of the Firm. Pharmaceutical Industry Project Working Paper, Centre for Strategic Economic Studies, Victoria University, Melbourne, 32, 1-11.

Richter, M. (2013). Business model innovation for sustainable energy: German utilities and renewable energy. Energy Policy, Elsevier, 62(C), 1226-1237.

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

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

Sørensen E., Torfing J., Enhancing collaborative innovation in the public sector, Admin. Soc. 43 (8) (2011) 842–868.

Sousa, T., Soares, T., Pinson, P., Moret, F., Baroche, T., Sorin, E. (2019). Peer-to-peer and community-based markets: A comprehensive review. Renewable and Sustainable Energy Reviews, Elsevier, vol. 104(C), pages 367-378.

Stubbs, W., and Cocklin, C. (2008) Conceptualizing a "sustainability business model". Organization & Environment, 21 (2). pp. 103-127.

The Young Foundation (2012) 'Social Innovation Overview - Part I: Defining social innovation'. A deliverable of the project: "The theoretical, empirical and policy foundations for building social innovation in Europe" (TEPSIE), European Commission – 7th Framework Programme, Brussels

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Thiel, A. (2016). The polycentricity approach and the research challenges confronting environmental governance. Discussion Paper No. 2016-1. Humboldt-Universität zu Berlin, Berlin, Germany, 27 p.

Ugarte, S.; Larkin, J.; van der Ree, B.; Swinkels, V.; Voogt, M.; Friedrichsen, N; Michaelis, J.; Thielmann, A.; Wietschel, W.; Villafáfila, R. (2015): Energy Storage: Which Market Designs and Regulatory Incentives Are Needed? Committee on Industry, Research and Energy Committee (ITRE) Study for the European Parliament. Brussels: European Union.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

Appendix I

#	REFERENCE	Applicability
1	Hayes, B.P., Thakur, S., Breslin, J.G. Co-simulation of electricity distribution networks and peer to peer energy trading platforms (2020) International Journal of Electrical Power and Energy Systems, 115, art. no. 105419. DOI: 10.1016/j.ijepes.2019.105419	YES
2	Fina, B., Auer, H., Friedl, W. Profitability of PV sharing in energy communities: Use cases for different settlement patterns (2019) Energy, 189, art. no. 116148. DOI: 10.1016/j.energy.2019.116148	YES
3	Boulaire, F., Narimani, A., Bell, J., Drogemuller, R., Vine, D., Buys, L., Walker, G. Benefit assessment of battery plus solar for customers and the grid (2019) Energy Strategy Reviews, 26, art. no. 100372. DOI: 10.1016/j.esr.2019.100372	YES
4	Troncia, M., Galici, M., Mureddu, M., Ghiani, E., Pilo, F. Distributed ledger technologies for peer-to-peer local markets in distribution networks (2019) Energies, 12 (17), art. no. 3249. DOI: 10.3390/en12173249	YES
5	Puranik, S., Tuiskula, H., Ilieva, I., Torrent, F., Colomer, J., Melendez, J. Multi-vector energy optimization tools for energy islands (2019) 2019 IEEE Milan PowerTech, PowerTech 2019, art. no. 8810932. DOI: 10.1109/PTC.2019.8810932	YES
6	Nielsen, B.F., Baer, D., Lindkvist, C. Identifying and supporting exploratory and exploitative models of innovation in municipal urban planning; key challenges from seven Norwegian energy ambitious neighborhood pilots (2019) Technological Forecasting and Social Change, 142, pp. 142-153. DOI: 10.1016/j.techfore.2018.11.007	YES
7	Moroni, S., Alberti, V., Antoniucci, V., Bisello, A. Energy communities in the transition to a low-carbon future: A taxonomical approach and some policy dilemmas (2019) Journal of Environmental Management, 236, pp. 45-53. DOI: 10.1016/j.jenvman.2019.01.095	YES
8	Hofmann, B., Jevnaker, T., Thaler, P. Following, challenging, or shaping: Can third countries influence EU energy policy? (2019) Politics and Governance, 7 (1), pp. 152-164. DOI: 10.17645/pag.v7i1.1853	YES
9	Mamounakis, I., Efthymiopoulos, N., Makris, P., Vergados, D.J., Tsaousoglou, G., Varvarigos, E.M. A novel pricing scheme for managing virtual energy communities and promoting behavioral change towards energy efficiency (2019) Electric Power Systems Research, 167, pp. 130-137. DOI: 10.1016/j.epsr.2018.10.028	YES
10	Massey, B., Verma, P., Khadem, S. Citizen engagement as a business model for smart energy communities (2019) Proceedings of the 2018 5th International Symposium on Environment-Friendly Energies and Applications, EFEA 2018, art. no. 8617063. DOI: 10.1109/EFEA.2018.8617063	NO
11	Moroni, S., Antoniucci, V., Bisello, A. Local energy communities and distributed generation: Contrasting perspectives, and inevitable policy trade-offs, beyond the apparent global consensus (2019) Sustainability (Switzerland), 11 (12), art. no. 3493. DOI: 10.3390/su10023493	YES
12	Pichler, M., Meisel, M., Goranovic, A., Leonhartsberger, K., Lettner, G., Chasparis, G., Vallant, H., Marksteiner, S., Bieser, H. Decentralized energy networks based on blockchain: background, overview and concept	YES

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.

	discussion (2019) Lecture Notes in Business Information Processing, 339, pp. 244-257. DOI: 10.1007/978-3-030-04849-5_22	
13	Xie, S., Wang, H., Wang, S., Lu, H., Hong, Y., Jin, D., Liu, Q. Discovering communities for microgrids with spatial-temporal net energy (2019) Journal of Modern Power Systems and Clean Energy. DOI: 10.1007/s40565-019-0543-4	YES
14	Adu-Kankam, K.O., Camarinha-Matos, L.M. Emerging Community Energy Ecosystems: Analysis of Organizational and Governance Structures of Selected Representative Cases (2019) IFIP Advances in Information and Communication Technology, 553, pp. 24-40. DOI: 10.1007/978-3-030-17771-3_3	NO
15	Schiera, D.S., Minuto, F.D., Bottaccioli, L., Borchiellini, R., Lanzini, A. Analysis of Rooftop Photovoltaics Diffusion in Energy Community Buildings by a Novel GIS- and Agent-Based Modeling Co-Simulation Platform (2019) IEEE Access, 7, art. no. 8756277, pp. 93404-93432. DOI: 10.1109/ACCESS.2019.2927446	YES
16	Good, N., Mancarella, P. Flexibility in Multi-Energy Communities with Electrical and Thermal Storage: A Stochastic, Robust Approach for Multi-Service Demand Response (2019) IEEE Transactions on Smart Grid, 10 (1), art. no. 8052516, pp. 503-513. DOI: 10.1109/TSG.2017.2745559	YES
17	Ahlers, D., Wienhofen, L.W.M., Petersen, S.A., Anvaari, M. A smart city ecosystem enabling open innovation (2019) Communications in Computer and Information Science, 1041, pp. 109-122. DOI: 10.1007/978-3-030-22482-0_9	YES
18	Karunathilake, H., Hewage, K., Mérida, W., Sadiq, R. Renewable energy selection for net-zero energy communities: Life cycle based decision making under uncertainty (2019) Renewable Energy, 130, pp. 558-573. DOI: 10.1016/j.renene.2018.06.086	YES
19	Tikka, V., Mashlakov, A., Kulmala, A., Repo, S., Aro, M., Keski-Koukkari, A., Honkapuro, S., Järventausta, P., Partanen, J. Integrated business platform of distributed energy resources - Case Finland (2019) Energy Procedia, 158, pp. 6637-6644. DOI: 10.1016/j.egypro.2019.01.041	YES
20	Nardelli, P.H.J., Alves, H., Pinomaa, A., Wahid, S., Tome, M.D.C., Kosonen, A., Kuhnlenz, F., Pouttu, A., Carrillo, D. Energy Internet via Packetized Management: Enabling Technologies and Deployment Challenges (2019) IEEE Access, 7, art. no. 8629864, pp. 16909-16924. DOI: 10.1109/ACCESS.2019.2896281	YES
21	Hossain, M. Grassroots innovation: The state of the art and future perspectives (2018) Technology in Society, 55, pp. 63-69. DOI: 10.1016/j.techsoc.2018.06.008	NO
22	De La Nieta, A.A.S., Gibescu, M., Wang, X., Song, M., Jensen, E., Saleem, A., Bremdal, B., Ilieva, I. Local economic dispatch with local renewable generation and flexible load management (2018) 2018 International Conference on Smart Energy Systems and Technologies, SEST 2018 Proceedings, art. no. 8495823. DOI: 10.1109/SEST.2018.8495823	YES
23	Richter, B., Mengelkamp, E., Weinhardt, C. Maturity of blockchain technology in local electricity markets (2018) International Conference on the European Energy Market, EEM, 2018-June, art. no. 8469955. DOI: 10.1109/EEM.2018.8469955	YES
24	Scheller, F., Johanning, S., Reichardt, S., Reichelt, D.G., Bruckner, T. Competition effects of simultaneous application of flexibility options within an energy community (2018) International Conference on the	YES

	European Energy Market, EEM, 2018-June, art. no. 8470007. DOI: 10.1109/EEM.2018.8470007	
25	Li, X., Chalvatzis, K.J., Stephanides, P. Innovative energy islands: Life-cycle cost-benefit analysis for battery energy storage (2018) Sustainability (Switzerland), 10 (10), art. no. 3371. DOI: 10.3390/su10103371	YES
26	Makris, P., Efthymiopoulos, N., Vergados, D.J., Varvarigos, E., Nikolopoulos, V., Papagiannis, J., Pomazanskyi, A., Irmscher, B., Stefanov, K., Pancheva, K., Georgiev, A. SOCIALENERGY: A gaming and social network platform for evolving energy markets' operation and educating virtual energy communities (2018) 2018 IEEE International Energy Conference, ENERGYCON 2018, pp. 1-6. DOI: 10.1109/ENERGYCON.2018.8398797	YES
27	Hyysalo, S., Juntunen, J.K., Martiskainen, M. Energy Internet forums as acceleration phase transition intermediaries (2018) Research Policy, 47 (5), pp. 872-885. DOI: 10.1016/j.respol.2018.02.012	YES
28	Makris, P., Efthymiopoulos, N., Nikolopoulos, V., Pomazanskyi, A., Irmscher, B., Stefanov, K., Pancheva, K., Varvarigos, E. Digitization era for electric utilities: A novel business model through an inter-disciplinary s/w platform and open research challenges (2018) IEEE Access, 6, pp. 22452-22463. DOI: 10.1109/ACCESS.2018.2828323	YES
29	Olivella-Rosell, P., Lloret-Gallego, P., Munné-Collado, Í., Villafafila-Robles, R., Sumper, A., Ottessen, S.Ø., Rajasekharan, J., Bremdal, B.A. Local flexibility market design for aggregators providing multiple flexibility services at distribution network level (2018) Energies, 11 (4), art. no. 822. DOI: 10.3390/en11040822	YES
30	Koirala, B.P., Araghi, Y., Kroesen, M., Ghorbani, A., Hakvoort, R.A., Herder, P.M. Trust, awareness, and independence: Insights from a socio-psychological factor analysis of citizen knowledge and participation in community energy systems (2018) Energy Research and Social Science, 38, pp. 33-40. DOI: 10.1016/j.erss.2018.01.009	NO
31	Barbour, E., Parra, D., Awwad, Z., González, M.C. Community energy storage: A smart choice for the smart grid? (2018) Applied Energy, 212, pp. 489-497. DOI: 10.1016/j.apenergy.2017.12.056	YES
32	Gui, E.M., MacGill, I. Typology of future clean energy communities: An exploratory structure, opportunities, and challenges (2018) Energy Research and Social Science, 35, pp. 94-107. DOI: 10.1016/j.erss.2017.10.019	YES
33	Popović, D.V. Institutional design of state aid authorities in south east Europe: The unfit legal transplant and its ramifications (2018) Contributions to Economics, pp. 63-77. DOI: 10.1007/978-3-319-76644-7_4	NO
34	Young, J., Brans, M. Analysis of factors affecting a shift in a local energy system towards 100% renewable energy community (2017) Journal of Cleaner Production, 169, pp. 117-124. DOI: 10.1016/j.jclepro.2017.08.023	YES
35	Sanduleac, M., Ciornei, I., Albu, M., Toma, L., Sturzeanu, M., Martins, J.F. Resilient prosumer scenario in a changing regulatory environment - The UniRCon solution (2017) Energies, 10 (12), art. no. 1941. DOI: 10.3390/en10121941	YES
36	Saintier, S. Community energy companies in the UK: A potential model for sustainable development in "local" energy? (2017) Sustainability (Switzerland), 9 (8), art. no. 1325. DOI: 10.3390/su9081325	NO

37	Good, N., Mancarella, P., Lintern, K. Techno-economic assessment of community energy solutions to network capacity issues (2017) 2017 IEEE Manchester PowerTech, Powertech 2017, art. no. 7980906. DOI: 10.1109/PTC.2017.7980906	NO
38	Bremdal, B.A., Olivella, P., Rajasekharan, J. EMPOWER: A network market approach for local energy trade (2017) 2017 IEEE Manchester PowerTech, Powertech 2017, art. no. 7981108. DOI: 10.1109/PTC.2017.7981108	YES
39	Löbbe, S., Hackbarth, A. The Transformation of the German Electricity Sector and the Emergence of New Business Models in Distributed Energy Systems (2017) Innovation and Disruption at the Grid's Edge: How Distributed Energy Resources are Disrupting the Utility Business Model, pp. 287-318. DOI: 10.1016/B978-0-12-811758-3.00015-2	YES
40	Koirala, B., Hakvoort, R. Integrated Community-Based Energy Systems: Aligning Technology, Incentives, and Regulations (2017) Innovation and Disruption at the Grid's Edge: How Distributed Energy Resources are Disrupting the Utility Business Model, pp. 363-363. DOI: 10.1016/B978-0-12-811758-3.00018-8	YES
41	Lynch, P.J., Power, J., Hickey, R., Messrevey, T.B. Business model strategies: Flexibility trade in low voltage distribution networks (2017) Entrepreneurship and Sustainability Issues, 4 (3), pp. 380-391. DOI: 10.9770/jesi.2017.4.3S(12)	YES
42	Hamwi, M., Lizarralde, I. A Review of Business Models towards Service-Oriented Electricity Systems (2017) Procedia CIRP, 64, pp. 109-114. DOI: 10.1016/j.procir.2017.03.032	YES
43	Simha, P., Venkat, K. Bioenergy in the republic of Macedonia: Regulatory uncertainties, EU policies, and civil society opinions shape the narrative (2017) Periodica Polytechnica Social and Management Sciences, 25 (2), pp. 79-86. DOI: 10.3311/PPso.9796	NO
44	Bellekom, S., Arentsen, M., van Gorkum, K. Prosumption and the distribution and supply of electricity (2016) Energy, Sustainability and Society, 6 (1), art. no. 22. DOI: 10.1186/s13705-016-0087-7	YES
45	Lynch, P., Power, J., Hickey, R., Kelly, D., Messervey, T., Espeche, J.M., Oualmakran, Y. Maximising value for local flexibility management in low voltage distribution networks (2016) IEEE 2nd International Smart Cities Conference: Improving the Citizens Quality of Life, ISC2 2016 - Proceedings, art. no. 7580830. DOI: 10.1109/ISC2.2016.7580830	YES
46	Kirchhoff, H., Kebir, N., Neumann, K., Heller, P.W., Strunz, K. Developing mutual success factors and their application to swarm electrification: microgrids with 100 % renewable energies in the Global South and Germany (2016) Journal of Cleaner Production, 128, pp. 190-200. DOI: 10.1016/j.jclepro.2016.03.080	YES
47	De Vries, G.W., Boon, W.P.C., Peine, A. User-led innovation in civic energy communities (2016) Environmental Innovation and Societal Transitions, 19, pp. 51-65. DOI: 10.1016/j.eist.2015.09.001	NO
48	Koirala, B.P., Ávila, J.P.C., Gómez, T., Hakvoort, R.A., Herder, P.M. Local alternative for energy supply: Performance assessment of integrated community energy systems (2016) Energies, 9 (12). DOI: 10.3390/en9120981	YES
49	Lenz, N.V., Prša, V. Growth potential of energy sector reforms: New evidence on EU and Southeast European countries by exploring impact on electricity generation [Article@Potencijalni učinak reformi u energetskom sektoru na ekonomski rast: Novi dokazi o proizvodnji električne energije	NO

	u EU i zemljama jugoistočne Europe] (2015) Zbornik Radova Ekonomskog Fakultet au Rijeci, 33 (2), pp. 275-297. DOI: 10.10.18045/zbefri.2015.2.275	
50	Bottaccioli, L., Patti, E., Acquaviva, A., Macii, E., Jarre, M., Noussan, M. A tool-chain to foster a new business model for photovoltaic systems integration exploiting an Energy Community approach (2015) IEEE International Conference on Emerging Technologies and Factory Automation, ETFA, 2015-October, art. no. 7301559. DOI: 10.1109/ETFA.2015.7301559	NO
51	Dóci, G., Vasileiadou, E., Petersen, A.C. Exploring the transition potential of renewable energy communities (2015) Futures, 66, pp. 85-95. DOI: 10.1016/j.futures.2015.01.002	NO
52	Huang, Y., Warnier, M., Brazier, F., Miorandi, D. Social networking for Smart Grid users (2015) ICNSC 2015 - 2015 IEEE 12th International Conference on Networking, Sensing and Control, art. no. 7116077, pp. 438-443. DOI: 10.1109/ICNSC.2015.7116077	YES
53	Romero-Rubio, C., de Andrés Díaz, J.R. Sustainable energy communities: A study contrasting Spain and Germany (2015) Energy Policy, 85, pp. 397-409. DOI: 10.1016/j.enpol.2015.06.012	NO
54	Tosun, J., Schulze, K. Compliance with EU biofuel targets in South-Eastern and Eastern Europe: Do interest groups matter? (2015) Environment and Planning C: Government and Policy, 33 (5), pp. 950-968. DOI: 10.1177/0263774X15605923	NO

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837752.