Energy communities in different national settings – barriers, enablers and best practices

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

Deliverable 3.3

Energy communities in different national settings – barriers, enablers and best practices

Version: 2.0 - final

WP 3: National polycentric settings: mapping and comparison

Author: Jenny Palm, Lund University

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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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ABBREVATIONS

Abbreviation	Explanation and translation
CEC	Citizen energy communities, defined in the revised Electricity Directive (IEMD, 2019/944/EU) in the European Commission's 'Clean Energy for all Europeans' package.
CEP	The Clean Energy for all Europeans Package
CHP	Combined heat and power
CO_2	Carbon dioxide
DE	Germany
DNOs	Distribution Network Operators
DSO	Distribution System Operators
EC	Energy community
ESO	Electricity System Operator
EU	European Union
EUR	Euro €
FiT	Feed-in tariff
GB	Great Britain
GDP	Gross domestic product
GDP per capita ($)	Gross domestic product by its total population
GDP PPP	Gross domestic product based on purchasing power parity
GHG	Greenhouse gas(es)
IAD	institutional analysis and development framework
IEA	International Energy Agency
IEMD	The revised Electricity Directive (2019/944/EU) in the European Commission's 'Clean Energy for all Europeans' package.
IT	Italy
JRC	Joint Research Centre, the European Commission's science and knowledge service
kW	Kilowatt
kWh	Kilowatt-hour
Mt	Million tonnes
MW	Megawatt
NEWCOMERS	New Clean Energy Communities in a Changing European Energy System
NGESO	National Grid Electricity System Operator (United Kingdom)
NI	Northern Ireland
NL	The Netherlands
PPA	Power Purchase Agreements
PPP	Purchasing power parity
PV	Photovoltaics
RE	Renewable energy

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REC	Renewable energy communities, defined in the revised Renewable energy directive (RED II, 2018/2001/EU) in the European Commission's 'Clean Energy for all Europeans' package.
RED II	The revised Renewable energy directive (2018/2001/EU) in the European Commission's 'Clean Energy for all Europeans' package.
RES	Renewable Energy Source(s)
SDE +	The Sustainable Energy Transition Scheme (the Netherlands)
SE	Sweden
SI	Slovenia
tCO_2	Tonnes of carbon dioxide
TPES	Total primary energy supply
TSO	Transmission System Operator
UK	United Kingdom
USD	US Dollar

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1 EXECUTIVE SUMMARY

The NEWCOMERS project aims to explore how new clean energy communities (ECs) develop, under which polycentric settings ECs evolve and under what conditions such initiatives are suppressed. At a national level, the project will assess socio-economic, technical, institutional characteristics and actors supporting the emergence of new clean energy communities.

In Deliverable 3.1. and 3.2. the national characteristics of the six NEWCOMERS countries (Germany, Italy, the Netherlands, Slovenia, Sweden, and the United Kingdom) were described and compared. In this report, the six countries will be compared, with the aim to identify barriers and enablers for new clean energy communities to emerge in different national settings and to discuss the potentials for learning between different countries. The focus for the analysis lies on socio-economic conditions, the technical system, the institutional setting, and actors on the electricity market.

Identified barriers are amongst others lack of knowledge, centralised energy production systems, too broad or too narrow definitions of ECs in regulations and policies, lack of tailormade policies for ECs and few dominating market actors. Identified enablers are for example trust, access to finance, a country's fossil fuel dependency, a liberalised market, Feed-in Tariffs (FiTs), and umbrella organisations.

Several best practices supportive for clean energy communities to emerge were identified in the different NEWCOMERS countries and these are meant to be used as inspiration for others. These are for example virtual power plants, virtual net metering, government strategy for ECs, tailormade regulations, and umbrella organisations.

National settings supporting ECs to emerge were identified and included the existence of a definition of EC in a national strategy or the legal framework, high GDP/capita which lie grounds for households to join an EC, fossil fuel dependency, tailormade programmes and schemes for ECs, decentralised market with multiple of actors and decentralised production, and umbrella organisations to guide ECs.

National settings inhibiting ECs to emerge were also identified. These were lack of a national definition of ECs, lack of trust in others and to the legal and political system, a fuel mix with a high share of renewables which makes a transition less urgent, a high share of individual ownership in for example PVs, centralised electricity market with few dominating actors and centralised production, and lack of umbrella organisations that can push the idea with ECs and facilitate for new actors to enter the market.

The Clean Energy for all Europeans Package (CEP) has not been analysed per se but is anyway very present in the report. Collectively the CEP has the potential to become an important enabler for ECs to emerge. Nonetheless, Member States retain considerable flexibility in how the CEP is transposed and for that reason the impact of the CEP on the emergence of ECs in the NEWCOMERS countries will need to be assessed in future research.

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2 INTRODUCTION

The European Union has over the years developed and confirmed its vision that citizens should have a central role in the clean energy transitions (European Commission, 2015, 2019). An EU citizen should have the possibilities to be involved in everything from energy production to storage and distribution. There is a wish for a more decentralised system which would benefit renewable energy production and a move away from passive consumers towards a more dynamic relationship where active consumers are engaged and take responsibility for energy production and consumption (Coy et al., 2021). These high expectations makes it important to understand how these new forms of energy communities develop and operate (van der Grijp et al., 2019).

Research in NEWCOMERS is carried out in six European countries: Germany, Italy, the Netherlands, Slovenia, Sweden, and the United Kingdom. These countries have been selected to differ in their energy systems including for example the share of renewable energy, regulatory environment, and the number of ECs. The NEWCOMERS project aims to assess regulatory, institutional, and social conditions which support the emergence and operation of new clean energy communities as well as their potential for diffusion.

The project uses polycentric governance as its guiding theory. In this report the countries energy systems have been analysed using inspiration from both polycentric governance theory (Ostrom, 2010) and sociotechnical systems theory (Hughes, 1983). The theoretical underpinning of the NEWCOMERS project is found in van der Grijp et al. (2019) and will only shortly be recaptured here.

Polycentric governance is related to network governance and it has been developed in relation to climate related issues by Ostrom (2010). Ostrom meant that a polycentric system, including a variety of actors at different government levels that engage in an issue based on their situation and context, would be beneficial for finding new and dynamic solutions to several environmental problems. When a goal, such as climate change, is shared among several actors, polycentric systems of governance are thought to be more effective than more hierarchical approaches. Socio-technical systems theory is utilized in the NEWCOMERS project in combination with polycentric governance theory. Sociotechnical systems perspectives emphasise interlinkages between society and technology and employs system-based approaches. In a sociotechnical systems perspective, technical components, individual actors and organizations, legal frameworks and institutional and political structures interact with each other in non-linear ways. Change in one part of the system must take account of pre-existing parts in order to maintain a working whole. The energy systems within which energy communities operate and within which governance takes place are conceived as socio-technical in character. Situating governance arrangements as parts of evolving sociotechnical systems further emphasises how actors interact with each other and the complex socio-technical reality that surrounds them.

To understand how polycentric existing governance arrangements are and what benefits this may bring, a series of propositions were developed at the project level building on the work of Jordan et al (2018) (see van der Grijp et al., 2019). These propositions aim to test the extent to which polycentric governance arrangements foster energy communities better than others. In this report attention is directed to the following proposition:

"Energy communities are hindered or facilitated by local social, political, cultural and geographic factors that collectively amount to local 'technological styles'".

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The concept of technology style was introduced by Hughes to mark the historically and geographically conditioned character of electricity systems (Hughes, 1983). Technical systems interact with their environment and are subject to varied influences external to the technology which influence its style, such as geographical, political, economic, social, legal, cultural, and historical conditions (Palm and Wihlborg, 2006). A systems technological style is time and spatially delimited and this is why energy systems evolve differently in countries.

This report investigates national level social, technical, institutional and geographic elements of energy systems and their impact on energy communities. It takes a top-down approach to understanding the national settings in six countries. It singles out some national electricity system characteristics and compares them to draw conclusions about what can be learned between countries. It complements the work carried out elsewhere in the project that takes a bottom-up perspective on the emergence and operation of energy communities (WP4). The report does not provide, by itself, a holistic analysis of governance arrangements within which energy communities operate. This comparison is restricted to the aspects described in Figure 2.1 below, and it is in relation to these aspects that lessons learned from the countries will be discussed.

2.1 Background

The NEWCOMERS project aims to explore how new clean energy communities develop and in which national settings energy communities evolve. The different countries' national settings were described in Deliverable D3.1. (Palm et al., 2020), providing the countries were characterized in relation to socio-economic conditions, technical systems including energy and electricity production and consumption, institutional settings and actors. In D3.2. a comparison of the countries was done with a focus on the same characterizations as in D3.1. (Palm and Eitrem Holmgren, 2020). In this Deliverable 3.3. this framing will be kept i.e., the analysis will concentrate on socio-economic conditions, the electricity technical systems, institutional settings with a focus on energy communities (ECs), renewables and actors influencing the emergence of new clean energy communities. The aim is to identify barriers and enablers for new energy communities to emerge in different national settings and to discuss the potentials for learning between the different countries.

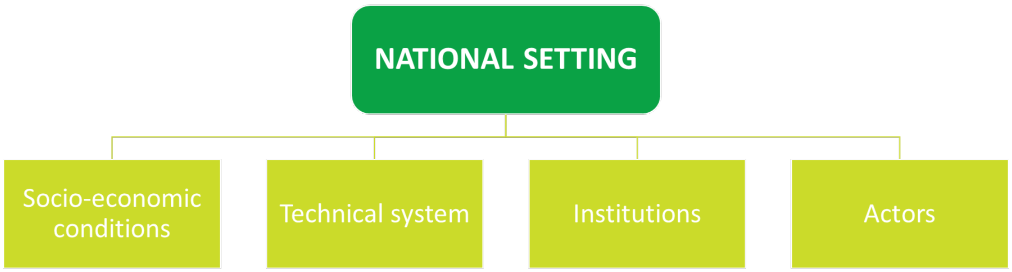

Figure 2.1 The aspects in focus in WP3 and this report

2.2 Role of this deliverable in the project

In this deliverable, the results of D3.1 and D3.2 will be discussed in relation to earlier research on ECs. The deliverable aims to compare how the countries' different national characterisations encourage or hinder the development of energy communities and analyse the possibilities for learning between the countries. Focus will be on the electricity system in each country. The

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results will feed into the analysis in WP4, 5, and 6 and also contribute to synthesizing in WP7 and to the policy recommendations on how to create favourable environments for new clean energy communities and which barriers need to be eliminated for new ECs to emerge.

2.3 Approach

The comparison and discussions are based on the country descriptions in D3.1. and the comparison in D3.2. The country specific data was collected with the aim to be comparable and with this in mind the data from the International Energy Agency (IEA) has been used when possible. When IEA's review reports were outdated or did not include all information, then national reports and statistics were used. For the socio-economic background, information from websites such as Worldometer, Statistics times or Trading economics, were used for all six countries. Furthermore, the partners from each country provided additional national information. More details on how the data was collected is described in D3.1. (Palm et al., 2020) and D3.2. (Palm and Eitrem Holmgren, 2020). Not all findings from D3.1 and D3.2. are included here, but only the ones relevant for the discussion on barriers and enablers as well as those related the best practices.

The results from D3.1. and D3.2. will be discussed in relation to earlier research on energy communities. Earlier research has been searched in Scopus and Web of Science by combining the keywords energy community/community energy AND barriers, energy community/community energy AND enablers/drivers/motivations. We have also searched specific aspects such as energy community/community energy AND electricity consumption to find earlier research in relation to the specific factors included in our country analysis. Thus, a systematic literature review of earlier research on ECs has not been done, but the focus has been on earlier research on ECs in relation to the factors of interest for WP3.

2.4 Structure of the document

The report is structured in the following way. In the next chapter an overview of existing ECs in the NEWCOMERS' countries is presented and explains how this relates to the definition of ECs. The analysis of the six countries' characteristics in relation to earlier research is discussed in chapter 4. The countries' socio-economic conditions are contrasted in section 3.1, followed by a discussion of the electricity system, including electricity generation and the grid. The institutional settings are analysed in 4.3 and the actors in 4.4. Chapter 5 recapitulates and discusses barriers and enablers, best practices and identified trends in relation to the findings on the NEWCOMERS countries national settings. Chapter 6 summarises the conclusions.

3 DEFINING AND QUANTIFYING ECS

This chapter presents an overview of existing ECs in the NEWCOMERS' countries. The number of ECs in a country is however not easily defined. There is a lack of studies that systematically has counted the number of citizen-owned projects (Gorroño-Albizu et al., 2019). The number of ECs is also not fixed but changes over time when ECs stop existing or new ones emerge.

Table 3.1. below list the numbers of ECs in the NEWCOMERS' countries and these are related to NEWCOMERS' definition of clean energy communities in deliverable D2.1:

"an association of actors engaged in energy system transformation for reduced environmental impact, through collective, participatory, and engaging processes and seeking collective outcomes". (van der Grijp et al., 2019, p. 23).

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The NEWCOMERS definition is broader than for example the definitions of citizen energy communities (CEC) made by the EU in the revised Electricity Directive (IEMD) (European Parliament and Council of the European Union, 2019) and renewable energy communities (REC) in the revised Renewable energy directive (RED II). (European Parliament and Council of the European Union, 2018). In both directives, ECs are defined as voluntary, member-controlled initiatives to organise collective cooperation of energy-related activities in a way that emphasizes different benefits, not only focusing on financial profits. RECs have stricter requirements, such as only allowing renewable energy production and including proximity conditions of members. The full definitions of CEC and REC and a further discussion on their similarities and differences can be found in deliverable D2.1. The NEWCOMERS' definition is broad because the idea was to have an inclusive rather than an exclusive definition, to allow for all varieties that exist locally in the countries.

When defining the number of ECs in a country, we relied on public figures when those existed and otherwise on earlier research (Palm and Eitrem Holmgren, 2020). In Table 3.1 the number of ECs identified in each country is shown. As can be seen, the United Kingdom and Germany have the largest number of established ECs in absolute terms, followed by the Netherlands and Sweden, and after them Italy and Slovenia. The figures used for the United Kingdom deviated most from earlier studies. An often cited JRC report presents 431 energy communities in the United Kingdom (Caramizaru and Uihlein, 2020). The United Kingdom figure of over 5,000 ECs was chosen by the NEWCOMERS project because they are government numbers (Gov.UK, 2015). Furthermore, the type of initiatives included by the United Kingdom government aligns well with the type of initiatives included by public sources in other studied countries, such as in the Swedish case.

The figures in Table 3.1. reflect however patterns found in earlier research where it is shown that ECs are more common in Northern Europe compared to the southern parts (Candelise and Ruggieri, 2020; Tricarico, 2021). Germany and the United Kingdom have also been identified as frontrunners, together with Denmark (Ruggiero et al., 2021).

Table 3.1 Overview of the countries' energy communities

	UK	DE	NL	SE	IT	SI
Number of ECs	>1500 ECs		>100 ECs		<50 ECs	
First EC	In the 1990s	Has existed for at least 2 decades	1980s	1970	1962	1992
Energy activity	Wind, solar, hydro-electricity, heat pump, biomass energy efficiency	Solar, wind, biogas, DH, own grid	Solar, wind, heat, car sharing	Wind, heat, eco-villages, solar, "rural communities"	Hydro-electricity, solar, wind	PV, hydro-electricity, (wood biomass for) DH

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The included countries often lack a national definition of ECs and that is one reason why the number of ECs in a country can differ between different studies. Germany, the Netherlands, Slovenia, and the United Kingdom have legal frameworks in place for some type of ECs, but these were established without the RED II and IEMD definitions in mind. These directives are under transposition in the EU Member States which makes it reasonable to assume that there will be national definitions of ECs in the future which are quite coherent within the EU. This however does not necessarily benefit the emergence of ECs.

It is important to acknowledge both the (inter)national and local versions of how an EC is defined. The way in which an EC is defined differ within the EU (Candelise and Ruggieri, 2020), and a too strict definition risks excluding already developed variants of ECs. An inclusive definition allows for many flowers to bloom (Seyfang et al., 2013) which will benefit a further expansion of ECs and contribute to the flourishing of innovative business models. A drawback of a vague definition is however that it will be more difficult to target ECs with policy measures and support (Gorroño-Albizu et al., 2019). Another deficit is that a lack of one unanimously agreed definition contributes to an ambiguous usage of the concept, leading to confusion and overlooks differences in the models that can be important for understanding how ECs emerge (Becker and Kunze, 2014). It makes it difficult to achieve a systematic operationalisation (Becker et al., 2017) and makes it hard to pinpoint specific features of the sector as such (Seyfang et al., 2013).

A lack of one definition can be negative if it contributes to a lack of common understanding (Brummer, 2018). A too encompassing definition can also result in that for example a project run by large distant investors will fit the definition of an EC (Grashof, 2019). Brummer (2018) emphasizes however that the problems with a vague definition should not be exaggerated because there exists a wider understanding of what an EC includes regardless of whether there exists one universal definition or not. There is also an attractiveness in having flexibility in the concept, inviting many dimensions of an EC to emerge. A common definition can on the other hand be attractive because it will be easier to communicate the idea of EC and attract new ECs to start.

As mentioned, a single government-defined national definition of ECs is lacking in our six NEWCOMERS countries. The development of ECs has however been going on for many years in the NEWCOMERS' countries, varying between 20-60 years. During these years local versions of ECs have developed and that is also why it is difficult to come up with one definition that fits them all. The EC developments within the NEWCOMERS countries are at the same time similar in that many ECs are cooperatives engaging in solar and wind power (Palm and Eitrem Holmgren, 2020).

Table 3.1. exhibits that ECs across the six countries share certain common traits concerning the type of energy produced. All the countries have ECs that focus on solar power and nearly all (not Slovenia) include wind power projects. United Kingdom, Italy and Slovenia also have ECs with registered hydroelectric initiatives. Other types include biogas, district heating (DH) and other heat production, ownership of a local grid, eco-villages as well as other sharing initiatives. These findings are mirrored in a JRC report which found solar power to be the dominant generated energy source, followed by wind and biomass (Caramizaru and Uihlein, 2020).

In Deliverable 3.2. NEWCOMERS' six partner countries were divided into three segments based on the number of ECs established in each country, see figure 3.1. These categories of high, medium, and low numbers of ECs with corresponding colours were used throughout D3.2 when comparing the countries and this colouring will be used throughout D3.3. as well.

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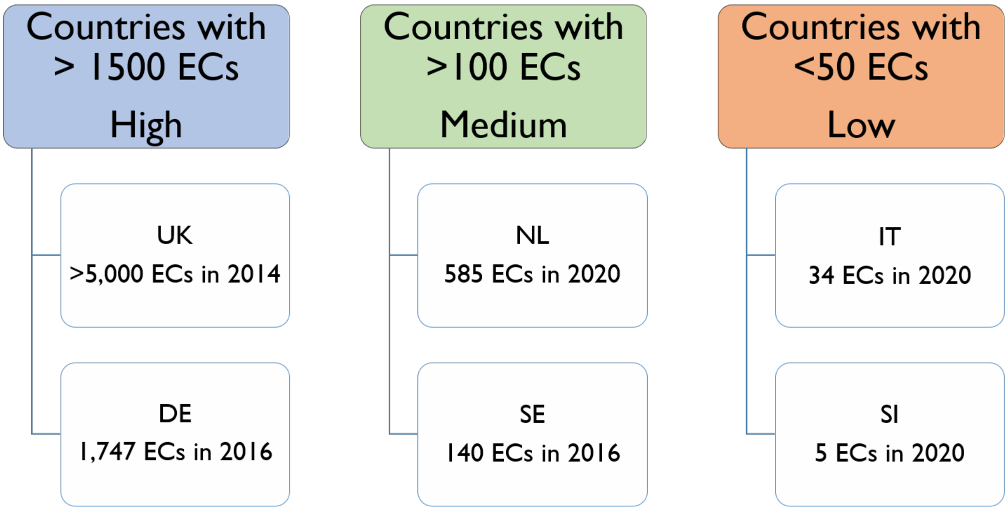

Figure 3.1 The countries divided into three segments according to their number of energy communities

4 ANALYSIS

In Deliverable 3.1, and 3.2. socio-economic, technical, and institutional characteristics of the six partner countries (DE, IT, NL, SI, SE, UK,) were described and compared. In this chapter the results from Deliverable 3.1. and 3.2. will be further analysed in relation to earlier research. It begins with a discussion of the socio-economic conditions.

4.1 Socio-economic conditions influencing energy communities

In this section, the findings for the studied aspects concerning socio-economic conditions will be discussed. The focus will be on aspects highlighted in earlier research as important for ECs to emerge and include urban and rural aspects, education, trust, and GDP and households' economy in relation to electricity prices.

4.1.1 Urban and rural aspects

As discussed above, ECs are not a new phenomenon but must be understood as something that has existed and developed over time in remote places and islands. The development of ECs is influenced by spatial factors and several studies reflect upon the geographical differences that exist between EC diffusion within Europe (Candelise and Ruggieri, 2020; Ruggiero et al., 2021). In Busch et al's (2019) literature review, they found that in earlier studies 18% of the studied ECs were located in a rural context, while only 2% were in an urban context. Around 75 % of the studied articles did however not report on urban or rural context.

Lowitzsch et al (2020) discuss that more and less spatially dense areas will demand different renewable energy sources (RES). Urban centers need tailored solutions that fit dense areas and will focus on e.g. combined heat and power and district energy, solar PV, and on small or no wind power generation (Bracco et al., 2018). Rural settings have more space and can promote different technological solutions such as a combination of PVs and wind (Lowitzsch et al., 2020). In Fina et al's (2019) study of profitability of PV sharing in energy communities, it turned out that the establishment of an EC was of the greatest value for single-family buildings in the rural areas. These buildings had a 5 % cost savings with an EC compared to if the building installed PVs individually.

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Among the NEWCOMERS countries, wind and PVs are the dominant technologies employed by ECs. When studying the NEWCOMERS countries, the Netherlands was the country where most people lived in an urban area (92%) and Slovenia was the country the least urbanised (55%). As can be seen in Table 4.1. of our four NEWCOMERS countries with most ECs are also the ones most urban. This opposes earlier research, but can also be a reflection of that many of the ECs in the NEWCOMERS countries have invested in PVs, which according to Lowitzsch et al (2020) suit both urban and rural ECs.

Table 4.1 Urban population (Palm and Eitrem Holmgren, 2020)

Country	Urban population (%) (2020)	Urban population (%) EU Average (2019)
Netherlands	92 %	75 %
Sweden	88 %	
United Kingdom	83 %	
Germany	76 %	
Italy	69 %	
Slovenia	55 %	

4.1.2 Education

When discussing membership of ECs, then education and awareness are often emphasized (Ruggiero et al., 2021). Koirala et al (2018) found in their survey that education, energy-related education and awareness of local energy initiatives correlated with the willingness to participate in an EC. Especially lack of technical knowledge has been seen as a barrier for participation in ECs (Bomberg and McEwen, 2012; Koch and Christ, 2018; Koirala et al., 2018; Mirzania et al., 2019; Wierling et al., 2018), but also for how the ECs and their (technical) solutions are developed (Horstink et al., 2020). Nolden et al (2020) also highlights the problem that the future can bring a need for more professional competence, due to the trend that e.g. community PV business models include more and more components, such as batteries and private wires, and more stakeholders. This increases the complexity of the system and will increase the need for professional expertise when entering the system. Nolden et al also observed how a mature segment of ECs slowly became more professional and they mean that the number of community-based initiatives will remain low. The lack of expert knowledge will be a major barrier for newcomers (Nolden et al., 2020).

Several policy programs have been developed to educate and raise awareness among citizens about energy efficiency or renewables. These have however been ineffective because it has been relying too much on the idea of rational actors and not considering a broader social context (Hill and Connelly, 2018). In his literature review of grassroots innovations, Hossain (2018) also found that these emerge from experiences and knowledge within a community rather than through education and research.

There is no obvious way to study the influence of education on ECs at a national level. We decided to test if the level of tertiary education (college and university level) in a country had any correlation to the number of ECs. The results are shown in Table 4.2. United Kingdom, Sweden, the Netherlands, and Slovenia had a higher share of tertiary educated population than the EU average, while Germany and Italy were below EU average. The comparison indicates that there is no clear relationship between a country's number of ECs and its share of inhabitants with higher education, as both the relative placements of Germany and Slovenia did not follow this trend. Germany had a high number of ECs but a lower share of its population with higher education than the EU average and Slovenia displayed the opposite values with a low number of ECs but a higher ranking of higher education than the EU average. Knowledge and education are

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probably factors that are more interesting to investigate further in relation to different case studies.

Table 4.2 Tertiary education (Palm and Eitrem Holmgren, 2020)

Country	Population (15-64 years) with tertiary education (%) (2017)
United Kingdom	38.7
Sweden	36
Netherlands	32.1
Slovenia	28.7
EU-28	27.9
Germany	24.8
Italy	16.5

4.1.3 Trust

In earlier research on ECs, trust is a factor often mentioned even if it comes with different meanings and in different contexts. Trust has been highlighted in earlier research as necessary for support in local renewable energy projects (Hill and Connelly, 2018) and for becoming a member of an EC (Kalkbrenner and Roosen, 2016). Trust has been a factor explaining why citizens are willing to pay more for locally generated power (Sagebiel et al., 2014) and has been described as a driver for people to participate in an EC (Koirala et al., 2018). Trust has been perceived as both a necessary characteristic and an outcome of an energy community (Walker et al., 2010). In an earlier study, members of ECs in interviews described how the establishment of an EC has created trust, but surveys measuring trust before and after the establishment of an EC seem to be lacking. An EC is also not one-dimensional, and distrust can also be present. An EC can be exclusionary and marginalize people that are seen as not fitting. (Walker et al., 2010).

Trust can also occur in relation to different actors, such as trust in the members, or stakeholders involved, trust in the investors or trust in the project set up (Tricarico, 2021). An EC can contribute to increased trust within the community, but also in relation to local government (Koirala et al., 2016). Participation in an EC may also provide a member access to other social groups than the ones they usually engage in (Hanke and Lowitzsch, 2020). This might shape new values and norms and contribute to the creation of trust. This might be of particular importance for vulnerable households and may contribute to overcome social isolation and systematic injustices such as lower education, and unemployment (Hanke and Lowitzsch, 2020).

In WP3 we have looked into different measurements of trust within the NEWCOMERS countries. The Table is included also here, see Table 4.3.

Table 4.3 Trust in other people. The table is ranked according to the first category "Most people can be trusted" (Palm and Eitrem Holmgren, 2020)

Country	Most people can be trusted (%)	Need to be very careful (%)	Don't know (%)	No answer (%)
Sweden	62.8	35.7	1.2	0.4
Netherlands	58.5	39.8	1.5	0.2
Germany	43.4	52.5	3.2	0.8
United Kingdom	40.2	59.3	0.5	0.0
Italy	26.6	71.3	1.6	0.6
Slovenia	25.3	73.2	1.0	0.5

As can be seen in Table 4.3, trust levels in other people are around 60% in Sweden and the Netherlands. In Italy and Slovenia these figures are much lower. Germany and the United

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Kingdom come in between. In an earlier study from Eurostat, the figures for Slovenia indicated a higher trust in others (Eurostat, 2013), see Table 4.4.

Table 4.4 Trust in others, trust in the political system and in the legal system. The unit of measure is the average of all individuals' ratings on a scale from 0 ("not satisfied at all") to 10 ("fully satisfied").

Country	Trust in others (2013)	Trust in political system (2013)	Trust in legal system (2013)
Sweden	6.9	5.5	6.7
Netherlands	6.8	5.5	6.2
Slovenia	6.5	1.8	2.7
United Kingdom	6.1	3.8	5.5
EU-28	5.8	3.5	4.6
Italy	5.7	2.1	3.6
Germany	5.5	4.9	5.3

In Table 4.4 Sweden and the Netherlands have similar results and both countries seem to have a relatively high levels of trust in society. Slovenia has high levels of trust in others but low levels of trust in the political system and in the legal system. Germany has similar levels of trust in all three categories. While both the United Kingdom and Italy show most trust in others and least trust in the political system. In all countries, there seems however that the citizens have a higher trust in the legal system than in the political system.

These results indicate that the Netherlands and Sweden have a good base for creating ECs, due to their overall higher levels of trust. For Slovenia and Italy, trust appears to be more of a barrier in need for consideration in the future development of ECs. Earlier research has however mostly studied trust at a community level, and it is less clear that trust in the political or legal system has the same significance for the emergence of an EC.

4.1.4 GDP, household economy and electricity cost

Earlier research has emphasized that central government actions are critical to the development of ECs, where state funding and subsidy mechanisms are discussed as having significant influence (Creamer et al., 2018; Walker, 2008). Potentially a wealthy state would be able to support ECs more than a less wealthy nation. Table 4.5 ranks the countries' GDP per capita with their corresponding European and world rankings.

Table 4.5 GDP per capita

Country	GDP per capita (USD) (2019)	GDP per capita (USD) Rank Europe (2019)	GDP per capita (USD) Rank world (2019)
Netherlands	52,367.9	7	12
Sweden	51,241.9	8	13
Germany	46,564.0	12	18
United Kingdom	41,030.2	15	23
Italy	32,946.5	16	28
Slovenia	26,170.3	20	36

Table 4.5 shows that the GDP per capita of the Netherlands is double the size of Slovenia's GDP per capita. Within the European ranking the Netherlands and Slovenia represent a wide range, from place 7 (NL) to 20 (SI). In the world ranking, all six countries represent the top 36 countries with highest GDP per capita. Italy and Slovenia with both low numbers of ECs are here placed in the bottom of the six countries.

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The importance of ECs for the local community and the local economy has been stressed in earlier research (Bomberg and McEwen, 2012; Busch et al., 2019). Economic benefits for the local community, in general, are highlighted (Busch et al., 2019; Gui et al., 2017; Hoppe et al., 2015; McKenna, 2018; Walker and Devine-Wright, 2008). ECs can contribute to that the members save both energy and money (Bomberg and McEwen, 2012; Koirala et al., 2016) and feel less risk to invest in different energy solutions (Koirala et al., 2016). Other possible benefits raised are that ECs can bring welfare to low-income households and contribute to the collective distribution of benefits (Koirala et al., 2016). Others found that social motivations such as being part of a transition overruled financial motivations (Hanke and Lowitzsch, 2020; Tricarico, 2021). There are also indications that customers are prepared to pay more for locally generated power and that the locality contributes to a feeling of trust in the energy system (Koch and Christ, 2018).

There is evidence that medium and small-scale wind and hydro projects have positive local economic effects. There is however a lack of evidence of how representative these results are for ECs in general. Existing literature is mainly based on anecdotal evidence, based on one-time interviews with project participants and residents. There is a lack of systematic analyses of long-term effects on local economies (Berka and Creamer, 2018).

Traditionally renewable energy cooperatives have dominated ECs (Gancheva et al., 2018). In theory, these have an open set-up where all citizens can be included, but in practice, this has not been the case. In for example Germany more than 70% of the members of the cooperatives were male, with relatively higher education and higher income. People with lower income were especially underrepresented, which is due to the need to have access to finance to take part in a RES project (Hanke and Lowitzsch, 2020). In Germany, a member usually needs to buy shares and the average individual contribution of a cooperative amounts to EUR 3899 with an average required minimum contribution of EUR 511 (Hanke and Lowitzsch, 2020). Financial resources are often mentioned as a main barrier for participation in an EC (Bomberg and McEwen, 2012; Koch and Christ, 2018; Koirala et al., 2018; Rahmani et al., 2020).

The level of average disposable income has been identified as a key factor that explains the different levels of ECs between Italy and Germany (Magnani and Osti, 2016). This is confirmed by our results in Table 4.6, where this hypothesis is further strengthened by the fact that also Slovenia has low average disposable income and a low number of ECs. A high level of disposable income seems however not to be an obvious enabler for ECs. Sweden and the Netherlands have a higher disposable income than Germany and the Netherlands, but fewer ECs. Financial barriers for membership is a barrier for ECs to emerge, but this could be dealt with through for example cooperative banks, low-interest loans, or subsidies targeting low-income groups (Hanke and Lowitzsch, 2020).

Table 4.6 Electricity prices as share of household income (Palm and Eitrem Holmgren, 2020)

Country	Households' electricity costs as avg. share of income (%) (2017)	Households' avg. price per 100 kWh (EUR) (2017)	Households' avg. electricity usage (kWh) (2017)	Households' avg. electricity cost/year (EUR) (2017)
Sweden	6.7 %	19.4 EUR	9601 kWh	1862.6 EUR
Slovenia	5.1 %	16.1 EUR	4280 kWh	689.1 EUR
Germany	3.9 %	28.7 EUR	3334 kWh	956.9 EUR
EU-28	3.9 %	20.4 EUR	3713 kWh	757.5 EUR
Italy	3 %	21.4 EUR	2651 kWh	567.3 EUR
United Kingdom	2.6 %	17.7 EUR	3666 kWh	648.9 EUR
Netherlands	1.8 %	15.6 EUR	3051 kWh	476 EUR

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There is no clear relation between the amount of ECs in the NEWCOMERS countries and their relative share of electricity costs in household expenses. Table 4.6 shows that Swedish households have the highest electricity usage and highest yearly electricity cost, and Slovenia has the second-highest figures in those categories. Despite having the second-lowest electricity costs per 100 kWh, Slovenian households pay the second-highest relative share of electricity costs. This is due to having the lowest average yearly income among the countries.

Germany has a substantially higher average electricity price per 100 kWh than the other countries. Germany stands out as having the highest share of electricity-related taxes and levies as it amounts to more than half of its electricity prices (see Table 4.7 below). The share of electricity costs of German households' incomes is however the same as the EU average. Despite having the lowest share of taxes and levies, the United Kingdom has higher electricity prices than Slovenia and the Netherlands. In total, all countries but Germany and Italy have lower electricity prices than the EU average of 20.4 Euro per kWh.

All NEWCOMERS countries have larger shares of taxes and levies in the average household electricity price than the median tax rate of IEA member countries (22 %) (Palm and Eitrem Holmgren, 2020). However, compared to the EU average of 37 % of taxes and levies in the average household electricity price, the majority of countries have lower shares (SE, SI, NL, UK), see Table 4.7. In all countries, but the United Kingdom, the share of taxes and levies mirror their situation in the ranking of electricity price. The United Kingdom has higher electricity prices than Slovenia and the Netherlands despite a lower share of taxes and levies. Germany and Italy are the only countries with electricity prices above the EU average. High electricity prices could hypothetically be an enabler for ECs to emerge. This has however not been indicated in earlier research, nor by our comparison. Earlier research has however found that energy prices set by a market mechanism with no correction for externalities may act as a barrier for EC development (Kooij et al., 2018).

Table 4.7 Electricity prices (Palm and Eitrem Holmgren, 2020)

Country	Share of taxes and levies in average electricity price (%) (2017)	Households' average electricity price per 100 kWh (EUR) (2017)
Germany	54 %	28.7 EUR
Italy	38%	21.4 EUR
EU-28	37 %	20.4 EUR
Sweden	35 %	19.4 EUR
Slovenia	31 %	16.1 EUR
Netherlands	27%	15.6 EUR
United Kingdom	24%	17.7 EUR

4.1.5 Summary socio-economic conditions

The main findings for the socio-economic conditions are summarised below, in Figure 4.1.

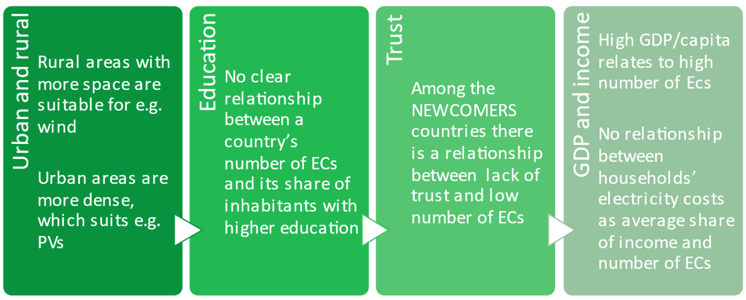

Figure 4.1 Summary of the findings for socio-economic conditions

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4.2 The technical system: electricity generation and the electricity grid

In the following section the countries' electricity generation mix, related emissions, and the electricity grid will be discussed.

4.2.1 Electricity generation mix

Table 4.8 presents the countries' electricity generation according to their energy source. The countries are ranked according to the column 'Total Fossil fuels' which is the countries' share of fossil fuels in their electricity generation mix.

Table 4.8 Electricity generation mix (Palm and Eitrem Holmgren, 2020)

Country	Total Fossil fuels (%)	Total Fossil fuels IEA avg. (%)	Energy sources in electricity generation mix (%)								
			Oil	Natural gas	Coal	Nuclear	Wind	Solar	Bio/ waste	Hydro	Other
Netherlands (2019)	73.2	47	0.1	58.7	14.4	3.2	9.5	4.3	4.6	0.1	5.2
Italy (2015)	59.7		4.8	38.3	16.6	-	5.2	9.3	7.8	15.6	2.2
Germany (2018 prov.)	51.5		0.8	13.2	37.5	11.8	17.3	7.4	9.1	2.8	-
United Kingdom (2017)	48.2		0.5	40.8	6.9	21.0	14.9	3.4	10.7	1.8	-
Slovenia (2018)	31.4		0.1	2.9	28.4	35.4	-	1.6	1.7	30	4.6
Sweden (2017)	0		-	-	-	39	11	0.1	9	40	0.9

Earlier research shows that the number of ECs in a country is related to energy path dependency and available natural resources (Horstink et al., 2020). From this we infer a high dependency on fossil fuel import is an enabler for ECs to emerge. If a country has access to cheap domestic energy sources this is a barrier for ECs (Kooij et al., 2018). As seen in Table 4.8 the NEWCOMERS countries are still rather dependent on fossil fuels. Slovenia with a low number of ECs has less fossil fuels in its generation mix (31 percent). Italy which also has few ECs has a higher share fossil fuels in their mix (60 percent). The Netherlands has one of the most carbon-intensive electricity generation mixes in Europe with a share of 73% fossil fuels. Sweden has one of the lowest fossil fuel shares in its mix among the IEA countries. Earlier research has shown that ECs have contributed to an increase in renewables. In Germany around half of the renewable electricity is generated by citizen initiatives (Wagemans et al., 2019). Germany is phasing out nuclear power. The Fukushima accident in 2011 was the starting point for the Energiewende legislative package in Germany, which is the main mean of shifting away from nuclear power. The Energiewende supported decentralised renewable energy, combined heat and power and energy efficiency (Gancheva et al., 2018). Sweden has 51% renewables in the electricity mix, but this is mainly hydro, owned by energy utilities (Kooij et al., 2018). Slovenia also has a high percentage of hydro, but also in this case these are not owned by ECs.

When consumers start to be a producer of electricity, i.e. becoming prosumers, this triggers a learning process and increases knowledge of RE (Roth et al., 2018). Studies have indicated that solar energy is the energy source people prefer (Koch and Christ, 2018). Studies have however also shown that people already owning a PV installation perceive this as a barrier to participate

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in an EC (Koirala et al., 2018). Italy has the largest share of solar power of all IEA countries (Palm and Eitrem Holmgren, 2020) and this could potentially become a barrier for emerging ECs. The United Kingdom and Germany have the largest share in wind power among the NEWCOMERS countries.

In earlier research environmental benefits and reduction in carbon emissions are often referred to as important drivers or benefits of ECs (Busch et al., 2019; Gui et al., 2017; Koirala et al., 2016; Walker, 2011). Table 4.9 presents the NEWCOMERS' countries energy-related emissions. The countries are ranked according to the CO_2/population and from the highest to the lowest.

Table 4.9 Energy-related emissions (Palm and Eitrem Holmgren, 2020)

Country	CO_2/Pop (tCO_2/capita) (2017)	CO_2 emissions (Mt of CO_2) (2017)	CO_2/TPES (tCO_2/toe) (2017)	CO_2/GDP (kg CO_2/2010 USD) (2017)
Netherlands	9.08	155.6	2.10	0.17
Germany	8.70	718.8	2.31	0.19
Slovenia	6.49	13.4	1.94	0.25
United Kingdom	5.43	371.1	2.04	0.13
Italy	5.31	321.5	2.10	0.15
Sweden	3.74	37.6	0.77	0.07

As can be seen in the Table 4.9 the carbon-dioxide emissions per capita differ greatly between the countries. The Netherlands' CO_2 emissions per capita are the highest among the countries, Sweden has the lowest. Sweden's emissions are the second-lowest figure among the IEA countries. The shares of fossil fuels, renewables, and nuclear power of the Netherlands and Sweden are as expected mirrored in their CO_2 emissions per capita.

The EU-28 average amounted to 6.3 tCO_2/capita in 2017. In comparison, half of the NEWCOMERS countries have higher carbon-dioxide emissions per capita than the EU average (NL, DE and SI) and the other half have lower emissions (UK, IT, SE).

In Busch et al's (2019) literature review, it was found that earlier research claims that ECs contribute to emission reduction, but few studies have calculated the volume of these reductions (Busch et al., 2019). Berka and Creamer (2018) also found that environmental impacts outside the project, to a wider community, is uncommon. There is a lack of evidence that projects involving renewable energy technology and/or self-consumption induce community-wide behaviour change or increase the use of renewables.

Studies that are calculating emissions usually focus on the building level (Fouad et al., 2020), do potential studies focusing on hypothetical emission reductions (Blumberga et al., 2020), and compare different technologies (Schram et al., 2019). As expected, these studies confirm that an increase in the use of RES will reduce emissions if they replace fossil fuels. In cases with a high share of RES in the energy mix investment in RES will not reduce GHG emissions (Karunathilake et al., 2018). No before and after studies were found, where emissions are measured before and after the establishment of an EC. If the search had been done excluding the keyword EC then such comparative studies of emissions would most likely appear. But for this report, we were only interested in research specifically focusing ECs. Following the ranking of the NEWCOMERS countries, there is no clear relationship between the countries' energy-related emissions and the number of ECs.

4.2.2 The electricity grid

Table 4.10 shows that the number of TSOs and DSOs differ between the countries. The countries are ranked in relation to the number of DSOs.

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Table 4.10 The number of TSOs and DSOs

Country	TSO	DSO
Germany	4	880 (2013)
Sweden	2	173 (2013)
Italy	1	144 (2013)
United Kingdom	Great Britain (GB) is operated by a single Electricity system operator (ESO): National Grid Electricity System Operator (NGESO). EirGrid is the TSO for Northern Ireland (NI).	15 Distribution Network Operators (DNOs) in total. A process is underway to transform DNOs into DSOs.
Netherlands	1	8 (2017)
Slovenia	1	5 (2018)

The majority of the countries have a single TSO (IT, NL, SI,), Sweden has two, while Germany has four. The United Kingdom has an overarching ESO for Great Britain and a regional TSO present in Northern Ireland. The countries' systems of DSOs differ likewise, where some countries have less than ten (SI, NL), and others have over a hundred (IT, SE) or even closer to a thousand (DE). There has however been a push with the EU to not have too many DSOs. Germany for example, with a tradition of cooperatives and small grid operators, has been under pressure by the EU to reduce the numbers of DSOs (Horstink et al., 2020).

The United Kingdom has fifteen DNOs that are transitioning to become more active system operators over the next decade. Germany has a tradition of small grid operators. Italy has in some regions a history of cooperatives owning the local grid (Ines et al., 2020). Germany has many DSOs and also many ECs, but otherwise, there are no obvious patterns or correlations between the number of DSOs and the number of ECs in a country.

Table 4.11 The roll out of smart meters (the countries are listed alphabetically)

Country	Smart meters
Germany	First stage of a smart meter rollout commenced in 2016 targeting users of 6000 kWh or more per year
Italy	Almost 32 million installed in homes and businesses in 2015.
Netherlands	In 2018, around 5.2 million (54%) households had a smart meter. Obligation for the DSOs to implement to all residential by 2023.
Slovenia	57% of consumers were equipped with smart meters in 2017.
Sweden	In the process of rolling out second generation of smart meters by the end of 2024.
United Kingdom	Since 2016, a full-scale rollout of smart meters on a voluntary basis in GB. Planned end-date of 2024. Semi-smart prepayment meters were used in ca 40 percent of households prior to this

As can be seen in the Table 4.11 all six countries are currently rolling out smart meters. No obvious pattern was found, and the countries are listed alphabetically.

In Germany, the Act on the Digitalization of the Energy Transition makes it possible to install smart meters which allows the plant operator in a block of flats to sell the locally produced electricity to end-users in the proximity. The operator becomes an electricity supplier and receives a self-consumption tariff from the distributer, ranging from 2.1 to 3.7 cents/kWh of PV-generated electrical energy for 20 years. Maximum RES capacity and annual production limits apply. The collective self-consumers must also pay an EEG-surcharge as a part of the retail

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electricity price to contribute to the finance of the German RE support scheme (Frieden et al., 2019)

In Slovenia, the regulation on self-supply with electricity from RES from 2019 is a way to stimulate the private investments in RES generation. The law makes it possible for residents in the same multi-apartment building to share RES-generated energy. The law also introduces RES communities which is a community of final consumers connected to two or more metering points and to the same low-voltage network as the RES generation unit (Frieden et al., 2019).

In 2020, Italy implemented a new law (law n.8/2020), which aims at the early transposition of Articles 21 and 22 of the REDII. The legislation introduced a legal framework for collective self-consumption and energy sharing by renewable ECs. It is an experiment, and the total installed production cannot exceed 200 kW. The entry points of consumers and the renewable energy installations must be located on the same low voltage grid under the same medium/low voltage substation transformer. The energy is shared through instant self-consumption. The general system charges will be applied to both the shared energy and the energy withdrawn from the public grid. The renewable power plants participating in collective self-consumption or renewable ECs will be able to access a new tariff and a feed-in tariff will be used to reward the renewable power plants that participate (REScoop.eu, 2020).

In Sweden collective self-consumption in a multi-apartment building is allowed if all apartments are connected to the same grid connection. The building has one contract with the utility, but the electricity consumption can also be measured internally and thus be added to the monthly rent (Frieden et al., 2019). Collective self-consumption where electricity is transported over a grid, covered by the grid concession, and shared between different property owners is not allowed.

Net metering can serve as a best practice, as a simple tool encouraging self-consumption of own generated electricity. Net metering is possible in Italy, the Netherlands, and Slovenia, but not in the United Kingdom, Germany, Sweden (IEA, 2016; Ines et al., 2020; Palm et al., 2018). Net metering is a billing mechanism that allows prosumers (households having e.g. PVs and generating their own electricity) to use this electricity at any time. The own production can be "stored" in the electric grid and by this the self-consumption increases. Monthly net metering allows for example households with PVs to use solar power generated during the day at night or later in the month. Annual net metering allows surplus PV production during the summer months to be saved to the winter months (Luthander et al., 2015).

Virtual net metering is legally possible in some countries which opens up for new innovative solutions for ECs, where people not having access to suitable generating still can participate and share the electricity generated from a facility (Ines et al., 2020). Virtual net metering has been tried out for community solar, where solar power is not installed on-site, but externally and the electricity is shared among subscribers. Ines et al (2020) state that if only the regulatory framework is flexible enough ECs may find creative ways and solutions such as aggregators and virtual plants, while inflexible regulatory frameworks only create lock-in effects and do not allow for innovation by the EC. Virtual power plants have been tried out in Germany and in the Netherlands, Ireland and Belgium under the cVPP project (cVPP, 2021). Virtual power plants are interconnected small, decentralised and usually privately-run RES power producers and storage facilities. Those small-scale plants are owned by companies or households or ECs who become prosumers. These plants are connected and sell their energy as one virtual power plant on the market. Individually would those small power plants have difficulty entering the market but integrated in a virtual power plant this is possible. VPP are an established business model that is receiving increased attention by established EC who are looking to utilize existing renewable generation projects within their local areas (Van Summeren et al., 2020).

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4.2.2.1 The CEP and sharing of electricity

The CEP and the EU electricity directive (IMED) emphasize peer-to-peer (P2P) solutions and states that consumers should be able to participate in all electricity markets. The IMED requests that all legal and commercial barriers to implementation should be removed. This includes "*disproportionate fees for internally consumed electricity, obligations to feed self-generated electricity to the energy system, and administrative burdens, such as the need for consumers who self-generate electricity and sell it to the system to comply with the requirements for suppliers, etc,*". Consumers should "*contribute adequately to system cost.*" The member states are requested to ensure that sharing of renewable energy should be permitted, including also multi-apartment blocks. The IMED defines citizen energy communities as a legal entity that: *(c) may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders.*

The IMED leaves however to the member states to regulate price setting and if energy communities will be able to act as distribution operators. The Council of European Energy Regulators (CEER) states in their report (2019b) that

"Energy communities owning grid infrastructure remains optional for MS. However, if and where this approach is adopted, it should avoid duplication of assets, ensure economic efficiency, be subject to appropriate regulation in line with the regulatory framework for DSOs and ensure customers receive an adequate level of quality of service."

In all our NEWCOMERS countries the grid needs network investments due to aging electricity infrastructure and increased use of intermittent power generation sources (IEA, 2019; Mateo et al., 2017). These can be a significant cost for customers in remote communities or all customers if the investment is cross-subsidized as is the fact today (Gui and MacGill, 2018). Microgrids are seen as an alternative to existing grid upgrades that can both increase the reliability of the grid and lower the cost, at least for the energy community owning the microgrid (Kojonsaari and Palm, forthcoming). The existence of microgrids for P2P markets has been identified as an enabler for EC to emerge (Bukovszki et al., 2020). For the other customers that are not able to invest in a microgrid, this can result in higher costs because they must carry a bigger share of the cost of the existing grid. It is often the vulnerable consumers who cannot benefit from emerging energy grid communities and need to carry an increased burden of rising grid tariffs, levies, and energy costs (Hanke and Lowitzsch, 2020).

4.2.3 Summary the Technical system

The main findings for the technical system are summarised below, in Figure 4.2.

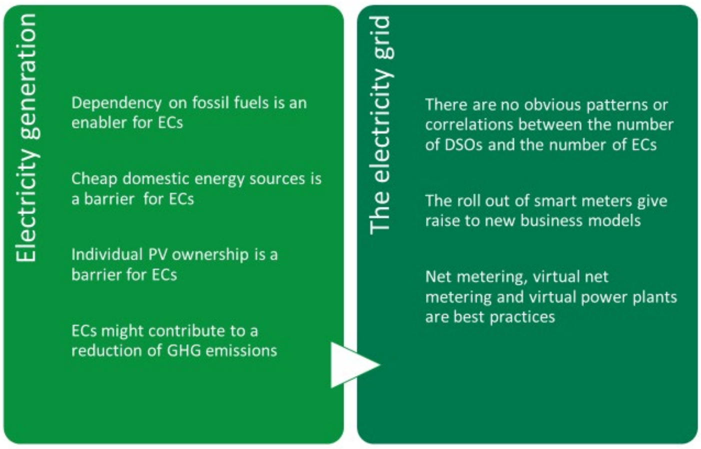

Figure 4.2 Summary of the findings for the technical system

4.3 Institutional settings

In this section, the need for policies and regulations exclusively for ECs will be discussed together with the implementation of the CEP in the member states. The countries' existing subsidy schemes and support for renewables and ECs are presented.

4.3.1 Policies and regulation targeting ECs

The lack of tailor-made policies for ECs is one often mentioned barrier (Gancheva et al., 2018; Ines et al., 2020). This barrier, the lack of tailor-made policies for ECs, will most likely be reduced with the transposition of CEP into national legislation. Ruggiero et al (2021) discuss that existing energy market regulation and policy instruments, in general, are largely inadequate and not supportive of ECs. They study Poland and Finland and found discriminatory taxes, inadequate metering regulation, slow building permits, and lack of grid connection as examples of existing limitations. Bureaucracy, legislative and administrative burdens are a barrier often mentioned in earlier research (Brummer, 2018; Gancheva et al., 2018; Hall et al., 2019; Horstink et al., 2020; Wagemans et al., 2019; Warbroek et al., 2018). Wierling et al (2018) even discuss the presence of a hostile institutional context as a barrier within the EU. The CEP tries to deal with this. It provides a legal enabling framework that includes e.g., simplified administrative and regulatory requirements, lower levies, and taxes for EC (Hanke and Lowitzsch, 2020).

RED II obliges the member states to introduce an enabling framework to allow RECs competing "on an equal footing" (Hanke and Lowitzsch, 2020).

"Member States shall provide an enabling framework to promote and facilitate the development of renewable energy communities. That framework shall ensure, inter alia, that unjustified regulatory and administrative barriers to renewable energy communities are removed;" (RED, Article 22, (4a))

The RED II should ensure that unjustified regulatory and administrative barriers to REC are removed and ensure the participation of all consumers, also low-income or vulnerable households. Regulatory and capacity-building support should be provided to public authorities in enabling REC and in helping authorities to participate directly (Hanke and Lowitzsch, 2020). The requested enabling framework should include possible tax incentives and exemptions from levies. Prosumerism should provide tangible benefits with lower energy costs and additional revenues (Hanke and Lowitzsch, 2020).

Horstink et al (2020) raise an interesting dilemma connected to the CEP. The CEP offers ECs clarity and support, but it also requires a formalisation of initiatives. The ECs need to choose if they are a renewable energy community or being jointly acting renewables self-consumers. Horstink et al mean that this can hinder rather than stimulate the expansion of civic-inspired prosumer initiatives. Informal groups or partnerships do not qualify as an EC. Horstink et al discuss that the member state can pick up on this when implementing the directives. This will however lead to diverse interpretations and treatment of prosumers within the EU, but the benefits can be that it advances inclusive, democratic, and a more rapid energy transition (Horstink et al., 2020). (See also the discussion above on definitions of ECs). The REScoop project has in several reports analysed how the member states plan to implement the CEP and they also reflect upon limitations and possibilities in the member states approach (see e.g. REScoop.eu, 2020; Roberts and Gauthier, 2019).

Policy-makers at all levels need to ensure a stable and regulatory framework for ECs (Gancheva et al., 2018; Horstink et al., 2020). When targets are transferred from the EU level down to lower levels (regional, municipal, neighbourhood) it becomes important to take local conditions into account. Ambitious targets need to come with an understanding of what activities are needed at

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a local level to implement them (Walnum et al., 2019). That is also why the CEP needs to be adapted to and embedded in a national and local setting. Hall et al (2019) call for greater devolution and allow for regulations, incentives, and decisions to be adapted to local needs. This would also benefit democracy according to the authors. How the implementation of the CEP is done in the different member states is however too early to study because this is an ongoing process.

However, in parallel with the transposition of the CEP in the member states, ideas emerge on how to improve the CEP and/or how the country can transpose the directives in creative ways. One suggestion is that tax exemptions could be granted for those ECs that have a diverse membership, for example, those with 10% vulnerable households included (Hanke and Lowitzsch, 2020). Another suggestion is that energy taxation and renewable levies should be turned into general taxation because it falls disproportionately on the electricity bill and disincentives prosumer business models (Hall et al., 2019). Depending on the design of the system, high levies can also encourage prosumers, if the prosumer does not need to pay taxes or fees for self-consumption. REScoop, also closely follows how EC-related policy develops within the EU and their member states and they have in several reports criticized the slow developments of support mechanism in the countries. REScoop does not only criticise the development but contributes with supportive tools and advice (see rescoop.eu).

4.3.2 Subsidies and support schemes

Financing ECs and their projects is often seen as one of the biggest barriers to overcome (Warbroek et al., 2018; Wierling et al., 2018). Earlier research has highlighted the importance of state funding, subsidy mechanisms, and dedicated support programs for the development of ECs (Creamer et al., 2018; Gancheva et al., 2018; Hall et al., 2018; Ines et al., 2020; Walker, 2008). In particular, it seems difficult to secure funding in the early stage of an EC, when plans are going to be implemented. ECs need subsidies to start. If the EC wants to develop wind and solar projects, it needs access to fund the project development phase. Bank finance might be needed. In for example the Netherlands, finance of ECs is provided by crowdfunding among the members and a larger public.

According to Horstink et al (2020) access to subsidies and grants are both critical enablers and critical barriers when they are absent. Horstink et al also discuss that it is not enough that subsidies and grants are in place, but that an EC also needs to be aware about their existence. This can be as problematic as the absence of financial support. Different support schemes have played a crucial role in many countries for ECs to become economically viable and it can offset some of the costs and risks for emerging EC (Bomberg and McEwen, 2012). Wierling et al (2018) have shown that the removal of supportive schemes led to a remarkable downturn in the founding of new energy cooperatives in Austria, Denmark, Germany, and the United Kingdom. However, grants and subsidies also come with a cost because they are related to bureaucracy and administration (Brummer, 2018). The benefits of a support scheme need to be assessed considering its administrative costs and the time needed for applicants and control authorities to uphold the system.

According to Brummer (2018) the design of support schemes in different countries is one explanation of national differences in the number of ECs. All our NEWCOMERS countries have national level programmes that support the deployment of renewable energy technologies. In Table 4.12, the countries' main subsidies for renewable energy and feed-in-tariff schemes relevant for ECs are listed. The countries are presented in alphabetic order.

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Table 4.12 Renewable energy subsidies and programme

Country	Main subsidies and programmes
Germany	Since 2015, biofuels are subsidised solely through EU biofuel targets. The cooperative law facilitated the process of establishing new renewable energy communities. The act on the digitalization of the energy transition makes it possible to install smart meters which benefit the integration of RE into the existing energy mix FiTs and feed-in premiums supported all RES since the 2000s. The Renewable energy source act (2000) enabled financial support, guaranteed grid connectivity for renewables and preferential dispatch for 20 years.
Italy	Waste, biomass and other renewable energy are exempt from taxes if used for heat or electricity. Support schemes for RE electricity, such as a favourable VAT regime (10% instead of 20%) Tax credits for instalment costs of a PV system. Net metering scheme for renewable energy producers. FiT scheme in place between 2005-2013, especially beneficial for PV. A FiT will be used in relation to law n.8/2020 targeting REC
Netherlands	A tender-based premium feed-in scheme (SDE+) since 2011. Replaced by SDE++ scheme in 2021, where sustainable energy technologies will compete on the avoidance of CO_2 emissions cost-effectively instead of on produced sustainable energy. Regional energy strategies to realise fifty percent local ownership in wind and solar projects by 2030 Energy consumers receive a tax deduction for the amount of energy that local community-owned renewable energy projects produce ("postcoderoos")
Slovenia	A net metering scheme from 2016 targeting households and SMEs, from 2019 for collective self-consumption in multi-apartment buildings and REC. RES and CHP support scheme in place since 2009, grants producers state aid for electricity produced using RES and CHP (guaranteed prices or operational support). A FiT and premium tariff since 2002, granted via tender procedures. Electricity producers can select either a guaranteed FiT or a bonus (premium) on top of the free market price for electricity.
Sweden	Tradable green certificate system. Subsidy programme supporting local and regional infrastructure investments since 2015. Investment aid of 20% for installation of PVs until Dec. 2020. Since 2021 tax reduction of 15% for PVs and 50% for storage for households. Prosumers who are net buyers from the grid are exempted from network charges for the electricity they feed into the network
United Kingdom	Support schemes for electricity generation based on RES include renewable obligations (since 2002 but closed for new applications in 2017) with obligations of UK electricity suppliers to source an increasing proportion of the electricity from renewable sources and contracts for difference (since 2013) between current and contracted prices paid to suppliers to support new large-scale low-carbon generation projects. Urban and rural community fund support renewable energy projects. FiT scheme between 2010-2019 supported solar PV, onshore wind, hydropower and anaerobic digestion up to 5 MW and micro co-generation. Generators received payment for every kWh generated and extra for energy exported to the local network.

Table 4.12 displays the range of relevant EC renewable subsidies present in the countries, which all can function as best practices inspiring others. Germany for example subsidise biofuels and has a cooperative law facilitating new REC to emerge. Italy has support schemes for RE electricity and tax exemption for renewables. The Netherlands has the ambition to realise 50% local ownership in wind and solar projects by 2030 through the development of thirty regional

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energy strategies. The country has a policy instrument that aims to stimulate local ownership of renewable energy projects through its postal code area scheme ("postcoderoos"). Energy consumers receive a tax deduction for the amount of energy that local community-owned renewable energy projects produce. Slovenia has a support scheme for RES and CHP. Sweden has a tradable green certificate system and a program supporting local and regional infrastructure investments. Wales and Scotland within the UK have targets for levels of community energy (Roberts and Gauthier, 2019). The United Kingdom government support for ECs has overall decreased since 2010, but a few programmes such as the research and development programme 'Prospering from the Energy Revolution' have some links with ECs. The UK also have contracts for difference between current and contracted prices paid to suppliers to support new large-scale low-carbon generation projects and urban and urarl community fund support renewable energy projects.

The FiT scheme is a policy that has been widely used. It has given a push to ECs to develop, even if the uncertainty of the level of the FiTs also has been a barrier to progress in some ECs (Bomberg and McEwen, 2012). According to Lowitzsch (2020) guaranteed FiTs have been proven most effective when it comes to repaying RES installation loans and providing investment security. The model has enabled renewables to be competitive with fossil energy. Several of the NEWCOMERS countries (DE, NL, SI) have FiT schemes in place to encourage renewable energy production. Italy has had a FiT scheme in place and is since 2020 trying a model with a specific FiT for RECs as described above. Sweden is the only country that never has had a FiT scheme in place. The United Kingdom had a FiT scheme in place but has ended the schemes. The trend is to stimulate increased self-consumption rather than selling to the grid, of which the abolishment of FiTs is a sign (Horstink et al., 2020).

Germany is a country where FiTs has increased the share of RES. The use of FiTs has however slowed down in recent years. One reason is that FiTs have contributed to fewer medium and large-scale projects with citizen involvement being implemented, because of inadequate potential for scaling of investments (Lowitzsch, 2020). The second reason is that FiTs have been replaced by auctions, which have made it difficult to refinance RES plants. This policy change has led to a 10% reduction in the share of citizen-owned projects in Germany between 2012 and 2016 (Lowitzsch, 2020). This has led to market consolidation and ownership concentration and it is important to find a financing system that includes more and diverse groups in society. The conventional business model does not seem to meet the requirements of ECs and organisational innovations are needed (Lowitzsch, 2020).

Herbes et al (2017) argue that the change from FiTs to an auction system will impact ECs negatively because it removes investment security and introduces a pricing risk. Corporate entities benefit from auctions because they can employ professionals in managing risk. ECs rely on the other hand on their local expertise. Corporate entities also have a large project portfolio allowing risk diversification (Herbes et al., 2017).

In Italy, FiTs contributed to an increase in renewable energy plants, but when the FiT scheme was cancelled in 2013 only a few ECs had developed (Candelise and Ruggieri, 2020). A revised version of FiTs will now be tried out and these will specifically be targeting ECs. This might contribute to a rise in the number of ECs in Italy.

There are also benefits identified in moving away from FiT and net metering support mechanisms. Hall et al (2019) suggest a shift to export guarantees and incentives are beneficial because they reflect the value of exported power to the system. Yet, to support prosumers and ECs they argue for guaranteed prices for exported power and tax incentives on renewable hardware (Hall et al., 2019). Another suggestion is that ECs get special FiTs or other incentive

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schemes supporting these kinds of initiatives which deliver social value or having non-profit as a value (Hall et al., 2019; Sokołowski, 2020). Such incentives and grants should also benefit marginalised groups such as the energy poor and ECs (Hall et al., 2019).

In the United Kingdom government-backed generation and export payments under the FIT scheme meant community groups took on project risk but not revenue risk. Even project risks were somewhat muted by revolving catalyst funds which only required repaying if projects were successful. With the closure of FITs, communities took on revenue risk too: their income became less predictable because they were exposed to wholesale markets. At present, many UK community groups are risk-adverse. They also do not have the generation portfolios of professional developers to balance or spread risk. Few opportunities exist for communities to reduce revenue risk. Hence fewer RES projects are being developed. Long-term Power Purchase Agreements (PPA) offer one option, removing exposure to the wholesale market, but require finding and negotiating with suitable clients. Another option is the creation of standardised routes for public sector organisations to procure CE alongside energy from the wholesale market, which are in essence a special public-backed PPA arrangement (Energy Programme of the Environmental Change Institute, University of Oxford, 2021),

4.3.3 Summary institutional setting

The main findings for the institutional settings are summarised below, in Figure 4.3.

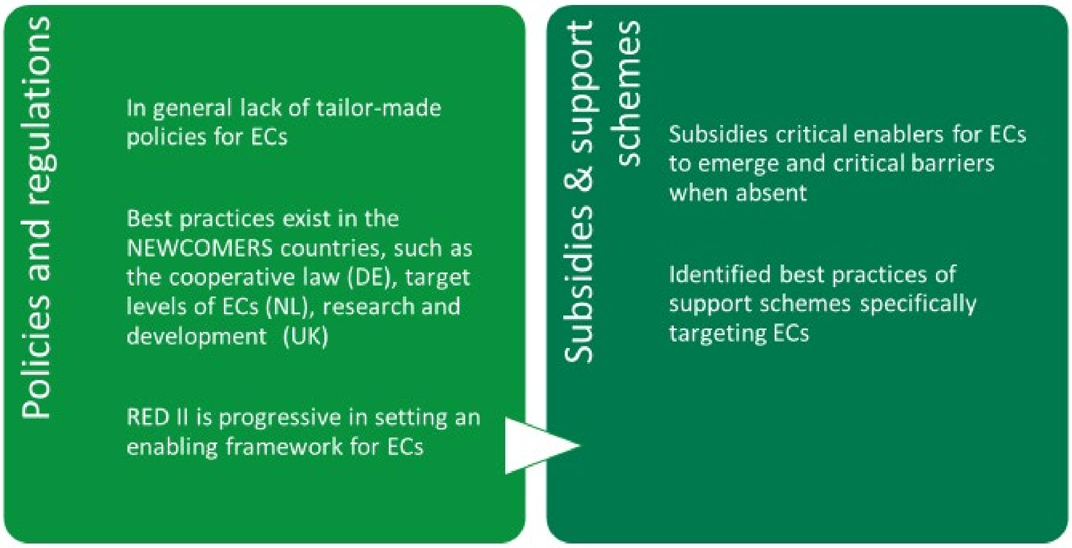

Figure 4.3 Summary institutional settings

4.4 Actors in the electricity system

In D3.1, the countries' main government actors and institutions responsible for energy policy and regulation were presented. In all six NEWCOMERS countries, ministries and implementing agencies are responsible for formulating and implementing national climate and energy policy. Regional and local governments or federal states likewise have responsibilities in for instance policy implementation or other aspects of energy deliverance. Independent regulatory authorities exist in some countries, overseeing electricity and energy markets. Competition and market authorities to safeguard competition are also common in all six countries.

Earlier research most often emphasized the need for policymakers at all levels to support ECs to emerge. A common suggestion is that national, regional, and local governments should adopt

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policies and outcomes promoting ECs (Gancheva et al., 2018; Ines et al., 2020; Kooij et al., 2018). In earlier research, it has been noticed that lack of political support and lack of access to politicians and policymakers are barriers for ECs to develop (Brummer, 2018). Linking EC development to overarching policy objectives has however been identified as an enabler, which can secure support stakeholders and citizens (Gancheva et al., 2018). In our six NEWCOMERS countries, the United Kingdom was early with developing a strategy for ECs (Palm and Eitrem Holmgren, 2020). Earlier research found that many countries do not have ECs on the political agenda (Brummer, 2018). The CEP will however contribute to that ECs become an issue on the political agenda in all EU member states.

Kooij et al (2018) discuss how political discourse can enable ECs. In their study it turned out that Denmark had beneficial discourse emphasizing renewable energy, while the discourses in the Netherlands and Sweden became barriers. If and how the CEP can influence a county's political discourse is still to be seen. Ruggiero et al (2021) emphasize the need for alternative visions to guide and inspire actors to initiate an EC and perhaps the CEP can contribute to developing such alternative futures. These visions and imaginaries need however to be contextualized in the local settings and match cultural norms and available resources. Earlier research has emphasized the important role of local and regional governments. Even if the national level has been in focus for WP3 it is still interesting to reflect upon these other levels. Earlier research often finds that ECs collaborate with multiple governance levels. It has also been noticed that municipalities often have been reluctant to work together with EC and that ECs are unsure what to expect from municipalities (Wagemans et al., 2019).

Table 4.13 provides an overview of electricity market actors. It also includes national household switching rates.

Table 4.13 Actors active in national electricity market (CEER, 2019a; Palm et al., 2020)

Country	Production	Trade	Switching rate
Germany	Several hundred electricity providers. Over 50% of production comes from the four large utilities, 25% comes from public utilities. Renewable power has a larger, more eclectic group of producers	The market share for the four largest companies is less than 40%. End-users had 143 providers to choose from in 2017, and households 124 providers.	In 2017, the switching rate for households was 7.2%. 41.2% had contracts with the default supplier.
Italy	In 2013, Enel Servizio Elettrico was the largest power producer (25 %). The next five largest companies cover 24% of the market	Three retail markets: -Enhanced market: In total 236 suppliers, but Enel serves 85% of customers. A significant share of purchases from the single buyer, AU. Italy is the only country in Europe to retain the single buyer model. -Open market: the largest number of retail providers (336 in 2016). Enel largest provider with 35%. -Safeguarded: two companies.	In 2018 9,3% switched suppliers.

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Netherlands	4 main companies in terms of power generating capacity	In 2019, there were 57 active electricity suppliers on the retail market. The three largest energy suppliers accounted for over 70% of retail electricity sales in 2018.	In 2019, 20% of retail customers switched suppliers, an increase from around 12.6% in 2012.
Slovenia	2019, nine companies were operating large fa-cilities with an installed capacity of over 10 MW. Most of the major actors in electricity production are owned by the two parent companies, HSE and GEN Energija.	2019 there were 22 electricity suppliers active of which 16 supplied electricity to households. The market share of the three largest suppliers was 56.7% of household customers.	2019, 4.9% of households switched suppliers. The number of switches has decreased in the last three years and was close to 7% in 2016.
Sweden	Electricity generation is dominated by a few large. The three biggest generate 73% of the total, whereof Vattenfall generates 40% of the total	More than 120 suppliers. At the end of 2017, the 3 largest suppliers had about 42% of customers. Some suppliers operate only locally or regionally.	In 2018 11,3% of the end-users switched supplier.
United Kingdom	2018, 170 licensed electricity generators active. Eight generators provide 71% of the volumes in 2017. 6 owned approx. 50% of the total installed capacity in 2017.	A wholesale market dominated by six vertically integrated companies active in generation and retail during the last twenty years. In 2018 73 suppliers active in GB's electricity market.	In 2018, around 18.4% of consumers switched suppliers. More than 60% have only switched once or never. 54% have been on default tariffs for more than three years.

The structure of the electricity market has in earlier research been proven important for the emergence of ECs. A main barrier for bottom-up initiatives such as ECs is a centralized design and regulation of existing energy systems (Brummer, 2018; Koirala et al., 2018; Kooij et al., 2018; Warbroek et al., 2018). In his study, Brummer (2018) found the existence of a regime in the United Kingdom discriminating against small community-driven initiatives and benefitting big energy companies. Kooij et al (2018) found in their study that decentralised organised energy infrastructure with an SME economy was enabling the emergence of ECs.

Table 4.13 reveals that all NEWCOMERS countries are dominated by a few large energy utilities. Several of the countries have a large number of companies present in the market such as Germany and the United Kingdom, even if there are a few with dominating shares of the production. The countries' retail markets are similarly moderately concentrated, as a few electricity trade companies have large market shares of the customers. The number of retailers can be contrasted with the rate of households switching energy suppliers. A country's switching rate can reveal the retail market's competitiveness and the activity and agency of consumers in their energy choices. It might however also only be a sign of that the households are sensitive to energy prices and that it is easy to compare energy suppliers, which stimulate a high switching rate. Italy has the highest number of providers (336) among the six countries, but not the highest switching rate. Italy had around 10% switching suppliers, while the Netherlands had a switching rate of 20%. The Netherlands switching rate is among the highest in Europe. The United Kingdom has also a comparable high switching rate (18,4%).

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A liberalized market with domestic competition has been identified as more beneficial for ECs than a closed energy market where rules and resources are tailored to large players. As also discussed above, a monopolized grid is a barrier for ECs together with no grid access, while cooperating energy companies and affordable grid access are enabling for ECs to emerge (Bukovszki et al., 2020; Kooij et al., 2018). Large energy companies, as well as state owned energy companies, are constraining conditions, while small energy companies, consumer-owned companies, and competition and unbundling are enabling conditions (Kooij et al., 2018). As also discussed in chapter 3, most ECs are cooperatives and these exist under different conditions in our six countries. In Germany, which has a tradition of cooperative ownership, there still exist barriers. An example of such barrier are the regulations requiring cooperatives to hold a banking licence if they want to hold a minority share in renewable projects (Brummer, 2018). Another identified barrier is the lack of government-backed bank funding for ECs (Brummer, 2018). This can be solved by e.g. the state or the municipality provide debt securities (Hall et al., 2019; Hanke and Lowitzsch, 2020). ECs have the potential to change not only the fossil dependency but also the whole owner-structure of the market. Wierling et al (2018) discuss that actors starting ECs in Canada and New Zealand belonged to groups outside the mainstream, which in this case means that they have been initiated by ethnic minorities. This successful inclusion of marginalised groups motivates governments to actively interfere in the market and develop regulations and support programme specifically targeting ECs.

4.4.1 Umbrella organisations

An enabling factor which can contribute to put ECs on the political agenda is support of an umbrella organisation (Bukovszki et al., 2020; Kooij et al., 2018; Rahmani et al., 2020; Wagemans et al., 2019). In the United Kingdom, the Netherlands and Germany ECs are part of larger cooperative organisations. The United Kingdom has for example Community Energy England, but also NGOs supporting local initiatives. The Netherlands has the umbrella organisation Energi Samen and Participation Coalition offering support for municipalities and regions. In Germany the German Cooperative and Raiffesen Confederation (DGRV) and the Citizens Energy Alliance (BBEn) assist ECs (Palm and Eitrem Holmgren, 2020). These intermediaries contribute with networks, a possibility for learning between ECs, and a platform for sharing of best practices (Kooij et al., 2018). Similar organisations are lacking in Italy, Slovenia and Sweden. See also Table 4.14.

Table 4.14 Umbrella organisations

Country	Organisation
United Kingdom	Community Energy England; Community Energy Wales; Community Energy Scotland; also local governments and NGOs
Germany	German Cooperative and Raiffesen Confederation (DGRV) and the Citizens Energy Alliance (BBEn)
Netherlands	Energie Samen Participation Coalition (Participatiecoalitie)
Sweden	None
Slovenia	None
Italy	None

The ten NEWCOMERS case study communities examined in D4.2 also provided evidence that ECs are often engaged with a range of actors, particularly energy suppliers, technical delivery partners, and installers, software developers and grid operators. Collaboration and networking with others are often listed as one of the top facilitating factors by the ECs (Boyle et al., 2021;

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Horstink et al., 2020; Ruggiero et al., 2021; Wagemans et al., 2019). Intermediary organisations can help EC to build knowledge, skills, and other capacity needed to fulfil their ideas (Boyle et al., 2021; Rahmani et al., 2020). Umbrella organisations can be important actors in this regard.

Almost all studies also highlight the extreme dependence of EC on volunteer labour. Horstink et al (2020) have a quote capturing the problem: 'We need to move from hobby to lobby, from volunteer organisation to professionalisation'. How big of a problem this is can however vary. Brummer for example found the reliance on volunteers to be less problematic in the United Kingdom compared to Germany and the USA (Brummer, 2018). To ease this burden of volunteers, umbrella organisations can have an important role to fulfil by creating standardised business models, reducing costs associated with negotiation and by sharing best practice for instance (Nolden et al, 2020).

4.4.2 Summary actors

The main findings in relation to the electricity market actors are summarised below, in Figure 4.4.

Actors

- NEWCOMERS countries all have centralised markets
- The markets are dominated by a few large energy utilities
- The retail markets are similarly moderately concentrated
- In the UK, NL and DE, ECs are part of larger cooperative organisation

Figure 4.4 Summary actors

5 DISCUSSION

The aim of this Deliverable 3.3. is to identify barriers and enablers for new energy communities to emerge in different national settings and to discuss the potentials for learning between different countries. Below are identified barriers and enablers discussed and thereafter is identified best practises summarised.

5.1 Summary barriers and enablers for ECs to emerge

In this report barriers and enablers for ECs to emerge have been discussed in relation to earlier research and the findings from our six NEWCOMERS countries. The focus for the analysis has been barriers and enablers in relation to socio-economic conditions, the electricity system, the institutional setting, and actors in the electricity system. Below these findings are summarised in figures 5.1-5.4.

A factor can sometimes be a barrier and sometimes an enabler depending on how an EC can harness the factor in question (Horstink et al., 2020; Reindl and Palm, 2021). In the figures below the intention is to capture when a factor has been identified mainly as a barrier or an

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enabler. When a factor has been seen mainly as a barrier it has been categorised as a barrier and when it appears mostly as an enabler it has been categorized as such. When it is equally mentioned as a barrier and enabler it has ended up in both categories.

Figure 5.1. summarises the identified enablers and barriers for ECs to emerge in relation to to socio-economic conditions.

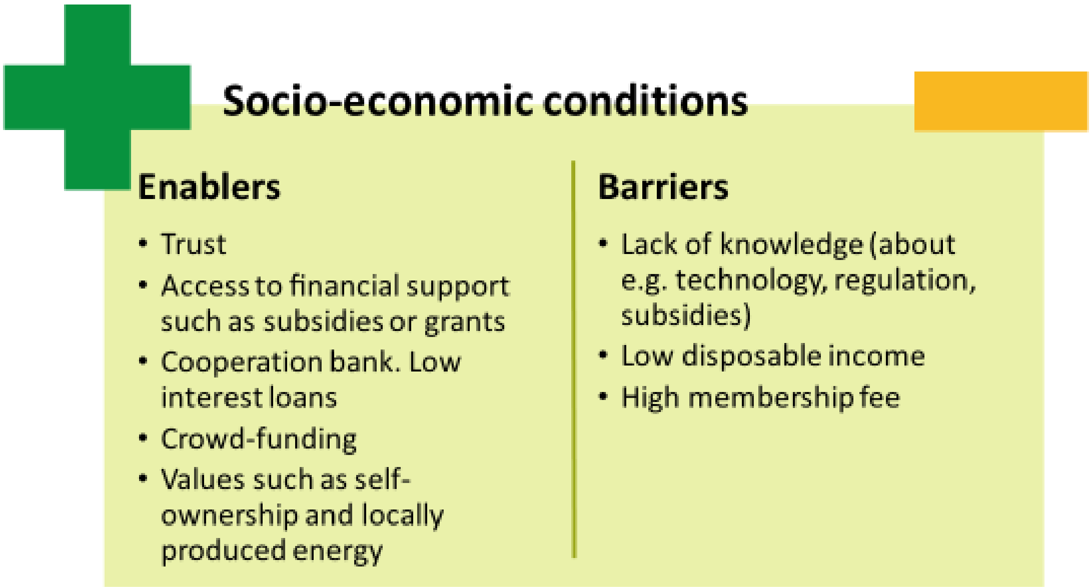

Figure 5.1 Identified barriers and enablers for ECs to emerge in relation to socio-economic conditions

One barrier is related to lack of knowledge in different areas, such as energy-related technology, about existing subsidies or what it is regulatory possible to do or not do when it comes to for example sharing electricity in a community. Low disposable income was another barrier discussed in relation to the possibility for a person to join an EC. This is also connected to if there is a membership fee which exclude low-income households to join. The level of disposable income as a barrier was confirmed by the NEWCOMERS countries. The corresponding enabler to these barriers is access to financial support. The financial support was discussed both in relation to individual citizens and to ECs as organisations. That is why this enabler also comes back under institutional settings. Cooperation banks and low-interest loans were discussed both as solutions to individuals' financial limitations and as a way to enable the emergence of new ECs. Crowd-funding was another enabler discussed as a way to finance the start-up of an EC.

The most often mentioned enabler in earlier research was trust at a general level. Trust was one of the factors that quite often occur as both a barrier and an enabler, but most often it was discussed as an enabler. In the analysis of the NEWCOMERS countries, the result indicates that the Netherlands and Sweden have a good base for creating ECs when considering trust. For Slovenia and Italy, which had low trust in others and a low number of ECs, trust could be a barrier important to consider in the emergence of ECs.

A discussed enabler was that ECs bring values such as self-ownership and locally produced energy. An EC can also bring value to more people than individual investment. Compared to individual actions an EC requires less time, knowledge, and financial investment from each individual. This also enables citizens who lack some of the necessary resources to take part in the energy transition.

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When it comes to the influence of urban and rural settings, these are not included in the figure. It was hard to find any evidence that an urban or rural setting would be a barrier or an enabler for ECs to emerge.

In relation to the technical system, several barriers and enablers were identified. These are summarised in figure 5.2.

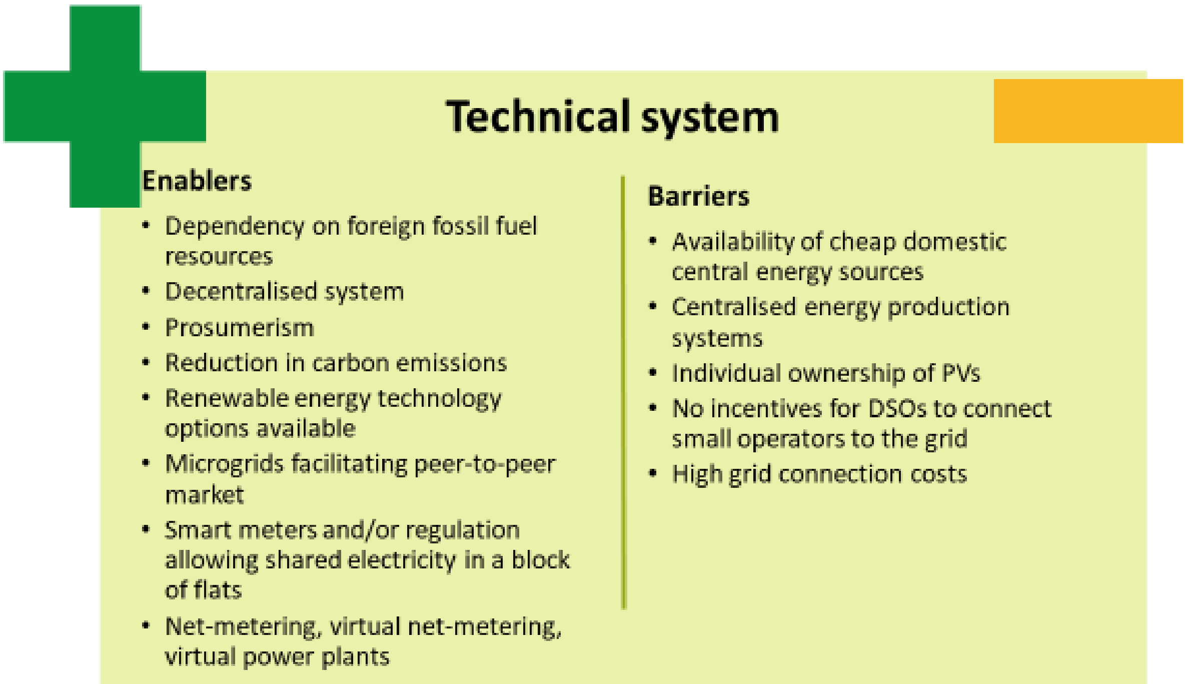

Figure 5.2 Identified barriers and enablers for ECs to emerge in relation to the technical system

Earlier research shows that the number of ECs in a country is related to energy path dependency and the availability of RES. A high dependency on fossil fuel import is an enabler for ECs to emerge. If a country has access to cheap domestic energy sources this is a barrier for ECs. The NEWCOMERS countries (except Sweden) are still rather dependent of fossil fuels. Among the NEWCOMERS countries, ECs have already contributed to an increase of RES in the electricity mix. A centralised system is identified as a barrier for ECs. All NEWCOMERS countries have centralised systems, where large-scale solutions dominate. Renewables and the possibility of prosumerism are seen as enablers. Among our NEWCOMERS countries, Italy has the largest share of solar power. Individual ownership of PVs has however been identified as a barrier for ECs which could explain the low number of ECs in Italy. Sweden has 51% renewables in the electricity mix, but this is mainly large-scale hydropower plants owned by energy utilities. Slovenia also has a high percentage of hydro, but also here these are not owned by ECs.

High carbon emission in need of reduction has been identified as an enabler for EC. Among the NEWCOMERS countries, there was no correlation between carbon emissions and the numbers of ECs. High GHG emission can however still be an important driver for ECs in our countries.

Concerning the electricity grid, there are several barriers and enablers identified which are dealt with in the CEP, for example, incentives for DSOs to connect small operators to the grid, microgrids, and facilitating P2P market. The CEP has the potential to become an enabler for EC to emerge, but this is still to be seen. It will depend on how the member states transpose the directives into the national law. The suggestion in Sweden is for example that ECs will not be allowed to own an electricity grid.

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The electricity grid is a natural monopoly heavily regulated, but it can be more or less dominated by a few actors. Germany has many DSOs and also many ECs, which could indicate this to be an important factor for ECs to emerge. But this was not a correlation found for all NEWCOMERS countries. High grid connection costs were a barrier found in earlier research, but not investigated in the NEWCOMERS countries.

Smart meters have been identified as an important enabler which among others makes it possible to share electricity. All NEWCOMERS countries are in the process of rolling out smart meters. Net-metering and virtual net-metering are other enabling factors. This is possible in Italy, the Netherlands, and Slovenia. However, the relationship to the number of ECs was weak. Virtual net metering is also emphasized as an enabler and here Germany has this. Virtual net metering is however a quite new phenomenon, and it is not likely that this has had any major impact on the number of ECs.

Figure 5.3 displays identified barriers and enablers in relation to the institutional setting.

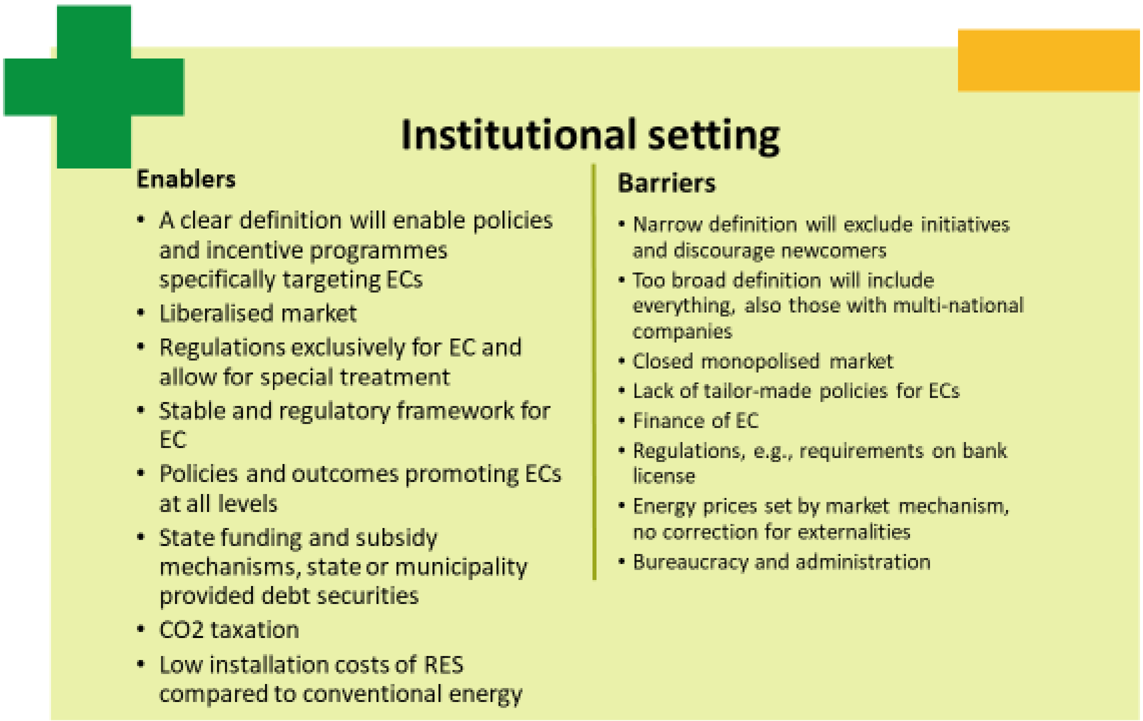

Figure 5.3 Identified barriers and enablers for ECs to emerge in relation to the institutional setting

How an EC is defined in regulations and policies will influence the emergence of ECs. A broad definition can be beneficial for many different initiatives to flourish, while a narrow definition will exclude initiatives and discourage new ECs. A too broad definition can however also be a barrier because it becomes too encompassing. Germany, the Netherlands, Slovenia, and the United Kingdom have legal frameworks in place in which ECs are defined, even if these are not related to the RED II and IEMD definitions. The CEP is being transposed into national laws and national definitions of ECs are under development. Several researchers have emphasized that this also is an opportunity for the countries to find definitions that work as an enabler rather than a barrier for ECs.

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The structure of the market has proved to be decisive for the emergence of ECs. A monopolised market is a barrier for ECs to emerge, while a liberalised market is seen as an enabler. Another identified barrier is the lack of tailor-made policies for ECs, while enablers are regulations exclusively developed for ECs and stable and regulatory frameworks for ECs. The NEWCOMERS countries have in general few policies especially targeting ECs, but more general RES policies, regulations, and subsidies. This is however something that will change with the implementation of the CEP. These are also barriers and enablers that will be interesting to follow and study more closely when the new regulations are in place in the NEWCOMERS countries and elsewhere.

Finance was a barrier discussed in relation to individual members. This barrier can be lifted or at least reduced using state funding and subsidies. Also, CO2 taxation and low installation costs of RES can function as an enabler for ECs because it lowers the threshold that needs to be stepped over to initiate new ECs.

Bureaucracy and administration were often mentioned barriers of ECs. This we have not specifically studied in WP3, but there is no indication that the NEWCOMERS countries would differ in this aspect compared to other EU countries. Former legislation has even been described as non-supportive and even hostile to ECs. This is however discussed and included in the CEP where the member states are instructed to facilitate and simplify regulation and administration for ECs.

Figure 5.4 displays identified barriers and enablers in relation to actors.

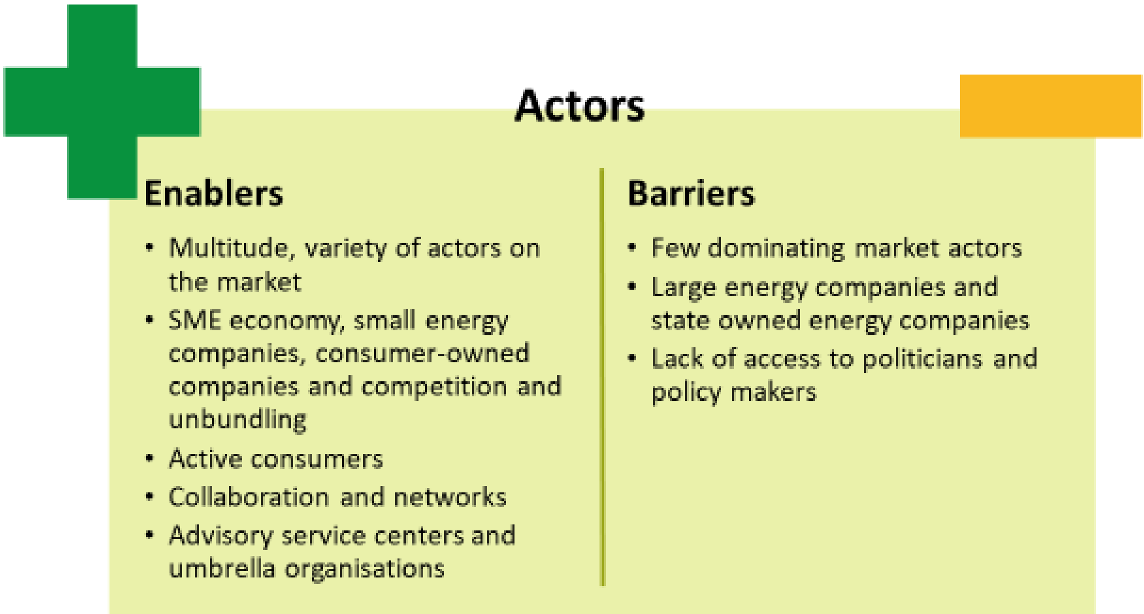

Figure 5.4 identified barriers and enablers in relation to the market actors

The structure of the market has proved to be decisive for the emergence of ECs, as discussed under institutional settings. A barrier is a centralised structure with a few dominating incumbent actors and an enabler a decentralised SME market with a multitude and variety of actors. All NEWCOMERS countries are dominated by a few large energy utilities having the lion's share of the market. Germany has however a tradition of cooperatives and small grid operators which has led to that the country has many DSOs, and this can be an enabler for emerging ECs.

A high number of switching households could be an indicator on active consumers, which could be an enabler for ECs to emerge. Among the NEWCOMERS countries, the Netherlands has a

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switching rate of 20%, which is among the highest in Europe. Also, the UK has a high switching rate.

The existence of EC-related policies and strategies has been discussed as an enabler. Related to this, lack of access to politicians has been raised as a barrier, inhibiting new ECs to emerge.

Umbrella organisations have been identified as an enabler together with other intermediaries. These umbrella organisations can support in the contacts with politicians, work as lobby groups and be a platform for networking and learning. All these are enablers for ECs. Among the NEWCOMERS countries the United Kingdom, the Netherlands, and Germany have such umbrella organisations, which could be a factor benefitting the emergence of ECs in a country.

5.2 Best practises

Ruggiero et al (2021) emphasize the importance of identifying good examples of ECs as a way to support the development of ECs. The literature on ECs often discusses in terms of best practices but is at the same time quite coherent in emphasising that it is important to not fall into simplistic prescription and give the impression of what works in one place can easily be replicated in another place. What is possible in one context is not necessarily achievable in another. It is important to consider the social and technical context in which an EC is embedded (Walker et al., 2010). There are also several studies emphasising that barriers and enablers depend on the national and/or local context (Horstink et al., 2020; Kooij et al., 2018). With this in mind, we will highlight some examples that could be working as inspiration by other countries. Figure 5.5. summarises identified best practices.

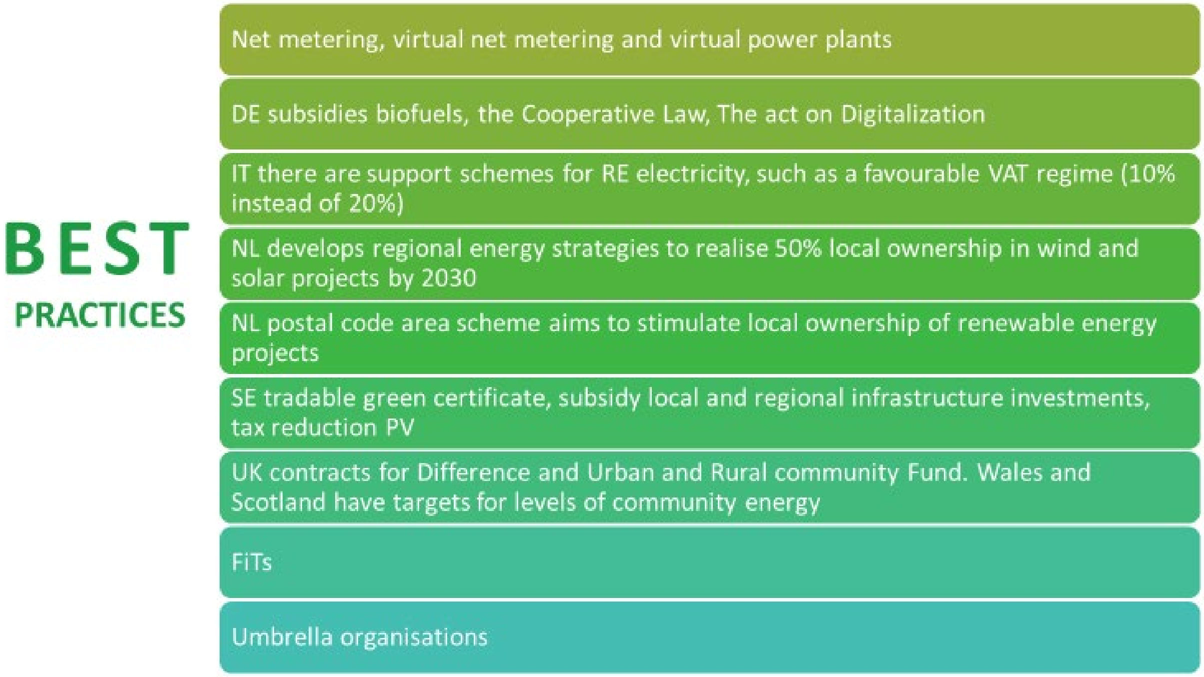

Figure 5.5 Identified best practices

Net metering, virtual net metering and virtual power plants were in 4.2.2 all identified as best practices enhancing prosumerism and electricity sharing within an EC. Net metering is a billing mechanism that allows prosumers to use own-produced electricity at any time. Virtual net metering has been tried out for community solar, where solar power is not installed on-site, but externally and the electricity is shared among the members.

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Some of our NEWCOMERS countries have programmes in place benefitting ECs, which was also described in chapter 4.3.2. Germany can set a good example by for example its tradition of cooperative ownership. As also mentioned above, Germany has a tradition of cooperatives and small grid operators. The network remains highly fragmented throughout Germany, preventing an actor monopolisation of the energy network. Other best practices are for example Italy that has support schemes for RE electricity, the Netherlands which stimulates local ownership of renewable energy projects through its postal code area scheme, and Sweden with the tradable green certificate system. The UK has targets for levels of community energy (Wales and Scotland) and urban and rural community funds amongst others.

The FiT scheme is a policy that has been widely used in many countries and is put forward as a best practice because it is simple and easy to understand for the users, and it has enabled renewables to be competitive with fossil energy. Italy has introduced a version of FiT specifically targeting ECs.

The benefits of umbrella organisations for the emergence of ECs have been shown above. An umbrella organisation facilitates diffusion of technical information, gives guidance on regulation and subsidies, works as networker and can function as a meeting arena.

5.3 Trends in relation to the findings on national settings and the number of ECs

In this final section, it will be discussed what kinds of settings seem to support ECs to emerge. In the tables below new combinations are tried out to see if different combinations can add to the understanding of what settings seem to support new clean ECs to develop.

Table 5.1 Definition, energy activity and urban/rural

	UK	DE	NL	SE	IT	SI
Number of ECs	>5000 ECs	1747	585	140	34	5
Definition of EC	EC is defined in the EC strategy	EC for wind-based electricity production is defined in Renewable Energy Act	EC in renewable electricity production defined in legal framework	Lack a definition	Lack a single definition	REC is defined in by-law
Energy activity	Wind, solar, hydro-electricity, heat pump, biomass energy efficiency	Wind, solar, biogas, DH, own grid	Wind, solar, heat, car sharing	Wind, solar, heat, eco-villages	Wind, solar, hydro-electricity,	Solar, hydro-electricity, DH
Urban population	83%	76%	92%	88%	69%	55%

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In table 5.1. it is shown that the United Kingdom, Germany, and the Netherlands, which has a definition of EC in a national strategy or the legal framework, also has many ECs established. Slovenia also has REC defined, but this is in a recently adopted law and it needs more time for this act to be reflected in established REC.

From Table 5.1 it seems like it matters if there is a definition in place in national policies or regulations. A lack of definition indicates a lack of a discourse around ECs in the country, which makes it more difficult to communicate and draw the citizens' attention to the existence of ECs.

The table also shows that the countries with the most ECs also have the most diversified energy activities represented in the communities. All countries have ECs which have invested in solar power and all, but SI, have ECs with wind power. Solar power is often seen as an easy technology to invest in, which probably is one important explanation to why this technology is common. Urban and rural areas will demand different energy technology. Rural areas have more space and can combine for example wind and solar power. Denser urban areas will need to rely more on district energy and solar PV. There is however no clear trend seen in our NEWCOMERS countries regarding the share of urban population and energy activity.

Next, in table 5.2, the number of ECs will be related to a countries GDP and the electricity costs.

Table 5.2 GDP/capita and electricity costs

	UK	DE	NL	SE	IT	SI
GDP per capita (USD) (2019)	41,030.2	46,564.0	52,367.9	51,241.9	32,946.5	26,170.3
Households' electricity costs as avg. share of income (%)	2,6%	3,9%	1,8%	6,7%	3%	5,1%
Share of taxes and levies in average price (%) (2017)	24%	54%	27%	35%	38%	31%

It would be reasonable to assume that a high overall cost for electricity would be a motivation for creating an EC and invest in own production because the development of an energy project might be expected to lead to lower energy costs. If comparing our NEWCOMERS countries this seems however not to be the case.

Membership in an EC needs some financial resources, to be able to buy shares. Italy and Slovenia have the lowest GDP/capita among our NEWCOMERS countries, which indicates that this could be an important factor for ECs to emerge. This is also supported by earlier research.

Trust has in earlier research been discussed as an important factor for ECs to emerge. In Table 5.3 is trust in political system, trust in legal system and trust in others compared with the number of ECs in a country.

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Table 5.3 Trust

	UK	DE	NL	SE	IT	SI
Trust in political system (scale 0-10)	3.8	4.9	5.5	5.5	2.1	1.8
Trust in legal system (scale 0-10)	5.5	5.3	6.7	6.2	3.6	2.7
"Most people can be trusted"	40,2%	43,4%	58,5%	62,8%	26,6%	25,3%

When studying trust in our NEWCOMERS countries, it was confirmed that trust could be related to the number of ECs. Among our NEWCOMERS countries, it seems like lack of trust correlates with a low number of ECs. The Netherlands and Sweden have however higher trust than the United Kingdom and Germany. High trust in the legal and political system can perhaps also lead to a trust that others will solve energy-related issues and that no action is needed from the individual. But this needs to be further researched.

In the CEP ECs are seen as an important actor in the energy transition and to increase the level of renewables. Table 5.4. compare if there is a trend in the share of fossil fuels and renewable and the number of ECs.

Table 5.4 Fossil fuels and renewables

	UK	DE	NL	SE	IT	SI
Total Fossil fuels (%)	**48,2%**	**51,5%**	**73,2%**	**0**	59,7**%**	31,4**%**
Wind, solar, hydro (%)	**20,4**	**27,5**	**13,9**	**51,1**	29,9	31,6
Nuclear (%)	**21,0**	**11,8**	**3,2**	**39**	-	35,4
CO_2/Pop (tCO_2/capita) (2017)	**5,43**	**8,70**	**9,08**	**3,74**	5,31	6,49

In the CEP ECs are seen as an important actor in the energy transition and to increase the level of renewables. If comparing the NEWCOMERS countries, there are no trends seen when it comes to the share of fossil fuels or share of renewables and the number of ECs. But emerging ECs are embedded in the CEP discourse, where ECs are described as an important part of the transition, where they will contribute to an increase in the share of renewables, which would imply a push for ECs in fossil fuel-dependent countries. The silence around nuclear power could make nuclear

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power a barrier for ECs to emerge. A high share of individual ownership in e.g. PVs could also be a barrier for ECs to emerge, as has been discussed for Italy.

Earlier research has emphasized the importance of dedicated support programmes for the development of ECs. In Table 5.5 is the NEWCOMERS countries support programmes that benefit ECs summarised.

Table 5.5 Programmes and schemes supporting ECs

	UK	DE	NL	SE	IT	SI
FIT	No	Yes	Yes	No	Yes for REC	Yes
Programmes benefitting ECs	Target levels of ECs, research and development programmes, urban and rural community energy fund	The Cooperative Law	SDE (+, ++) Postal code area scheme Tax reduction	Green certificate Subsidy programme supporting local and regional infrastructure investments	FiT targeting REC	Net metering scheme targeting REC

All NEWCOMERS countries have national-level programmes that support the deployment of renewable energy technologies, which have also benefited ECs by de-risking business models. In recent years there are also regulations specifically targeting ECs. FiTs have been described as important for ECs to emerge and all NEWCOMERS countries, but Sweden has had FiTs. The United Kingdom has abandoned its FiT scheme. Germany, the United Kingdom, and the Netherlands have had different regulations or schemes in place over several years and these seem to have contributed to ECs to emerge.

The structure of the electricity market has in earlier research been recognized as important for ECs to emerge. Table 5.6 summarises the actor structure at the electricity markets in the NEWCOMERS countries

Table. 5.6 Actors

	UK	DE	NL	SE	IT	SI
TSO/DSO	1 ESO; 1NGESO/15	4/880	1/8	2/173	3/144	1/5
Production	8 generators provide 71% of the volumes	4 generator producers over 50 % of the volumes.	4 generators provide most of the volume	3 generators provide 73% of the volume	1 generator provides 25% f volume, the next five largest generators provide 24 % of the volume	9 generators, where most of them are owned by two parent companies

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Trade	In 2018 dominated by 6 vertically integrated companies a 73 suppliers active	In 2017 the 4 largest companies has less than 40%. 124 providers to chose from for households	In 2018 the 3 largest accounted for 70 % In 2019, 57 active electricity suppliers.	In 2017 3 largest accounted for 42% More than 120 suppliers in total	In 2016 three retail markets: At the enhanced market 1 supplier accounts for 85 % At the Open market: 1 provider accounts for 35%. 336 providers in total At the safe-guarded market there are 2 providers	In 2019 3 providers had 56.7 % of household customers 16 providers in total serving households
Umbrella organisations	YES	YES	YES	NO	NO	NO

All NEWCOMERS countries have quite centralised markets, meaning that a few actors dominating production, trade, and distribution. Germany and the Netherlands have comparable less centralised markets, where the major actors are less dominating compared with the other countries. An enabling factor identified in earlier research is the existence of umbrella organisations that can support new ECs. Germany, the United Kingdom, and the Netherlands all have umbrella organisations that can support citizens in establishing ECs and maintain a network for ECs.

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6 CONCLUSION

The aim of this deliverable was to identify best practices and barriers and enablers for new energy communities to emerge. The deliverable is based on earlier research and the national characteristics in the six studied NEWCOMERS countries (Germany, Italy, the Netherlands, Slovenia, Sweden, and the United Kingdom).

Several barriers were identified such as lack of knowledge, centralised energy production systems, too broad or too narrow definitions of ECs in regulations and policies, lack of tailormade policies for ECs, and few dominating market actors. Identified enablers were trust, access to finance, a country's fossil fuel dependency, a liberalised market, FiTs, and umbrella organisations. Identified best practices in our NECOMERS countries were related to virtual power plants, net metering, government strategies, regulation, and cooperative ownership, and umbrella organisations.

When summarising the statistics of our NEWCOMERS countries some conclusions can be drawn about national settings supporting and inhibiting ECs to emerge. National settings supporting ECs to emerge was the existence of a definition of EC in a national strategy or the legal framework, high GDP/capita which makes it possible for the households to join an EC, fossil fuel dependency, tailor-made programmes and schemes for ECs, decentralised market with multiple of actors and decentralised production, and umbrella organisations to guide ECs.

National settings inhibiting ECs to emerge were lack of a national definition of ECs, lack of trust in others and to the legal and political system, a fuel mix with a high share of renewables which makes a transition less urgent, and a high share of individual ownership in for example PVs, centralised electricity market with few dominating actors and centralised production, and lack of umbrella organisations that can push the idea with ECs and facilitate for new actors to enter the market.

The CEP as such was not analysed in this report even it was present due to its relevance and the ongoing process of transposition of the directives into national regulations. This implementation of the CEP will most likely benefit new ECs to emerge, but how it will affect ECs will be a question for future research.

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