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

Deliverable 4.6

Final report on clean energy community business models: emergence, operation and prospects of European case studies

Version: 1

WP4: Emergence and operation of NEWCOMERS

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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.

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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/

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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

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1 EXECUTIVE SUMMARY

This report examines the emergence, operation and prospects of energy communities (ECs) based on a set of European case studies. It analyses ECs as organisational innovations within energy systems that are themselves in transition. There is a particular focus on the business models (BMs) of ECs, as these offer concise summaries of how communities aim to create, deliver and capture value for their members and for others.

Two questions drive the investigation: What makes energy community business models viable? What are energy communities' prospects for growth? In order to answer these, WP4 of the NEWCOMERS project examined 10 emerging ECs in Germany, Italy, the Netherlands, Slovenia, Sweden and the United Kingdom, over a period of two and a half years. Nine were locally based while one was a 'virtual community' of scattered electricity customers, coordinated by an energy company. Each EC operated in differing regulatory and social contexts and relied to varying degrees on specific technologies, skills and external support.

The report is based on a mixed-method study of the 10 communities, with data from stakeholder dialogues, surveys, interviews, an international stakeholder workshop, documents and quantitative assessment. The empirical material is framed and interpreted with assistance from the research and grey literature on community and local energy.

We have used a 'business model lens' to explore how ECs create and deliver value for stakeholders in energy systems. This approach emphasises the *actors* and *technologies* involved in ECs and the *value* created through their interactions. It has led to an analysis of business model activity systems in which the lens is applied beyond a single focal organisation to consider its relationships with other system actors.

Our findings can be summarised in terms of emergence and operation of ECs. Based on these, we conclude with some comments on value propositions, the study of EC business models and prospects for ECs in European energy transitions to renewables-based systems.

Emergence

New EC BMs rarely, if ever, start from scratch but re-order relationships between consumers and wider energy system actors, to create new value propositions. With the growing number of social, technical, political and scientific factors at play in energy systems, the array of possibilities for ECs has become wider. While all the NEWCOMERS case study communities stemmed from a common motivation – to contribute to energy transitions – they emerged in a variety of forms. We identified the main factors shaping those emerging forms:

- **The regulatory environment**, which defines the rules for energy generation, trade, storage and consumption; and the rules for EC constitution and governance. The changeable nature and complexity of energy system regulations can make them difficult to navigate, especially where professional support is lacking.

- **Energy infrastructure and assets available to a community**, including generation assets as well as equipment/ appliances for demand-side management, appropriate metering and controls, and a local power network able to adapt to new activities.
- **Social capital**: the knowledge, experience and trust that an EC can draw upon. These influence perceptions of feasibility, uncertainty and risk.
- **Alliances and networks**. All the studied communities had to partner with other organisations at some point in their development, for example to gain access to knowledge and skills, and to address institutional barriers. In most cases an established (licensed) energy supplier became involved to enable operation.
- **Leadership**, usually stemming from one or two highly motivated and energetic individuals. Their personal and professional networks can also be a valuable resource for ECs.
- **Good luck**: Serendipity was mentioned by several EC members, understood as the right people being in the right place at the right time. In policy terms, this is perhaps best understood as a reason for setting up an enabling environment for energy transitions and community-level participation, so that serendipity becomes more likely.

Operation

We identified three characteristics that benefit EC operation:

Alliances to increase operational options. A marked characteristic of the NEWCOMERS ECs was their ability to form alliances in order to increase the activities and possibilities open to them. Established (licensed) energy suppliers were particularly prominent, involved in all ECs that operated 'in front of the meter' (rather than 'behind the meter', as a single collective customer). Non-local actors typically brought skills, knowledge and operational capabilities to participate in electricity markets. Nevertheless, structures for governance and decision-making varied considerably. At one end of the spectrum EC decisions were made by a single actor; at the other, they were typically made by voting, with one vote per member.

New technologies. Although in most cases new technologies were not the focal point of the EC, all the BMs involved their use to some extent, ranging from analogue devices to simple digital communication to applications based on machine learning and automation (e.g., sonnenCommunity, SO_EN Social Housing). Less established technologies are more likely to cause unforeseen challenges or delays and to carry a greater financial risk; they also often require more expert knowledge.

A range of values. To be viable in the long run, an EC needs to be able to provide value beyond that supplied directly to its members. Over 50 different types of value (economic, environmental, social and technical) could be identified and linked to one or more beneficiaries: direct and indirect benefits to members, their local communities and society in general, including progress towards government goals.

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The challenge of valuing EC services and benefits

There are continuing difficulties in valuing the services that ECs can provide to the systems (electrical and social) that they form part of. It is difficult to put a figure on a social good such as social cohesion. It is also hard to value the services that ECs could provide in terms of reducing carbon emissions, providing local demand flexibility and offering ancillary services to grid operators, as few are yet equipped, organised and regulated in such a way that these services are enabled.

As a consequence, ECs still provide few direct benefits to electricity systems, while the indirect benefits they offer are poorly recognised and rewarded. Recognising ECs for their full value propositions may mean adapting how societies organise energy systems, to include democratisation, equity and inclusivity as guiding principles alongside competition, security, and reduced environmental impact.

Studying business models

New EC BMs rarely, if ever, start from nothing; instead, they re-order existing relationships between consumers and wider energy system actors, to create a range of new (complementary) value propositions. We recommend adopting an 'activity system perspective' which recognises that EC activities span geographical and organisational boundaries, as a helpful way of studying EC business models.

Prospects for energy communities in Europe

One driver for communities to multiply or replicate is through market-based mechanisms. Commercial actors may replicate BMs or parts thereof if there are suitable incentives, once a model has proved viable. A second driver for replication is non-market: ECs may grow when actors share their experiences, knowledge and skills with others who are able to translate an EC model to fit with conditions in their locality. In practice, both are likely to be needed for the spread of ECs, along with supportive regulation. A decisive factor will be the way countries transpose the EU-wide Clean Energy Package into national laws and regulations.

ECs are likely to play different roles with differing national transformation pathways, but they will pose similar challenges to traditional forms of energy governance. There is a perceived need to ensure that community energy does not weaken or circumvent market principles such as consumer rights and cost sharing. Another major regulatory issue is network reliability at a time when supply is increasingly distributed between many generators, and patterns of demand are shifting. The need for reliability can be used as an argument against continued growth of ECs. However, it is hard to see how a renewables-based, near-zero-carbon-demand system can operate effectively without harnessing community-level resources and activities to assist with system management. The growth of community-utility alliances, as observed in the NEWCOMERS project, shows how system operators and suppliers are recognising this. The project findings indicate that the challenges of negotiating alliances are worthwhile, in the cause of reconciling energy democratisation and community action with the technical and organisational complexity of creating stable, secure, reliable low-carbon energy systems.

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2 INTRODUCTION

2.1 Background

Driven by the trends of decarbonisation, digitalisation, and decentralisation – the 'three Ds' – energy systems are in a state of flux (Di Silvestre et al., 2018). As the urgency of a transition to renewables-based, low-carbon systems is growing, there is increased recognition of the importance of making systems people-centred, adding a fourth 'D': democratisation. The assumption is that timely, durable changes to renewable energy cannot be achieved without popular support and involvement (Barnes, 2021; IEA, 2021). One way to promote this change is through the development and growth of energy communities.

Energy communities (ECs) are a relatively new concept that has gained prominence since its introduction in the EU Clean Energy Package (CEP) (European Commission, 2020). Initiated in 2015 and formally agreed in 2019, the CEP describes two kinds of energy communities (renewable and citizen ECs, see section 3.1), and defines them as new types of legal entities.

Conceptually, renewable and citizen energy communities can be seen as bringing together elements of two previously distinct areas of activity: 'community energy' and 'local energy'. This is illustrated in Figure 1. *Community energy* is premised on the idea of active citizenship and defined in terms of open and participatory processes aimed at delivering local and collective outcomes (Devine-Wright, 2019; Walker and Devine-Wright, 2008). Such community-based activity on energy has a long history across Europe and, over the past decade, has flourished particularly in Germany, the Netherlands and the UK (Bauwens et al., 2016; Oteman et al., 2014; Seyfang et al., 2013; Wierling et al., 2018). This success is often credited to national policies promoting the uptake of renewable energy generation technologies (Hewitt et al., 2019; Nolden, 2013). In addition, community energy initiatives have relied heavily on the commitment of volunteer-based community organisations to lead their development and operation.

Local energy, in contrast, is a more recent phenomenon involving incumbent utilities and new market entrants such as technology start-ups and demand aggregators seeking to exploit the commercial potential of novel, locally based (decentralised) energy solutions (e.g., Devine-Wright, 2019). While 'community energy' foregrounds citizen participation and community value, 'local energy' retains a more conventional business focus on replicable, for-profit activities in novel energy system configurations.

With the decarbonisation, digitalisation, and decentralisation of energy systems, these two types of activity are now converging, defining the conceptual and operational space in which ECs operate. Changes to national policies supporting the deployment of renewable energy technologies have shifted away from subsidy-based schemes towards market-based mechanisms (Burger et al., 2020) and such changes have encouraged volunteer-led community organisations to become increasingly entrepreneurial and professionalised (Nolden et al., 2020). At the same time, incumbent energy utility business models are facing increasing pressure to reform (Richter, 2012) whilst decreasing costs associated with

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renewable energy technologies are creating opportunities for new organisations and for consumers to play more active roles as stakeholders in energy systems (Barnes, 2021). In this context, ECs represent new ways of organising and acting on energy issues that aim to combine democracy, citizen participation, environmental and financial sustainability, and technical and business innovation.

At the intersection of community action and commercial activity, ECs aim to build on the potential for collectives to harness benefits for local communities, energy systems, and society at large. This organisational innovation is the focus of this report, which investigates the emergence and operation of energy communities and the innovative business models they develop to deliver value and assesses their prospects across Europe. Two questions drive this investigation:

- What makes energy community business models viable?
- What are energy communities' prospects for growth?

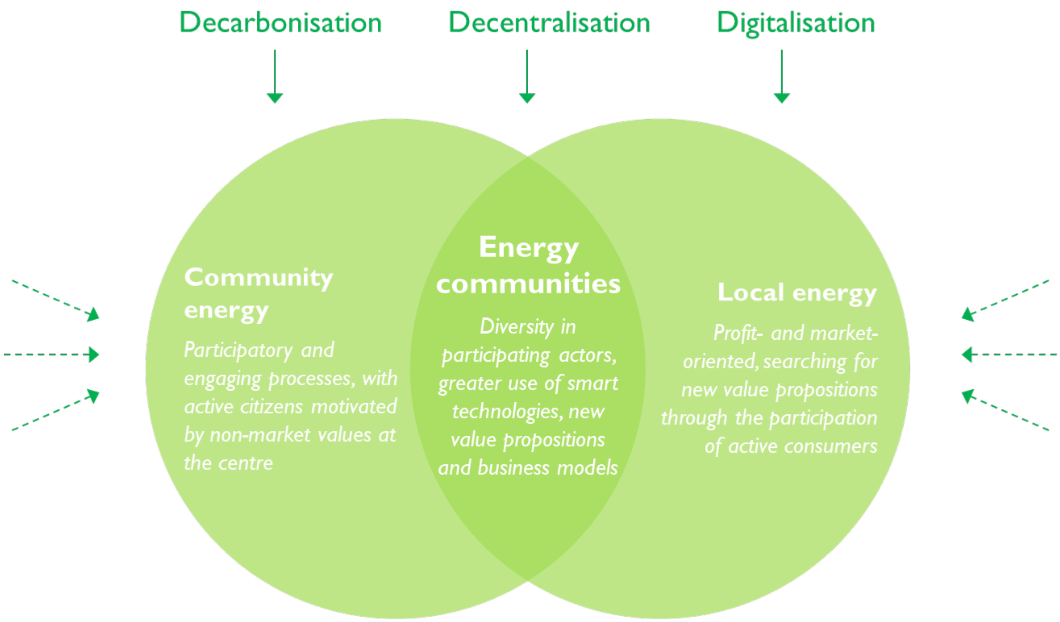

Figure 1: Energy communities as emerging from the intersection of two previously distinct areas of activity, situated within energy systems shaped by three broad trends (adapted from Grijp et al., 2019).

2.2 Role and structure of this report

This report is the final deliverable of Work Package 4 (WP4) of the NEWCOMERS project. It builds on and expands the comparative analysis of 10 in-depth case studies of new energy communities in six European countries to answer the two research questions posed above. It also feeds into WP7 (Synthesis and co-creation of policy recommendations). The report integrates insights from all WP4 activities and draws on various outputs prepared as part of this WP. A list of all WP4 outputs is provided in Annex 1. Summary case study reports can be accessed in Annex II to this document.

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The report proceeds as follows. **Chapter 3** outlines the research approach taken. **Chapter 4** discusses how ECs emerge and outlines the factors involved. **Chapter 5** presents insights regarding EC operation: it discusses actors, technologies, and the values produced by our case study ECs as key elements of their business models. **Chapter 6** discusses the prospects for EC business models. **Chapter 7** concludes.

3 Research approach

This chapter introduces our definition of energy communities, provides a theoretical background and outlines the research methods used in WP4 activities.

3.1 Defining energy communities

In this report, energy communities 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*.

This definition follows that proposed by Blasch et al., (2021). Table 1 compares this NEWCOMERS definition with the definitions of ECs adopted by the European Commission in the Clean Energy for All Europeans Package[1].

Table 1: Legal definitions of ECs within the Clean Energy Package (European Commission, 2020) compared to the working definition of ECs used in this report. Definitions are provided in two directives: the Internal Electricity Market Directive (IEMD), and the recast Renewable Energy Directive (RED II).

Citizen Energy Communities	*Renewable Energy Communities*	*NEWCOMERS definition*
Article 2(11) IEMD defines CECs as legal entities: • That are based on voluntary and open participation; • That are effectively controlled by members or shareholders who are natural persons, local authorities, including municipalities, or small enterprises; • Whose primary purpose is to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates rather than to generate financial profits; • That are allowed to engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric	Article 2(16) REDII defines RECs as legal entities: • That are based on open and voluntary participation; • That are autonomous and effectively controlled by members (who are natural persons, SMEs, or local authorities) located in the proximity of the renewable energy project that are owned by the REC; • Whose primary purpose is to provide environmental, economic, or social community benefits for their shareholders or members or for the local areas where they operate rather than financial profits; • That are allowed to produce, consume, store, share, supply, and sell renewable energy, provide aggregation, provide commercial energy services, and act as DSOs.	Associations of actors engaged in energy system transformation for reduced environmental impact, through collective, participatory, and engaging processes and seeking collective outcomes

[1] *The CEP consists of eight legislative acts, two of which contain definitions of ECs: the recast Electricity Market Directive and the Renewable Energy Directive. The differences between definitions stem largely from the orientation of directives, towards electricity markets and the promotion of renewable energy respectively.*

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vehicles or provide other energy services to its members or shareholders.		

Our definition differs in at least two respects:

- it recognises the increasing diversity of actors involved in new energy communities. Alongside 'bottom-up' initiatives with the active participation of energy citizens, institutional actors new to energy communities are now routinely involved. These include municipalities exploring ways to meet local decarbonisation targets, incumbent energy utilities seeking to diversify their business models and new market entrants exploiting emerging opportunities.
- rather than defining specific activities that may be pursued, it creates a more dynamic and open operational space that accommodates possibilities in increasingly distributed, 'smart' and localized configurations of demand, supply, and storage.

Note that we define energy communities based on prominent characteristics of the phenomenon and not in relation to their (potential) business models. The way BMs develop is part of the investigation (and a worthwhile undertaking in part because of the nature of ECs).

3.2 Energy communities as business model innovations

With the coming together of community action and commercial activity (Figure 1), a defining feature of 'newcomer' energy communities is the development and use of innovative business models that deliver new value propositions. In the last two decades, business models have been increasingly used to understand an organisation's role in economic and social change. They can be used to analyse, explain, differentiate or assess an organisation's activities. As stories about how organisations 'do business' (Magretta, 2002), they can be used to explain competitive strategies, as well as the institutional and financial architecture of businesses (Teece, 2010). They include implicit and explicit assumptions about, for instance, focal activities and customers (Teece, 2010).

Central to all research on business models is a focus on

- value propositions, typically concerning product or service offerings;
- value creation and delivery, including the resources, activities, partners and technologies required to deliver value propositions; and
- value capture, the means through which businesses earn revenues (Osterwalder & Pigneur, 2010).

One growing body of academic research explores how BMs co-evolve with other elements of socio-technical systems, such as technologies, users, policies and markets (Bolton & Hannon, 2016). Within energy systems, a variety of elements may influence the design and viability of business models. This includes market design and changes in national policies, for instance the promotion of renewable generation technologies, which can open up new or close down value creation

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pools (Hall et al., 2020). Technological change (e.g., declining solar PV costs or the development of smart technologies) can influence business activities and the value they create. In short, BMs do not develop or operate in isolation: they shape and are shaped by broader elements of socio-technical systems.

Emphasising the interactions between elements in energy systems highlights the role BMs may play in influencing system transformations (e.g., Bolton & Hannon, 2016; Hiteva & Foxon, 2021). In this report, a 'business model lens' is used to explore how energy communities create and deliver value for stakeholders in energy systems. Analytically, this approach emphasises the *actors* and *technologies* involved in ECs and the *value* created through their interactions. Each of these can be assessed at different stages of EC development. Distinguishing between the emergence, operation and prospects of energy communities provides a means of investigating the dynamics and processes through which they arise, their core activities, the arrangement of actors and technologies, EC viability in markets, and their potential to grow and diffuse across Europe. Figure 2 summarises this approach.

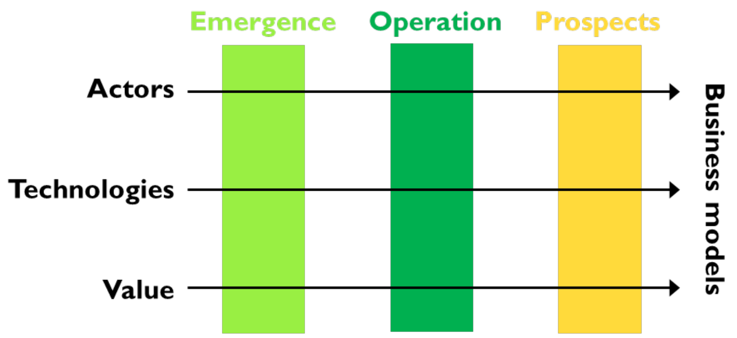

Figure 2: Key elements and themes of the WP4 research approach. Actors, technologies, and value are understood as key elements of business models which were considered in terms of their emergence, operation and prospects.

Building on this approach, questions were formulated to guide the research (shown in Table 2) that address actors, technologies, value, and business models, along with these research objectives:

- Conduct in-depth case studies of EC BMs;
- Explore the conditions that have led to their emergence;
- Analyse the configuration of actors, technologies and institutions involved in each EC, their use of technologies, mobilisation of resources, forms of collaboration, value creation and financial models;
- Evaluate the prospects of EC BMs.

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Table 2: Research questions for each of the guiding themes.

Theme	Research questions
Actors	Who is involved in the EC and what are their roles? What knowledge and skills are needed to develop and operate ECs?
Technologies	What technologies are employed in ECs? What are the advantages and disadvantages of certain novel technologies, including smart applications? What implications do they have for the viability of different EC BMs? What influences the choice of technologies employed in ECs?
Values	What forms of value do case study communities currently generate and for whom? What values do ECs provide to the energy systems they are connected to?
Business models	How are actors and technologies connected to deliver products or services? How do ECs emerge? How do they operate? How replicable and/or scalable are ECs likely to be? How might scaling/replication occur?

3.3 Research methods

Ten in-depth EC case studies were conducted to examine their emergence and operation, and assess their prospects for growth and replication. Cases were selected based on the diversity of their activities (including generation, efficiency, storage, and trading of electricity), the use of innovative and smart technologies, and the diversity of participating actors (see Table 3). Summary case study reports for each are provided in Annex 2. Each consortium partner organisation was responsible for communicating with the case study communities in their country.

Primary sources of information were:

- Stakeholder dialogues held in early 2020 to establish a baseline understanding of the case studies, and explore stakeholders' expectations and assumptions regarding the research;
- Interviews with EC practitioners, conducted in the second half of 2020, which served as the most important primary data source;
- An international stakeholder workshop, held in October 2021, which helped researchers to reflect on and validate findings in conversation with practitioners from case study communities.

The research also benefited from exchanges between consortium partners. Regular discussion meant that our understanding of the case studies was regularly updated as they evolved. WP4 activities were carried out by several partners. The University of Ljubljana team led the analysis of knowledge and skills (deliverable 4.3). The same team was also involved in delivering the international stakeholder workshop and contributed greatly to our understanding of value. All consortium partners, and especially the GEN-I team, supported the analysis of

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distributed energy resources (DERs) and system interactions. Local case study contacts solicited additional data from their local case study communities for this purpose. The GEN-I team carried out an analysis of system interactions (Task 4.5).

The data analysis was based on the analytical framework described in section 3.2 and involved several tasks. These included:

1. **Basic mapping of actor-technology relationships and resource flows** to gain a baseline understanding of how case study communities operate.
2. **Applying the standard 'business model canvas' to the case studies** to gain a baseline understanding of the business models used, and the value created and captured.
3. **Narrative analysis of case study communities' emergence** to identify enablers and barriers and to understand actors' motivations and the role of context.
4. **Systematic (rapid) review on the concept of smartness in energy communities** to clarify what it means conceptually and practically. This analysis has been published as a conference paper (Hansen et al., 2021).
5. **Assessing DERs, conceptually and in the context of the case studies,** to address task 4.4 of WP4. The analysis progressed our understanding of the value ECs may create for energy systems. A working paper discussing this analysis is available online (Hansen & Barnes, 2021).
6. **Analysis of BM governance** to examine the relationships between different actor constellations and BM activities. This analysis has been published as a book chapter (Barnes & Hansen, forthcoming).
7. **Analysis of BM activity systems** to advance understanding of the networked nature of EC BMs. In contrast to other BM approaches (such as the BM Canvas applied at the beginning of the research), an activity system perspective sees business models as "systems of interdependent activities that transcend the focal firm and span its boundaries" (Zott and Amit, 2010). It thus offers more nuanced insight into how value is created and captured in relation to the actors involved. This analysis will be published as a journal article.
8. **Analysis of the extent of community participation in the emergence and operation of BMs** to understand when and how community members may be involved in different types of ECs, and as a basis for reflection on energy system democratisation.

The remainder of this report describes and discusses the findings of the work package. Following the approach shown in Figure 2, **Chapter 4** presents findings on the emergence of ECs and their BMs. **Chapter 5** discusses how EC BMs operate by addressing the three core components of actors, technologies, and value. **Chapter 6** offers insights and reflections on the prospects of ECs in Europe.

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Table 3: Overview of case studies.

Name	Description	Country, setting	Started	Status
Buurtmolen Herbaijum	A renewable energy cooperative that facilitates member consumption of electricity from a local collectively-owned wind turbine	The Netherlands, rural	2017	Operational
Buurtmolen Tzum	A cooperative wind energy project at the planning and design stage, seeking to replace an existing wind turbine, foster community ownership and enable collective self-consumption	The Netherlands, rural	2016	Under development
Dalby Solby	A housing cooperative that aims to promote sustainable living and has implemented electricity generation and energy saving measures on communal buildings	Sweden, sub-urban neighbourhood	1978	Operational
Energy Local	A new approach linking local renewable generators with local consumers to reduce costs and increase local consumption of renewable energy through the creation of 'Energy Local clubs', using smart devices with communication and data transfer technologies.	United Kingdom, rural	2016	Expanding
Economia Rinnovabile e Circolare (ERiC)	A non-profit organisation promoting a sustainable circular economy by facilitating household purchase groups for solar PV.	Italy, regional (Sicily)	2018	Operational
GEN-I Jesenice	Apartment owners working in cooperation with a national utility to lower bills and reduce carbon emissions through implementation of onsite measures including solar PV and heat pumps	Slovenia, apartment block	2019	Operational
Project Z	A neighbourhood community trading surplus domestic generation to maximise consumption of local renewable generation and reduce reliance upon the grid.	Germany, neighbourhood	2019	Pilot

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Solidarity & Energy Social Housing (SO_EN)	A community-orientated energy service company premised on fostering energy equity and reducing social inequality through the provision of generation and storage assets and a 'social algorithm' to distribute payments between residents.	Italy, apartment block	2019	Under development
sonnenCommunity	A top-down 'virtual community' of prosumers sharing energy between members through cloud-based software.	Germany, national	2016	Expanding
Zuiderlicht	A cooperative of approximately 900 members, who collectively own and manage 18 roof-mounted PV installations.	The Netherlands, city	2013	Expanding

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4 Emergence of energy communities

ECs are forming as the lines between bottom-up community action and top-down commercial activity are becoming increasingly blurred. This chapter explores in more detail what affects this emergence, and outlines some of the critical factors for ECs to become established.

Investigation of the 10 NEWCOMERS communities suggests that the energy transition as a phenomenon in its own right is often what inspires the development of new ECs. All NEWCOMERS case studies share a similar motivation: contributing, in some form, to the success of energy transition. This may be framed in various ways, although participation appears to be a theme. A common means of participating – and sometimes a motivating factor itself – is through ownership of renewable generation assets. In terms of the general themes of energy transition, one might argue that this kind of motivation is most closely linked to objectives of democratisation and decarbonisation.

Contributing to the energy transition may alternatively be framed in terms of making it as easy as possible for people to join by creating more choice (for example, of technologies, tariffs and contracts) for energy users. This framing of participation, in which non-energy-professionals are still seen primarily as consumers rather than actors and investors/owners, is likely to be used by market incumbents and new entrants in pursuit of BM innovation. These two types of motivation are reminiscent of the differentiation between community energy and local energy, described in the Introduction.

The emergence of ECs is also shaped by other factors. Importantly, policy and regulatory changes affect how ECs emerge by defining the realm of (legal) possibilities for action. The rules that shape how energy is generated, traded, sold and used shape what is valued within the system at any point (in time and along the supply chain), and therefore the kinds of activities ECs can engage in. Legislation also shapes the constitution and governance of ECs. EC activities and BMs have co-evolved with these rules and continue to do so.

Specific rules targeting ECs can be critical enablers for their development. Grants, feed-in tariffs and (virtual) net metering arrangements have been particularly influential in the NEWCOMERS case studies. For example, GEN-I Jesenice made use of a new piece of legislation on collective self-consumption in its design; the SO_EN Social Housing project is currently re-evaluating its operational model after a new law came into force in 2020 allowing apartment buildings to become ECs.

At the same time, a lack of suitable support mechanisms can be just as decisive in steering the development of ECs by creating a barrier to realising new models. The changeable nature and complexity of regulatory and legislative environments can make them difficult to understand and comply with, especially where professional support is lacking. Some ECs have more access to such support than others; if it is not available from knowledgeable members, they may have to pay for it from consultants or form alliances with organisations that have the skills to navigate the regulatory landscape.

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The possibilities from which an emerging EC can choose, and their feasibility, also depend on what energy infrastructure and social capital already exist in each community: Resources and experience often influence the choices ECs make in their development, influencing perceptions of uncertainty and risk. One example, linked to the impact of regulation and legislation, is the use of tried-and-tested models. Greenchoice, a supplier associated with the case-study communities Buurtmolen Herbaijum and Buurtmolen Tzum, used their experience with Herbaijum to develop a replicable model of working with ECs that is now being used by the Tzum community.

Another resource ECs may build on is customers. An example of this is E.ON's Project Z. This community allows E.ON to develop a new service proposition that may eventually be available to many of its customers. It consists of a local group of E.ON customers that volunteered their involvement in a trial of technologies and procedures.

Project Z is also an example of a community that uses pre-existing renewable generation assets in its business model. In contrast to many early forms of ECs, the BM does not include or require a financing mechanism for new assets but involves members who already have solar PV installed on their roofs. Other communities that use existing generation assets are Energy Local and the sonnenCommunity.

Resources that can be essential for the development of ECs are the knowledge, experience and capabilities held by other organisations. All ECs studied in the NEWCOMERS project have had to partner with other organisations at some point in their development, for example to source knowledge and skills, or to address institutional barriers. In most cases an established (licensed) supplier became involved to enable an operational model. Beyond this, the alliances formed by ECs differ in type and purpose, include short- as well as long-term partnerships, and range from back-end or admin support to the provision of essential technical functions. Because of the importance and prominence of alliances between different actors, they are discussed in more detail when we address actors in the operation of EC BMs (section 5.1).

A supportive institutional environment, access to resources that lower uncertainty and risk, and suitable collaborators all favour the emergence of ECs and the likelihood of developing viable BMs. However, even when all these conditions are met, ECs – as any organisation – require leadership. The NEWCOMERS case studies are mostly led by enthusiastic individuals who in many cases have professional experience in the energy sector and/ or an educational background in a related discipline. This enables them to recognise problems for system operation and develop solutions.

Case study communities that feature leaders with prior energy system knowledge include the ERiC Project, GEN-I Jesenice, and Energy Local (see Annex 1 for details). Other case studies saw a professional organisation taking a leading role instead. For example, Project Z and the sonnenCommunity were developed by a large energy utility and a battery storage manufacturer respectively.

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Personal and professional networks constitute another important resource for the development of ECs that leaders often draw on. For example, in the case of Zuiderlicht, a contact at the municipality of Amsterdam led to the municipality becoming a crucial initial project partner and enabling the development of subsequent projects. In the ERiC project, founders used their personal and professional networks to conduct an initial survey that informed the development of the project. At GEN-I Jesenice, the relationship between the lead resident in an apartment block and the GEN-I subsidiary company GEN-I Sonce enabled the organisations' collaboration. One reason why pre-existing relationships are important enablers of ECs is because they come with a baseline level of trust. The NEWCOMERS cases strongly suggest that trust between community members, and between the community and its leader(s), are essential in establishing viable ECs.

Finally, even where the most capable people lead a trusting community, a measure of serendipity – good luck - is needed to enable operational ECs. As one practitioner stated, "a lot of things have to come together to make it work": getting ECs up and running is a non-trivial undertaking. In addition to enthusiastic leaders, significant time and resource commitments, and institutional support, luck can make the difference between success and failure. Several practitioners of NEWCOMERS case studies explicitly pointed to serendipitous events that were essential in developing their projects. For example, Zuiderlicht considered it lucky that the first two collaborations with roof owners came about. The project's viability couldn't be demonstrated without collaborators (roof owners), but because viability was not proven yet, participation involved a high level of risk. Because of these first two collaborators who were willing to take on the risk, Zuiderlicht was able to demonstrate the viability of their model, thus lowering the risk for future collaborators. An Energy Local co-founder told how their ability to start the project was the result of a series of serendipitous events, with the right people meeting at the right time: "there was an awful lot of serendipity, of things coming together" .

Figure 3 illustrates the various critical factors identified through the research as influencing the formation of ECs. External, structural factors (institutional support and existing resources) are positioned on one side, with internal 'softer' factors like trust, leadership, and collaboration on the other. Serendipity as the least tangible factor, bridges both sides.

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Figure 3: Critical factors shaping the emergence of energy communities.

In summary, the way ECs emerge as a new organisational configuration in energy systems is non-linear and dynamic. They are often motivated by a desire to contribute to the energy transition, but are constrained by what is already in place, including policy, regulation, and resources. Given the number of factors at play, the array of possibilities for ECs has become wider, anywhere on a spectrum from highly people-centred 'community energy' to more techno – and system-centric 'local energy'. Beyond structural factors such as regulatory incentives and disincentives, support and challenges, however, it is the people on the ground and at the 'grid edge' that determine whether a given model becomes operational, through leadership capabilities, trust, and the ability to forge productive collaborations. These can be hard to grasp, assess and support with policy mechanisms.

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5 Operation of energy communities

Three broad kinds of changes characterise ECs and set them apart from earlier community and local energy models (see Figure 1): a greater variety of actors involved in their development and operation, use of new technologies, and broader sets of values to be delivered. In this section, we examine what these trends mean for the operation of ECs and their BMs.

5.1 A greater variety of actors

Forming alliances

Across the ten cases studied a wide range of actors were involved, from local community members to government agencies and commercial enterprises. Licensed (established) suppliers were particularly prominent, involved in all ECs that operated 'in front of the meter'. In only three case study communities (Dalby Solby, the ERIC project and SO_EN), each of which operate as a single collective customer behind a single meter point, were suppliers not prominently involved. Beyond the suppliers, other actors support ECs at different stages of their development, providing products or services as needed. WP4 research found that in addition to such collaborations, a marked characteristic of ECs is the formation of alliances in their governance.

BM governance, in the sense used here, includes the design, management and delivery of business activities: it influences who is involved in the business and how (Brown, 2018; Zott & Amit, 2010). Such governance arrangements can vary in complexity and sophistication. Some BMs may be contained within a single, often hierarchical, organisational/institutional actor. Others may involve actors who collectively provide a product or service, typically resulting in interdependencies maintained through trust or contractual relations.

Three ideal-typical representations of BM governance in ECs can be identified, each associated with a range of BM activities (Barnes and Hansen, forthcoming). They are summarised in the top half of Table 4, whilst the BM activities associated with each are summarised in the bottom half of the table. The first representation, the idea of *doing it yourself,* places emphasis on collective decision-making, and the coordination and management of business activities within a single collectively controlled organisation. The second, *forming an alliance,* reflects the rise in formation of alliances to perform new energy activities. The third, *someone else doing it for you*, is premised on the development and implementation of replicable BMs by others to solve systemic issues. Each has distinct motivations and attitudes to governance.

Analysing BM governance arrangements provides one means to describe and differentiate emerging ECs. It also provides insights into the BM activities that can be pursued under each arrangement and the viability of certain BM activities for some actor combinations. The case study communities suggest that the range of activities open to ECs in which members retain sole control over the design, management, and operation of their BMs is small, in comparison with the wide range of BM archetypes often put forward as being possible (see for instance

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Brown et al., 2019; Reis et al., 2021). ECs employing *do it yourself* governance arrangements have historically been involved in collective renewable generation projects, at times combined with use onsite behind a single meter point. Analysis of our case studies suggests this is still the case, whilst finding ways to go further and collectively self-consume local renewably generated electricity requires partnering with others.

Table 4: Ideal-typical governance arrangements and associated activities of ECs (Barnes and Hansen, forthcoming).

Governance arrangement		*Do it yourself*	*Form an alliance*	*Someone else does it for you*
Business model governance	*Actors*	Single local organisation of individuals acting collectively	Networks of local and non-local actors including individuals acting collectively, SMEs, municipalities, and commercial enterprises	Single organisations or networks of non-local institutions working in partnership across sectors
	Motivation	Diverse, addressing community needs and tackling wider environmental challenges	Overlapping and competing	Financial gain through identifying locally beneficial solutions that are replicable elsewhere
	Attitude to governance	Emphasis on participation and consensual decision-making	Largely based on trust, underpinned by contracts	Fundamentally market driven
Business model activities	*Associated BM archetypes*	Collective generation; collective self-consumption;	Local supply arrangements; Micro-grids; private wire; Energy Service Company (ESCo)	Peer-to-peer; Virtual Power Plant; local energy market; aggregator
	Position in relation to infrastructure	Typically 'behind the meter' – acting as a single customer	Across multiple meter points but at low voltage levels	Across meter points (no scale limit)
	Interaction with value chains	Limited and discrete; adjunct	Potentially disruptive but reliant upon continued	Potentially disruptive

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			functioning of existing value chain	across full value chain
	Relation to energy markets	Largely separate	Protected engagement: resulting from market rules or relation to infrastructure (behind the meter)	Fully integrated

Forming an alliance with others opens up a wider array of BM activities including local supply arrangements, the development of micro-grids suppling multiple users, and ESCo models. Non-local actors, in particular, enlarge the range of activities an EC may engage in, typically bringing skills, knowledge and operational capabilities to participate in electricity markets, including the back-office services required to supply electricity to customers.

The full range of BM activities is only open to ECs where some functions can be organised by commercial, non-local actors. Studied cases which fit within this representation (Project Z and sonnenCommunity) indicate that their activities are unlikely to be limited to low voltage networks and may be fully integrated across electricity market value chains so that, for example, participants can contribute to peak demand reduction for the grid as a whole. The central reason for the formation of alliances in EC BMs is that developing and operating NEWCOMERS requires a wide range of skills and knowledge that often goes beyond what any one individual or organisation possesses.

Sourcing the knowledge and skills needed to design and implement shared renewable energy systems is an important part of EC development, as outlined above. These typically come either from community members (e.g., by offering their professional expertise), or from partnering organisations. From the cases studied, four broad types of knowledge are relevant to the development and operation of ECs: technical, legal and business knowledge, and knowledge about human behaviour (Golob, Kamin & Kogovšek, 2020). While the first three have been discussed in the literature (e.g., Seyfang et al., 2013), the fourth was not anticipated but discovered during the NEWCOMERS project; and was found to be very important by interviewees (Golob, Kamin & Kogovšek, 2020). It includes, for example, knowledge about cultural, geographic and demographic characteristics, individual and structural determinants of behaviour change, energy demand in households and people's interest in sustainable living. Such knowledge is often contextual and based on experience; it is mostly tacit and informal, not explicit (Golob, Kamin & Kogovšek, 2020). Consequently, it is all too easily ignored by researchers and policy makers.

Two broad types of skills are relevant for ECs: technical (specific to the area of work) and non-technical (general, widely applicable). The skills that were found to

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be most important for setting up the NEWCOMERS ECs were the abilities to organise people and to explain to them the basics and benefits of joining a new EC (Golob, Kamin & Kogovšek, 2020). Although some technical skills are needed to enable the initial development and implementation of ECs, many are acquired in the process. Indeed, NEWCOMERS typically develop through 'learning by doing', and there is little evidence of formal learning processes (Golob, Kamin & Kogovšek, 2020).

Community participation

The growing diversity of actors and importance of alliances in EC BMs has implications for the roles of community members. Previous models of community and local energy saw two contrasting possibilities: members as *participants* (active) and as *recipients* of an energy service or product (passive). These versions still exist in ECs but have become much more nuanced. Energy community members can increasingly take a variety of roles, at various points in time and to varying degrees.

The formation of alliances in the governance of ECs implies that the degree to which community members may participate in decision-making can vary widely. At one end of the spectrum (shown in Figure 4), where community participation in governance is low, decisions are made by a single, non-local organisational actor, typically in a hierarchical fashion. An example is Project Z, which is led and operated by a licensed/ established supplier, E.ON. The community then takes up a service offering. At the other end of the spectrum, where participation in governance is high, control rests with a single local actor (such as a formalised community organisation) and decisions are typically made through voting, with one vote per member. Dalby Solby and Zuiderlicht are examples of this kind of cooperative governance arrangement, which is highly valued in some European countries.

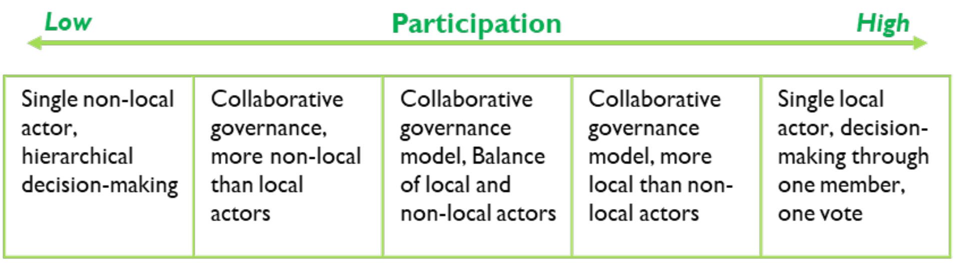

Figure 4: Degrees of citizen participation in the governance arrangements of ECs.

In addition to governance activities, community participation varies across stages of EC development. Examining the NEWCOMERS case studies, WP4 research assumed five broad stages of development in which a community may participate: initiation, design, consultation, investment, operation. Figure 5 shows some of the possibilities for community involvement at these stages, based on five degrees of participation. Two case studies that feature an overall high degree of participation are Dalby Solby and the ERiC project, through initiation, design, investment and operation. In contrast, Project Z features an overall low degree of participation, with minimal participation in development and operation, and consultation with prospective members only undertaken at key times with limited means.

Participation	Initiation	Design	Consultation	Investment	Operation
High	Bottom-up, by the community	Solution proposed and developed by a wide range of community members	Starts early and occurs often	From the community (individual and/or collective)	Participation of members essential
	Small group of community members	Solution proposed by a small group of community members	Starts early but is sporadic	From the community and non-local individuals	Important role for members, less space for variation
	Collaboration of local and non-local actors	Proposed solution a collective effort of local and non-local actors,	Occurs via various means but only during key times	Mix of community and institutional investors	Space for member involvement limited to project management
	Initiated from the outside with assumed knowledge of community	More non-local than local input into proposed solution	Occurs only at key times, with limited means	Solely public investment	No member participation. Activities managed by local and non-local actors
Low	Initiated from the outside, aiming for a generic model	Externally designed, generic model	Starts late, occurs rarely and via limited means	Exclusively non-local, private institutional investors,	No member participation. Activities managed by non-local actors

Figure 5: Stages of EC development and degrees of participation.

Once operational, the extent to which community members are involved in maintaining the BM also varies. Energy Local is the only case study where members' participation is essential to create value (altering their demand to maximise use of local generation).

One important role that community members can take in EC development and operation is that of ambassadors. They may share their experiences in formal or informal ways and thus help spread awareness and even recruit new members. Communities initiated by local actors, in particular, have emphasised the effectiveness of members as ambassadors. One reason for this is that they are often seen as more trustworthy than informants who are perceived as experts, professionals, or outsiders.

5.2 Use of new technologies

In addition to the variety of actors involved, new EC BMs are characterised by the use of new technologies in their operation. The use of 'smart technologies' (this is usually taken to refer to ICT) in the case studies was analysed in a WP4 research paper (Hansen et al., 2021). Results indicated that there are varying degrees of sophistication in the types of technologies ECs may use, from analogue devices to simple digital communication, to applications based on machine learning and

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automation. All case studies were found to use some form of ICT, with simple digital communication tools such as websites as a minimum, and billing or accounting software.

One way of differentiating the types of ICT used is by the functions they fulfil (Hansen et al., 2021). Three principal functions may be distinguished:

- Monitoring (e.g., GEN-I Jesenice)
- Operation, enabling the EC's core functionality (e.g., SO_EN's social algorithm, or the sonnenCommunity digital infrastructure), and
- Engagement, which may include front-end devices such as apps or web portals to help participants be more energy-wise. or simply as a means of conveying information (e.g., telling customers how well their system performs).

An alternative way of looking at ICT in energy systems is in terms of connecting elements of a system: different technologies or devices (e.g., Project Z's use of distributed ledger technology); humans with other humans (via online platforms); or technologies with humans, by transmitting information from one to the other (e.g., sonnenCommunity app, heating controls) (Hansen et al., 2021; Darby, 2020).

Interestingly, in most cases, novel technologies are not the focal point or activity of the EC. Most ECs in the case studies are in fact centred around relatively traditional technologies and activities, and ICT is not needed to enable the EC's core functionality.

A central function in all case study ECs is generation of electricity from renewable sources. Five of the NEWCOMERS cases pursue generation of renewable electricity from assets owned by the community (Buurtmolens, Zuiderlicht, GEN-I, Dalby Solby): SO_EN Social Housing involves the collective consumption of renewable electricity but in this case the assets are not owned by the building's tenants. Four cases involve generation of renewable electricity from assets owned by individual members. The sonnenCommunity and Project Z both involve households who already own a solar PV system (and in some cases, battery storage), implying that generation of renewable electricity is not a key objective but a prerequisite to their BMs. In contrast, the ERiC project is focused on enabling households to generate their own solar energy in the first place. Lastly, Energy Local may involve generation assets owned by individuals and/or third parties.

Seven of the ten ECs employ solar PV technologies, making it the most popular means of renewable generation in our case studies. Its advantages include being a well-established technology that is readily available at reasonable prices; it is relatively easy to install and use; and it is relatively socially acceptable. Solar PV is followed by wind in terms of popularity, used by three of our case studies (Buurtmolens Herbaijum and Tzum, Dalby Solby). A general advantage of wind power, identified in the NEWCOMERS International Stakeholder Workshop, is that it can complement solar in terms of supply variability and reliability. Several

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disadvantages were also associated with it, including the requirement for very specific locations with sufficient wind, and aesthetic impact on landscapes.

Several factors influence what technologies ECs choose to employ. Context is important, with regulatory and legislative environments a key factor influencing EC technology choices. Law and regulation affect what kind of support schemes may be available, costs of implementation and maintenance, who may be involved and in what capacity, what activities may be carried out, and ultimately the EC's viability. An example is smart meter roll-out: In the case of the sonnenCommunity and Energy Local, the need for smart metering in their BMs posed a significant challenge, as smart meter rollout in their countries was much slower than anticipated. Project Z, on the other hand, was wary of the difficulties associated with smart meters and opted for a model that wouldn't require them in their BM design.

A related and decisive factor in technological decision-making is the risk associated with a given technology. The more tried and tested a technology is, the smaller the risk of a project failing because of it. Novel, less established technologies are more likely to cause unforeseen challenges or delays and tend to carry a greater financial risk, exacerbated by upfront costs that are likely to be relatively high: affordability is an important factor in technological decision-making. Novel technologies also often require more expert knowledge, which affects whether specialist actors need to be brought in – temporarily or permanently – to operate them. There thus appears to be an association between the sophistication of the technology used and the actors involved in ECs, with models that involve more advanced or cutting-edge technologies often initiated and managed by third party/ commercial actors (Hansen et al., 2021).

Lastly, the technologies ECs use depend on community members' motivations for developing the EC and the values they seek to create. This highlights the interdependencies between actors and technologies in developing and operating ECs. In recognising this, it is helpful to use the term 'smart' to refer to a characteristic of sociotechnical configurations, rather than technologies alone (Hansen et al., 2021). *Smartness thus describes an EC's viability in terms of the alignment of its social and technical elements.*

5.3 Wider range of values

Today, the creation of viable community energy business models is thought to depend on the provision of benefits to members and also to energy system operators and societies in general (Hall and Roelich, 2016; Brown et al., 2019). The argument is that, for any community or local energy BM to survive in the long run, it cannot solely provide value to its primary customers; it must also benefit the system in which it is embedded. Hall and Roelich (2016, 287) define creation of a viable BM as a search for complex value propositions: the production and capture of values that may accrue to different parties, in different locations and at various times. It becomes a question of providing value to multiple system stakeholders and 'stacking' financial value from multiple sources (Braunholtz-Speight et al., 2021).

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ECs, whether they emerge from the bottom up, 'sideways' through partnerships or 'top down' from commercial actors, are likely to face similar pressures in this respect.

Examining the types of value created in our case study communities, and the people or organisations for whom that value is generated, serves three purposes:

- it creates space for the identification of multiple values for multiple parties and allows for analysis of potentially complex value propositions.
- it illustrates the role of ECs in developing and demonstrating innovative BMs, by identifying distinctive value propositions of case studies.
- it provides an additional avenue for understanding the challenges associated with creating financially viable BMs. Looking across the 10 case study communities, over 50 different types of value (economic, environmental, social and technical) can be identified and linked to one or more beneficiaries. Alongside the direct benefits members or customers may receive, ECs may generate direct benefits to local communities as well as indirect benefits to societies, including progress towards government goals. Note that ECs often rely on established energy system value chains. The values identified within the case studies and their beneficiaries are summarised in Table 5.

Benefits to EC members included financial savings (economic value) and access to cleaner sources of energy (environmental value), as particularly important across all cases studied. Yet beyond these, working with a range of energy communities emphasised how, as one practitioner stated, "there is more to energy communities than money and kilowatts". To community practitioners, their activities also served to support the empowerment of people in energy systems (a sense of being able to contribute to energy system transformation), connecting people (reducing social marginalisation and increasing cohesion), and supporting learning about technologies, new practices, or business activities. These latter two may be viewed as contributing to and reinforcing empowerment.

Benefits for communities in the vicinity of an EC – members and non-members alike – included collective renewable energy generation, often linked to consumption of local community-derived renewable electricity (environmental value); retention of money in local economies as fewer payments were made to remote incumbent energy suppliers; job creation that supports the local economy and develops skills; increased technical self-sufficiency, and the creation of social capital, increased social cohesion and education of community members. Beyond these, energy practitioners argued that their EC activities hold value in demonstrating alternative ways of acting and organising, and often result in spill-over effects, with local residents adopting more energy efficient technologies or behaviours.

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Table 5: Values of ECs to different beneficiaries

Beneficiaries & types of value	EC members	Non-members living near a place-based EC	Wider society (including governments)	Energy systems
Environmental	Contributing to energy transition, mitigating climate change; access to cleaner sources of electricity:	Collective generation; increased air quality, biodiversity	Climate change mitigation	Deployment of renewable generation: increased demand side flexibility
Economic	Affordable energy bills	Revenue generation; job creation, retention of money in the local economy	Economic benefits, job creation, more investment in renewable sources of generation	Reduced system costs, e.g., avoided network reinforcement and payments to curtail renewable generation
Technical	Access to new tech, energy literacy, skill development, increased sense of agency and control	Increased energy self-sufficiency (autarky)	Upskilling, energy literacy	Increased demand-side flexibility; local balancing; avoided network constraints; reduced curtailment
Social	Sense of community, social cohesion, being a part of the action, control, ownership	Increased social capital, trust; education of others; demonstrating new possibilities	Democratisation, empowerment; experimentation and demonstration of steps in energy transition	Affordability, fuel poverty reduction; acceptance of time of use tariffs

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Benefits for society, including governments, identified within the case study research, included direct benefits from increasing renewable energy generation (environmental); economic growth, job creation (economic); and upskilling of energy users who had previously only seen themselves (and been perceived) as passive consumers (technical). Indirect benefits included increasing awareness and participation in energy system change (social). More broadly, our analysis suggests energy communities hold potential to democratise energy systems by giving people a means to participate and a stake in how energy systems develop. To many of the practitioners we interviewed, energy communities also hold value as practical demonstrations of new ways of doing and organising energy systems under net zero transformation plans: they act as social teaching aids.

The benefits of ECs to energy systems are derived from the direct and indirect services they offer. In terms of direct benefits, two analyses[2] of the case studies performed in WP4 identified the increased deployment of renewable generation and the increased proportion of renewable energy in the supply mix as the primary values to energy systems. Whilst technologies used by ECs have the potential to provide a variety of services to energy systems, the studied cases were not configured with the intention of delivering ancillary services to distribution networks or transmission grids – for example, local constraint management or frequency regulation. A partial explanation for this is that there are currently few incentives for ECs, or indeed other energy system actors, to contribute to system services. In only a few cases were such services provided (notably the sonnenCommunity), by operating on a large scale and adopting explicit demand response strategies in which batteries were aggregated and controlled to offer ancillary services to system operators.

Analysis of the indirect benefits of energy communities provides a different outlook. Most of the cases studied were configured in such a way as to encourage increased consumption of locally- generated renewable electricity. Although primarily intended to increase community self-sufficiency, this practice results in a variety of system benefits including, most notably, reductions in grid energy demand. Where time-varying tariffs were employed (e.g., by Energy Local) and/or connective technologies (involving smart meters, apps and platforms) were used to link demand to local generation in near-real-time, this resulted in increased demand-side flexibility and more efficient system operation: more locally sourced renewable electricity was being used locally, as it was generated. Despite this indirect benefit of ECs being a clear benefit to electricity systems, contributing to system balancing, it is rarely acknowledged or rewarded.

The identification of values associated with ECs for members, their neighbourhoods, wider society, and energy systems underlines how they reach

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[2] *An analysis of the distributed energy resources (DERs) offered by the case study communities (where DERs were conceived as combinations of energy technologies and activities that are located on or below the distributed network and provide core operational services such as generation and flexibility to renewables-based energy systems), Hansen & Barnes, 2021; a techno-economic assessment of the benefits of energy communities to distribution networks, Nagode & Lacko, 2021.*

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beyond environmental and economic benefits. This suggests that ECs are well positioned to create viable BMs, *if* these values can be monetised, stacked and woven into value propositions. Yet there remain obstacles preventing ECs benefiting from the sum of values they currently provide and could provide.

More broadly, the high commonality between values directed towards EC members, their neighbours and wider society, indicates that values cascade out from ECs and that ECs have the potential for local *and* more widespread, diffused value creation. We suggest that values attributed to ECs may be arranged within a hierarchy or pyramid. Such a hierarchy speaks to the normative ambitions of many ECs, where higher-level values could be combined with lower-level values to create innovative value propositions.

Primary value propositions from the NEWCOMERS case studies

Identifying the value propositions of the 10 case study communities is not easy (Table 6). The qualities associated with product or service offerings in value propositions tend to be portrayed as narratives about each EC, summarising its purpose and expected outcomes. Making sense of these value propositions requires us to identify the primary beneficiaries of the BM, who are assumed to be community members.

Compared to the multiple values identified in the preceding section, these primary value propositions capture only a narrow range. Most are rooted in functional offers, such as collective ownership or use of renewable energy. Many also include more normative values, like equity, fairness or reduced environmental impact. Within 'newcomer' ECs, according to one practitioner, we are witnessing 'a mixing of values coming together in one story'. Yet the same practitioner also noted how creating stories that work for energy system actors such as politicians, suppliers, or network operators remains challenging, because of these actors' differing perspectives and the values they attach to different types of benefit. These considerations point to three challenges associated with creating viable EC BMs.

1. Many of the more normative social and political values stemming from energy communities (like democratisation, empowerment, inclusivity, and equity) are often poorly supported in practice (although recognised and even applauded by some national governments). The value of ECs, as experiments in and demonstrations of new ways of doing and organising, is hard to express in monetary terms via market arrangements. EC initiatives often rely on grant-based support, research & development programmes, or shielding from market forces in protected experimental niches. In many of the NEWCOMERS cases, normative values are woven into value proposition narratives, helping to justify participation for reasons that include economic gain but go beyond it. Recognising ECs for their full value propositions may mean adapting how societies organise energy systems, to include democratisation, equity and inclusivity as guiding principles alongside competition, security, and reduced environmental impact.

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Table 6: Case study communities' primary value propositions

Case study community	Primary value proposition
Buurtmolen Herbaijum	Collective consumption of local wind energy
Buurtmolen Tzum	Collective ownership and consumption of local wind energy
Dalby Solby	Creating sustainable lives and places through individual and collective solutions
E.ON Project Z	'Regional, sustainable energy autarky' based on trading surplus power from solar PV prosumers
Energiecoöperatie Zuiderlicht	'Energy generation for everyone', primarily collective generation, and in a few cases, use
Energy Local	Creating fair prices for generators and consumers through the local consumption of locally generated renewable electricity
ERiC Project	Expert advice and support to install residential solar PV systems
GEN-I Jesenice	Collective, onsite self-consumption for reduced costs and environmental impact
Solidarity & Energy Social Housing	Collective, equitable onsite self-consumption
sonnenCommunity	'Clean, reliable and affordable energy for everyone' through member-owned but centrally controlled solar PV and battery systems

2. Increasing reliance on partnership working calls for awareness of wider energy system actor roles and business models in which all partner-actors perceive value creation opportunities. Licensed/ established energy suppliers emerged as among the most important partners from the case studies (see section 5.1), which suggest ECs can provide a range of values to them, including:

- the potential to provide 'green' service offerings,
- customer acquisition and retention,
- reduced imbalance costs associated with the supply of electricity and, crucially,
- new revenue creation.

Creating viable EC BMs with established (licensed) suppliers as partners involved developing a holistic understanding of how electricity systems operate and the roles and functions of actors and technologies within them. BMs that rely on partnerships, such as those of Energy Local, the two Buurtmolens, GEN-I Jesenice and Zuiderlicht, are notably more complicated than those in which collectively owned generation assets supply electricity to a small number of customers (often co-located with the asset) and export it at times to the grid. To engage in partnership working therefore requires searching for secondary value propositions directed towards all partners, and activities through which all involved can capture value.

3. The benefits that energy communities provide to energy systems are poorly recognised or rewarded. Evidence from the case studies suggests ECs provide a variety of benefits to energy systems but at present few are rewarded. Whilst the original benefit – increasing the amount of renewable energy within a system – has been rewarded in the past through policies supporting the deployment of renewable energy generation technologies, in many countries such policies (reducing revenue risk through fixed support schemes) are being phased out in favour of market mechanisms (Burger et al., 2020).

Meanwhile, ECs are poorly incentivised to provide additional electricity system services such as flexibility /demand-side management, because in many cases the market structures to request, select and reward such services are confined to high-voltage transmission networks in which only those actors with large offerings (1MW and above) can operate. Such markets at the lower-voltage distribution network level remain in a formative stage and are often hard to understand and develop BMs around, not least because of short contract periods. To complicate things further, coordinating flexibility market activities between transmission and distribution levels and standardising market arrangements are proving to be very slow processes (Schittekatte & Meeus, 2020).

Meanwhile, the more indirect services and value ECs provide to energy systems (including reducing grid demand, reduced use of transmission and distribution networks, and reduced curtailment of renewable supply) are not currently recognised by market arrangements and cannot be rewarded via, for example, reduced system charges. The capacity of ECs to foster demand-side flexibility, e.g., through engaging citizens in time-of-use tariffs, goes largely unnoticed.

In sum, current market arrangements structure where and how energy system actors, including ECs, search for new service offerings and, ultimately, which values can be rendered economic in the creation of viable BMs. The ability of ECs to stack value from multiple sources to form viable BMs will continue to be limited in markets where the benefits they provide are inadequately rewarded.

5.4 Understanding energy community business models – an activity system perspective

The preceding sections have demonstrated the range of possibilities within each of the three key elements of EC BMs: actors, technologies, and value. By

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implication, making sense of EC BMs as a whole means considering many variables.

A popular approach to research on energy business models is to identify typologies of EC activities (e.g., Gui & MacGill, 2018; Milaric et al., 2019) and archetypes that describe how a BM functions (e.g., Reis et al., 2021). However, the number of variables in ECs and the range of possibilities resulting from them mean that no typology or archetype can present a comprehensive picture. Each type will be biased towards the variable it wishes to emphasise.

To date, most EC typologies and archetypes have focussed on core activities or are inconsistently based on different variables. For example, Tounquet et al. (2019) discussed four EC archetypes: cooperative investment, energy platform, aggregator and microgrid. Reis et al. (2021) identified eight archetypes based on an analysis of European ECs: prosumerism, energy cooperatives, community collective generation, community flexibility aggregation, local energy markets, third party-sponsored communities, community energy service company, and e-mobility cooperatives.

Based on WP4 research, we propose that when devising and using typologies, it is important to recognise that they are always framed with regards to a particular area of interest. For example, to complement work mapping the landscape of ECs based on primary activities, we put forward an alternative means of classifying ECs by the governance arrangements they adopt, outlined in section 5.1. Focussing on who is involved in EC governance, from the community's perspective, one can distinguish between three types of arrangements: do it yourself; form an alliance; or someone else does it for you.

Given the number of variables and possibilities to consider when studying EC BMs, WP4 research point to the usefulness of an *activity system perspective* on BMs. Compared to BM approaches based on elements or archetypes, an activity system perspective assumes that the activities that make up an EC are boundary-spanning (Zott & Amit, 2010), a helpful way of looking at *partnerships between actors* operating at different geographical and organisational scales. Vice versa, from an activity system perspective, BMs may be described as *systems of interdependent activities* (Zott & Amit, 2010). Given the learnings outlined in the preceding chapters, this is a fitting description of ECs, which comprise activities carried out by and for various actors, and create value for individual people, organisations and energy systems at large.

Being premised on an assumption of interdependencies, an activity system perspective is also compatible with the evolutionary, systems-based understanding of ECs adopted in this report. **New EC BMs rarely, if ever, start from scratch as might be the case in other markets and as much of the existing BM literature assumes. Instead, they re-order existing relationships, between consumers and wider energy system actors, to create a range of new (complementary) value propositions.**

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6 Prospects for energy communities in Europe

This research began with an interest in the cross-over between two kinds of energy activity, community energy and the more technologically- and market-focussed local energy (see Figure 1). We have described new clean energy communities – NEWCOMERS – as sharing characteristics of both – occupying the 'overlap' space in a Venn diagram of community and local energy. The findings outlined in this report show that the phenomenon of energy communities itself is at times difficult to grasp. Rather than describing a distinct type of activity undertaken by a particular actor in pursuit of a well-defined goal, the term 'energy community' covers a spectrum of possibilities emerging from both large-scale energy system trends and small-scale initiatives. ECs, broadly speaking, aim to balance the pursuit of participation and democratisation with the physical and organisational demands of energy systems. As with their emergence and operation, the prospects for scaling-up or replicating energy communities can thus be understood as relying on interactions between many system elements and trends.

One driver for communities to multiply/replicate is through market-based mechanisms. Commercial actors may replicate BMs or parts thereof in other communities if there are suitable incentives. An actor may be incentivised to take up another project elsewhere if their model has proven viable, and if rewards/returns are expected for future efforts elsewhere.

A second driver for replication is non-market in nature: ECs may grow when actors share their experiences, knowledge and skills with others who are able to translate an EC model to fit with conditions in another locality. Energy Local provides a good example of this approach, developing a simple prototype that can be adapted to local conditions with the aid of skilled advisers.

Generally speaking, because each EC is unique, tailored to specific contexts and motivations, it is unrealistic to expect to replicate a given EC in its entirety. However, aspects of it – one actor's BM or another's story of success – may be more easily replicable/ diffusible.

Each EC will benefit from different mechanisms to support growth. Importantly, whether a given model (or part thereof) can or should be replicated will depend on the regulatory environment. In this regard, a decisive factor will be the way countries transpose the EU-wide Clean Energy Package into national laws and regulations. All the NEWCOMERS case studies were developed before transposition of the CEP, and it is thus beyond the scope of the project to know how it affects them. What can be said is that regulatory change can be instrumental: GEN-I Jesenice and SO_EN Social Housing are examples of initiatives that were enabled by favourable national policies coming into effect.

Pathways and prospects for ECs will differ across countries. ECs are likely to play different roles with differing national transformation pathways, but they will pose similar challenges to all traditional forms of energy governance. For example, as the Council of European Energy Regulators has noted (CEER, 2019), while

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community ownership of generation assets or provision of direct services is unproblematic, energy sharing "in some ways defies the classical supplier-customer relationship" (p14). There is thus a perceived need to ensure that community energy does not weaken or circumvent market principles such as consumer rights and cost sharing. Another major issue for all regulators is network reliability at a time when supply is increasingly distributed and patterns of demand are shifting, not least due to the electrification of heating and transport. European electricity networks were not designed for current conditions, let alone those anticipated.

The central need for electricity system reliability can be used as an argument against continued growth of ECs; the issues are much debated (e.g., Koirala et al., 2016). However, it is hard to see how a renewables-based, near-zero-carbon-demand system can operate effectively without taking local conditions into account and harnessing community-level resources and activities to assist with system management. In practice, the growth of community-utility alliances shows how system operators and suppliers are recognising this.

As the share of renewables in networks grows and countries progress through different transition phases, attention will likely continue to shift to ECs that go beyond the production of renewable energy and aim also to contribute to network management through mobilisation of storage and demand-side resources. Given the complexity and need for technical expertise in designing and operating suitable configurations of technology, activity and governance, they are likely to be increasingly dependent on partnerships with for-profit businesses. What the NEWCOMERS project has observed, with non-community, non-local actors becoming increasingly important for ECs, seems set to continue, with alliances growing in significance.

By extension, this implies that the balancing act of reconciling democratisation and community action with the technical complexity of creating stable, secure, reliable low-carbon energy systems is going to persist. Some of the challenges include the uncertainty of novel forms of alliances and relationships, network reliability issues, and governance of the huge datasets generated by smart metering and controls.

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7 Conclusion

The NEWCOMERS case studies have illustrated some of the variability of ECs. This variability can open many doors: there are numerous ways in which citizens may participate in the energy transition, there is room for experimentation, adaptation and identification of best strategies and there are opportunities for improving electricity systems with regards to equity, effective operation and sustainability. At a time when electricity supply and storage are increasingly distributed, and demand patterns may change rapidly in particular localities, place-based ECs are well-suited to address the challenges of transition precisely because they are local, and in a position to mobilise local resources. It is no accident that electricity network operators are increasingly keen to understand local demand and supply and to work with communities.

At the same time, variability is a challenge: it is often difficult to know what works in what situations, what initiatives to take forward and how, and how to tailor suitable support for ECs. At local level, learning-by-doing is an important feature of many ECs and this is likely to continue: each situation is unique. Yet NEWCOMERS participants have shown how there are common aspects to most ECs, and common challenges to be faced. Specialist professional guidance can assist in negotiating these challenges; so can networking between communities, so that they can learn from and support one another. However, a major issue facing ECs at this stage in energy transition is the lack of a fully supportive legislative and regulatory framework for a system that relies on renewable supply plus demand-side and storage system assets that are all highly-distributed. ECs cannot realise the potential from 'stacked' values that they can offer the system via generation, storage and demand-side response unless there is a market that can reward these services. There also needs to be policy support for non-market values generated by ECs, such as local environmental improvements, social cohesion and skill development.

Looking ahead, the overarching challenges for ECs that have emerged from our research lie in overcoming and managing the tension between the notion of community (and the focus on people-centred energy systems it implies) and the inherent technical complexity of ECs as they become more reliant on increasingly sophisticated technologies, and pressure grows for them to create value for energy systems. There is a need to create value for communities whilst also playing a part in future-proofing electricity systems.

These challenges point strongly to a need to build alliances between communities and system operators, 'laypeople' and professionals, and to develop rules for managing those alliances to make them productive and fair. The questions guiding this piece of research - What makes energy community business models viable? What are energy communities' prospects for growth? – have consistently led the researchers to consider and value the significance of new alliances between a growing range of actors.

If ECs are to thrive, the crossover between bottom-up, democratic community action and top-down, profit-driven endeavours, needs to be taken seriously. Policy

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that supports and regulates alliances between the two is needed, based on careful valuation of the services that each can provide to the other. Some communities will be able to form productive alliances readily, but many will need some assistance in doing so.

The NEWCOMERS case studies illustrate how some of the groundwork for community-based energy transition activity has already been carried out. They have illustrated multiple benefits to a range of actors, including those that are not directly related to energy and those that it is hard to attach a price to. The case study communities have also shown that ECs can only thrive when there is a basic level of public support for them, based on a shared understanding of the value they can offer, allied with physical and financial resources, skills, knowledge and some regulatory support.

The findings suggest a potentially bright future for ECs if there is sufficient commitment to developing governance and regulatory arrangements to support EC activity, encourage the development and consolidation of business models, and realise the value from their market- and non-market contributions to energy transition.

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9 Annex 1: WP 4 outputs

Published works:

- Barnes, J. & Hansen, P. (Forthcoming). Governing energy communities: The role of actors and expertise in business model innovation. Book chapter in S. Löbbe, F. Sioshansi, & D. Robinson (Eds.), Energy Communities: Customer-centered, market-driven, welfare-enhancing?
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Unpublished works

- Barnes, J and Darby, S (2019) Analytical framework and research protocol for the study of energy communities, developed as part of the NEWCOMERS project, grant agreement 837752
- Hansen, P. Barnes, J and Darby, S (2020) Actors and technologies for distributed energy systems, developed as part of the NEWCOMERS project, grant agreement 837752
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10 Annex II: Case studies in the NEWCOMERS project

To understand what makes EC business models viable and their prospects for growth the NEWCOMERS project analysed 10 energy communities in depth. Each case study was guided by 14 research questions, across four themes. The themes and questions are presented in the following table.

Theme	Research questions
Actors	Who is involved in the EC and what are their roles? What knowledge and skills are needed to develop and operate ECs?
Technologies	What technologies are employed in ECs? What are the advantages and disadvantages of certain novel technologies, including smart applications? What implications do they have for the viability of different EC BMs? What influences the choice of technologies employed in ECs?
Values	What forms of value do case study communities currently generate and for whom? What values do ECs provide to the energy systems they are connected to?
Business models	How are actors and technologies connected to deliver products or services? How do ECs emerge? How do they operate? How replicable and/or scalable are ECs likely to be? How might scaling/replication occur?

Summary case documents were then produced focusing on the emergence and operation of each EC, showing how they create and deliver different types of value to citizens, consumers, and energy systems, as a business model. Each summary document concludes with a brief discussion of the potential for the EC to grow or to be copied in new contexts.

The 10 summary case can be accessed at the NEWCOMERS project website: https://www.newcomersh2020.eu/materials-and-deliverables

- Buurtmolen Herbaijum, The Netherlands
- Buurtmolen Tzum, The Netherlands
- Dalby Solby, Sweden
- Energiecoöperatie Zuiderlicht, The Netherlands
- Energy Local, the United Kingdom
- Economia Rinnovabile e Circolare (ERiC), Italy
- GEN-I Jesenice, Slovenia
- Project Z, Germany
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