Theoretical framework focusing on learning in polycentric settings

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Theoretical framework focusing on learning in polycentric settings

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WP2: Theoretical framework, typology and case study guidance

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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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RESEARCH HIGHLIGHTS

This deliverable

- recognises the potential of clean energy communities, and especially new forms of such communities, to accelerate the energy transitions in the European Union.
- identifies the need for enhanced learning processes within and between clean energy communities as a crucial factor for the further growth of energy communities.
- defines new clean energy communities, or so-called "newcomers", as energy initiatives that combine the characteristics of community energy initiatives and new business models, and can be characterized by a greater diversity of participating actors, use of innovative and smart technologies (e.g. P2P trading, virtual power plants, community energy storage), and creation of new values for their members and society that go beyond the joint production of renewable energy.
- presents a novel theoretical framework to study new clean energy communities that is based on polycentric governance theory, combined with elements from socio-technical systems theory, social innovation theory, and value theory.
- argues that polycentric governance theory allows a fresh entry-point into the study of (new clean) energy communities, carrying potential to explain the bottom-up and self-organized nature of these initiatives, the learning processes involved and allowing to expand on diffused and local decision-making processes alongside organizational considerations.
- develops a set of 12 research propositions that focus on various themes that are relevant from the perspective of polycentric governance theory and will be tested in the project.

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1 EXECUTIVE SUMMARY

This deliverable provides the theoretical underpinning of the NEWCOMERS project, including the key concepts and definitions as well as the formulation of research propositions in order to enhance the project's coherence. To this end, it develops a novel theoretical framework based on polycentric governance theory, combined with elements from socio-technical systems theory, social innovation theory, and value theory in order to facilitate the analysis of the emergence and diffusion of new clean energy communities and explore opportunities for learning in different national and local polycentric settings.

The deliverable is structured as follows. Chapter 2 provides the background of the NEWCOMERS project and introduces the theoretical perspectives that will be used in the analyses, including polycentric governance theory, socio-technical systems theory, and social innovation theory. Chapter 3 explores the concept of clean energy communities and develops a definition of new clean energy communities to be used in the project. Chapter 4 provides a state-of-the-art account of current thinking about polycentric governance and identifies the main themes of polycentric governance theory that are relevant for studying new clean energy communities. Chapter 5 summarises the set of research propositions to be tested in the NEWCOMERS project.

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2 INTRODUCTION

2.1 Background

Under the influence of the megatrends of decarbonisation, decentralization and digitalization, new opportunities have emerged in the energy sector for developing technologies, engaging citizens, and creating new value for business, citizens, and consumers. As a result, there is a growing consensus that future energy systems will involve a large share of distributed energy resources and the traditional business models of large centralized energy utilities will be severely challenged (Gui and MacGill, 2018). More specifically, increasing opportunities are being identified to create value with demand response, promising developments in energy storage technologies and rise of technologies that allow citizen engagement (such as smart controls, connectivity, or the Internet of Things) (Bryant, 2016). One of the major trends in this rapidly changing energy landscape is the emergence of new forms of clean energy communities (e.g. Bauwens, 2017; Gui and MacGill, 2018; Hewitt et al., 2019). These so-called newcomers divert from energy communities in that they are novel in at least one of the following respects: scope, purpose, technologies, actors, and mode of operation. Potentially, such energy communities may offer a particularly promising way for citizens to engage in energy transitions.

The European Commission expressed its vision that citizens should take a central role in the clean energy transitions "with citizens at its core, where citizens can take ownership of the energy transition, benefit from new technologies to reduce their bills, participate actively in the market, and where vulnerable customers are protected" (European Commission, 2015). The idea of 'energy citizenship' is a developing term relating to citizens to get involved in the production and storage of energy ("prosumage") at the local level, through community energy and citizen-owned distribution grids. It proposes that citizens need to become knowledgeable participants in clean energy transitions (Roberts *et al.,* 2014). With a view to these very high expectations, it is therefore pivotal to understand how these new forms of energy communities develop and operate, and what their impacts are through empirical research.

As part of the NEWCOMERS project, research will be carried out in six European Union Member States (NL, SE, UK, DE, IT, SI), which have been selected to differ in their share of renewable energies in total energy generation, their regulatory environment, the degree to which community energy models are embedded in society, as well as their economic and social structures. The project will assess these regulatory, institutional and social conditions, which support the emergence and operation of new, clean energy communities as well as their potential for diffusion.

Within the participating member states, the NEWCOMERS project aims to explore and evaluate several forms of new clean energy communities that volunteer to be case studies of social innovations and perform along dimensions, such as citizen engagement, value creation, and learning. More specifically, the project will explore how new clean energy communities meet their members' (i.e. citizens' and consumers') needs better than more traditional business models and whether they have the potential to increase the affordability of energy, their members' energy literacy and efficiency in the use of energy, while enabling participation in clean energy transitions in Europe.

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These on-the-ground observations will be made in six energy communities in all six partner countries as well as nine communities participating in selected research tasks, eventually leading to a set of policy recommendations at EU and national level. The NEWCOMERS project will address this research challenge using a holistic and integrative approach that draws on theories and methods from a wide range of social sciences, including public administration and policy sciences, law, sociology, economics, social psychology, communication sciences and energy systems research (Project description, part B, page 11 of 119). In order to provide a common understanding among the partners, the project uses polycentric governance theory (e.g. Ostrom, 2010; Jordan *et al.,* 2018) as its guiding theory.

In this context, this deliverable aims to provide the theoretical underpinning of the research, including the explanation of the key concepts and definitions as well as the formulation of research propositions in order to enhance the project's coherence (Project description, 1.3.3 WT3 Work package description, page 15 of 46). To this end, it will develop a novel theoretical framework based on polycentric governance theory, combined with elements from socio-technical systems theory, 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 (Project description, part B, page 11 of 119).

This chapter is structured as follows. Section 2.2 briefly describes the evolution of governance approaches, explaining how hierarchical, market-based and networked modes of governance have developed, and positions polycentric governance as a form of networked governance. Section 2.3 outlines the perspective of socio-technical systems theory, whereas Section 2.4 introduces social innovation theory. Section 2.5 elaborates on the approach used in the deliverable.

2.2 Role of this deliverable in the project

Governance encompasses purposeful efforts to "guide, steer, control, or manage the pursuance of public goods" (Termeer *et al.,* 2010:2). It can take a variety of forms, whether initiated by governments through centralized hierarchical systems, by market mechanisms, or through networked collaborations (Bevir, 2012). Table 2.1 presents each of these modes of governance and the features sustaining them, which are further explained below.

Table 1.1: Modes of governance: hierarchies, markets and networks (Rhodes, 1999)

	Hierarchies	Markets	Networks
Basis of relationships	Employment relationship	Contract and property rights	Resource exchange
Degree of dependence	Dependent	Independent	Interdependent
Medium of exchange	Authority	Prices	Trust
Means of conflict resolution and coordination	Rules and commands	Haggling and the courts	Diplomacy
Culture	Subordination	Competition	Reciprocity

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Hierarchical governance is the most prominent form of governance (Rhodes, 1999). Governing bodies are governments, which use authority for rule setting and rule-enforcement in a defined geopolitical system (Rhodes, 1997). Such a state-centric hierarchical system relies on top-down decision-making through the operation of one centralized decision-making centre (Smith, 2007). In this system, power through authority is the main driver of social and behavioural change. This comes through legislative polices, often referred to as command-and-control measures.

Hierarchies have been criticized for the possibility of vested interests from bureaucrats and a preference for short-term policy priorities of governments in power (Birkland, 2014; Keane, 2009). This is considered counterproductive for dealing with issues such as climate change and the renewable energy transitions, which require long-term planning and consistency.

Market-based governance relies on the power and logics of the market to create change. Prices are considered the main driver of social and behavioural change (Rhodes, 1999). The use of market-based instruments has emerged in climate governance in the form of a cap and trade system to reduce greenhouse gas emissions, subsidy schemes to stimulate investments in renewable energy, and labelling of consumer goods in terms of energy efficiency (Ellerman *et al.,* 2015; Gillingham and Palmer, 2014)). The apparent deficiencies of hierarchical and market-based governance systems, were followed by a response, which marked a shift in a new direction through the development of networked environmental governance (Rhodes, 1999; Ansell, 2008). The central idea is that complex environmental problems require a diverse range of actors and institutions, beyond the function of a single-unit governing system. This leads to the collaboration of multiple interdependent actors that exchange resources (information, materials, expertise) and bring different specialisations into the networked system.

Polycentric governance is a concept related to networked governance. The term was first established in 1951 by Michael Polanyi's essays in 'The logic of liberty' to describe methods of social organisation, where individuals can pursue objectives in a system of overarching rules (Carlisle and Gruby, 2017). Vincent Ostrom (V. Ostrom) then adopted polycentricity in 1961, while investigating the delivery of public services such as clean water and policing in metropolitan areas in the United States. There were concerns that too many governmental organisations were getting in each other's way and that up-scaling of single-institutions was the only way forward (Jordan *et al.,* 2018). V. Ostrom challenged this view, describing the emerging system as polycentric and beneficial for allowing a variety of local public service management approaches to develop (Aligica and Tarko, 2012).

Elinor Ostrom (E. Ostrom, 2010), subsequently, brought the concept of polycentric governance in connection with climate related issues. She suggested that new and more dynamic forms of bottom-up, dispersed, and multi-level governance could solve these issues. She argued that polycentric governance can work well when certain central goals – such as fighting climate change - are shared, when actors develop trust because of their continued mutual interactions in local initiatives, and when systematic evaluations take place and translate back to the identification of the best practises that can be scaled up. She promoted the theoretical benefits of polycentrism, stating that the existence of large numbers of governance units at multiple scales allows for collective-action

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problems to be addressed more effectively.

While E. Ostrom essentially had a positive view on polycentrism, she highlighted at the same time the importance of studying the strengths and the weaknesses of polycentric governance empirically (E. Ostrom, 2010). Jordan *et al.* (2018) took up this challenge by publishing the book "Governing climate change. Polycentricity in action?", in which an explorative analysis of relevant issues is made. In the book, the authors argue that such empirical studies should be done with an open and critical eye, claiming that too many researchers seem to treat E. Ostrom's predictions as things to be empirically confirmed rather than to be rigorously tested for.

Finally, a centrepiece of the NEWCOMERS project is linked to learning within and between energy communities. More specifically, it is aimed to link the characteristics of new clean energy communities and their settings with various types of learning. To this end, a distinction is made between cognitive, normative, and relational learning (Haug *et al.,* 2011). Cognitive learning is the acquisition of new knowledge and an improved structuring of existing knowledge, which is important in environmental governance for bringing advocacy and understanding feedback systems (Haug *et al.,* 2011; McFadgen, 2019). Normative learning results in changes of perspectives, goals, or priorities, important for the development of common interests and goals, resulting in political consensuses and collective-action (Haug *et al.,* 2011; Gerlak *et al.,* 2019). Relational learning results in changes in trust, ability to cooperate, and understanding of other stakeholders' ideas and values. This latter type of learning enables participants to consider alternative perspectives, improving cooperation and helping to increase acceptance of new innovative management approaches (Haug *et al.,* 2011; McFadgen, 2019).

In sum, by studying new clean energy communities from the perspective of polycentric governance, the NEWCOMERS project has the following ambitions:

- Add a new field of application to the polycentric governance framework, connecting the approach to the transformation of the electricity sector in the energy community domain and extending its application to also include energy-related practises and energy literacy in the use of energy;
- Provide insight into the complexity of governance arrangements in an attempt to establish sound strategies, which facilitate the empowerment processes and outcomes of citizens in electricity systems in general and energy communities specifically;
- Put a domain formerly pre-dominantly embedded in a bottom-up approach in a top-down perspective to show the options for energy communities to advance in different settings; and
- Provide evidence-based recommendations with regard to improving the outcomes of polycentric governance processes to facilitate and encourage different types of energy communities to grow.

2.3 The perspective of socio-technical systems theory

Socio-technical systems theory is utilized in the NEWCOMERS project as a theoretical backdrop to polycentric governance. The power of this approach to combining theories lies in the framing socio-technical systems theory can provide to the actor-focused approach of polycentric governance.

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Hence thinking in systemic terms, where elements of a system, such as technical components, individual actors and organizations, legal frameworks and institutional and political structures interact with each other in a non-linear manner can frame a polycentric approach. In this context, energy systems are socio-technical in their characterization, meaning that both the material and social/human parts of a system need to be considered to understand its functions and possible development paths. In a socio-technical system, such as the energy system, these elements are substantially intertwined and interrelated, to an extent that decisions in one part of the system can affect other seemingly independent parts of it (Palm, 2006).

For this reason, taking a socio-technical systems perspective on a polycentric arrangement gains power in that it opens up opportunities to understand the interactions of actors amongst themselves as well as with the complex socio-technical reality that surrounds them. Technologies with-in these systems are best described as seamless webs (Hughes, 1983; 1986). Change in one part of a system must take account of the other pre-existing parts in order to obtain a working whole. In this way, new technologies cannot be implemented in a manner ignoring existing solutions or knowledge within the system (Palm, 2006).

The close links between the various parts of a system have implications for how the system develops. Once a technology is chosen it will affect the system development for a long time. This is often described as technological path dependence (David, 1988) or momentum (Hughes, 1983). Momentum implies that systems will, with time, acquire a certain direction because institutions, organisations, interests, and actors mobilise support for reconfiguring the dominant system. Economic, political and cultural resources have been invested in the system, which will contribute to the path taken.

Hughes (1983) studied the development of electrical systems in Berlin, Chicago and London and found that they all developed by following the same phases. First came the invention and development phase, followed by a technological transfer phase, a system growth phase, and finally the momentum phase. In all three cases the developments are similar, but the outcomes are different. Socio-technical systems shape societies, but they are also shaped by actors that compose society. Technical systems contain a technical core, but many factors such as institutions, culture, politics, economy and organisations will influence how the system is designed at a certain place (Palm and Wihlborg, 2006). Nevertheless, these factors not only set a frame for understanding how actors relate to one another, but can also be affected through a number of approaches to self-organizing, lending agency to actors within the system (E. Ostrom, 2009; Basurto and E. Ostrom, 2009). Hence, electricity systems in Berlin, Chicago and London have similar technological cores, but different organisations, contexts, financial conditions, etc. Hughes (1983) described this local embeddedness of all socio-technical systems as a system's technology style.

Hence socio-technical systems theory frames the interaction between society and technology. Nonetheless, the socio-technical approach does not account for what role actors takes on with-in the system (Smith et al., 2005; de Haan and Rotmans, 2018), and hence how technical components, individual actors and organizations, legal frameworks and institutional and political structures interact and affect each other, whilst polycentric governance is explicitly concerned with the interaction of these elements, and therefore both can complement each other by adding analytical depth.

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2.4 The perspective of social innovation theory

In a special issue on Social Innovation and the Energy Transition, Hoppe and de Vries (2019) recently argued that social innovation is an important lens through which to view energy communities because "social innovation seeks to attain particular social goals, like community empowerment, alleviating (energy) poverty, (energy justice, social equality) and increasing the wellbeing of local communities" (p. 9). They refer to the definition of social innovation as "innovative activities and services that are motivated by the goal of meeting a social need, and are predominantly developed and diffused through organization whose primary purposes are social." (p. 3) With regard to social innovation in the energy sector, they suggest that "social innovation may also entail issues like introducing new energy practices, new behaviours and relationships for supporting and managing social groups or new solutions that contribute to low carbon energy transitions and at the same time to solving social problems. (p. 4).

In this same special issue, Hewitt *et al.* (2019) make a plea for a "new social contract for energy" stating that European policy-makers have thus far remained firmly anchored to the "technology focused" innovation paradigm in relation to energy transitions, and have not seriously contemplated any form of genuine reconfiguration. They also express the opinion that it is unclear what, if anything, European governments are doing to promote the transformation of ownership, control and civil society participation in energy systems that recent definitions of social innovation clearly imply. As a consequence, they argue for a "creative reconfiguration of social relations" in terms of governance, institutions and actor relationships.

2.5 Approach to the deliverable

To develop the theoretical framework, several steps have been taken. First, a literature review was done, focusing on the state-of-the-art in research exploring the concept of polycentric governance. Second, key concepts and boundaries of the research have been defined. Third, and based on the literature review, a set of research propositions has been formulated to be tested in the NEWCOMERS project. Through this testing, empirical evidence is expected to be provided about the practice of polycentric governance in the energy community domain and associated enabling and disabling factors towards their emergence and operation, and this may as such contribute to the formulation of policy recommendations as well as the further development of polycentric governance theory.

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3 THE CONCEPT OF ENERGY COMMUNITIES

3.1 Introduction

This chapter aims to give an overview of the state-of-the art in the literature about energy communities. Section 3.2 characterises energy communities and their main features in terms of actors, processes, outcomes, motivations, legal forms, and financial models. Section 3.3 provides the definitions of energy communities according to EU legislation. Section 3.4 develops the definition of new clean energy communities as it will be used in the NEWCOMERS project.

3.2 Energy communities and their main features

An often-used definition of community energy is that by Seyfang *et al.* (2013: 978) who understand them as "projects where communities (of places, or of interest) exhibit a high degree of ownership and control of the energy project, as well as benefiting collectively from the outcomes (either energy-saving or revenue-generation)". Moreover, such community energy projects may vary significantly according to the parts of the energy system they seek to influence, with different activities addressing how energy is generated, how it is moved around (transmission and distribution), and how it is sold (supply) to end users (demand) for energy.

3.2.1 Actors

Actors involved in energy communities may range from private individuals to citizen organisations, civil society groups, businesses, municipalities and government agencies. The variability of the types of actors in terms of technical knowledge, entrepreneurship skills, and access to resources may differ in each context, affecting the activities undertaken and the processes of learning in the communities (Bryson *et al.,* 2016; Hicks and Ison, 2018).

Recently, scholars have emphasized the emergence of so-called intermediaries, which can be conceptualised as individuals, organisations or networks who create spaces and opportunities for others (to learn, share knowledge, access opportunities), who mediate (i.e. work between, make connections) between other actors and technologies, and who broker resources, knowledge and relations (Stewart and Hyysalo, 2008; Hodson and Marvin, 2010). Intermediaries are subsequently defined by their 'in-betweenness', operating between others and performing relational work (Warbroek et al, 2018; Barnes, 2019). Intermediaries can perform a variety of roles in the development of energy communities, including but not limited to aggregating knowledge, sharing information, capacity building, brokering relationships, developing business coordinating and framing visions as well as advocacy and lobbying (Warbroek et al, 2018).

Middle actors are defined as individual or institutional actors with the expertise and experience to enable and facilitate activities by others, e.g. accountants, electricians, housing associations, and lawyers (Parag and Janda, 2014). Note that there is some crossover between the term intermediaries and middle actors, with the latter used to describe the capacity (often overlooked) of some actors to influence others through their everyday activities. For instance, an electrician can play an important

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role in helping a household understand how to use a new smart meter or smart radiator and how to interpret the information these digital devices provide.

3.2.2 Process and outcomes

What sets energy communities apart from other renewable energy projects are the internal *processes*; who the project is developed and run by, and the *outcomes;* how the outcomes of a project are distributed spatially and socially (Walker & Devine-Wright, 2008; Creamer *et al*., 2019). More specifically, the process dimension refers to the actors that establish and operate a project, those who are involved in the community and those who have influence. The outcome dimension is concerned with whom the initiative is for and who benefits from the outcomes.

The process and outcome dimensions can be utilised parallel to represent different combinations of 'process' and 'outcome' that could occur in energy community case studies (see Figure 3.1). Following from this, Walker & Devine-Wright (2008) suggest that a conventional utility-developed wind farm would be represented in the bottom left of the diagram and an 'ideal' community project in the top right. They suggest that the ideal community in the model would be one that is "entirely driven and carried through by a group of local people and which brings collective benefits to the local community" (p. 498).

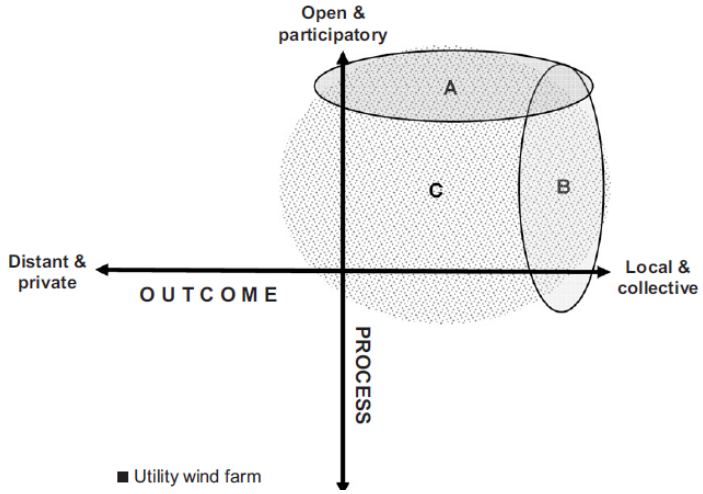

Figure 3.1 - Understanding of Community Renewable Energy in Relation to Project Process and Outcome Dimensions (Walker & Devine-Wright, 2008)

This definition however comes into contrast with recent developments at the practical level, namely linked to the non-localized nature of certain community initiatives (Moroni et al., 2018). These initiatives more and more commonly include a virtual element, which means that a part of the activities are shifted to the virtual realm ultimately challenging the localized nature of Walker & Devine-Wright's (2008) definition of community projects. Examples for these shifts include accounting for storage capacity through the creation of Community Energy Storage (CES) initiatives (Koirala et al., 2018; Barbour et al., 2018), the emergence of the peer-to-peer trading of energy

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(Zhang et al., 2017), or the creation of so-called Virtual Power Plants (VPPs) (Asmus, 2010). In line with these developments, Moroni et al. (2018) distinguish between *place-based* and *non-place-based* communities, to underline the potential shift away from a local spatial reference point.

What activities a community decides to engage in has a big impact on its processes and outcomes including who becomes involved in the community, how it operates and the potential outcomes (Walker & Devine-Wright, 2008). As outlined above, traditionally, energy communities focused on a single activity, usually power generation, but in recent years communities became involved in other energy-related activities such as energy storage and energy efficiency which led to the emergence of new forms of energy communities (Bauwens *et al.*, 2016).

3.2.3 Motivations

The motivations behind energy communities can vary greatly. Based on case study analysis, Hicks and Ison (2018) identified 22 different motivations, as is shown in Figure 3.2. Social motivations of energy communities include community empowerment and building of local ownership. Technological motivations refer to energy security or increased energy efficiency. Environmental motivations can be related to a desire to reduce CO_2 emissions or local environmental issues like air quality. Economically, many communities are motivated by cost savings or shareholder income that can be generated as a result of initiatives. Political motivations may include political mobilisation, for example in order to obtain enhanced autonomy, and the desire to create new types of energy actors. To conclude, it is important to recognise that motivations of energy communities may relate to more than one of these categories. In addition, the motivations of members and of the community as a whole may change over time in response to growth development and changes in the context around them.

3.2.4 Legal forms

Walker (2011) suggests there are basically five main models under which community energy projects are set up, developed, managed, and operated: cooperatives, charities and social enterprises, local energy service companies, local government led projects, and non-local co-operative ownership. Hewitt *et al.* (2019) confirm that energy communities can be found in many different organizational forms, distinguishing between renewable energy cooperatives, community development trusts, local government projects with citizen participation, public-private partnerships, private companies, other grassroots initiatives, and their associated business and service models, noting that these forms are largely determined by national institutional settings. These organizational characteristics and national institutional settings will be further elaborated in deliverable D2.2 (Typology of clean energy communities) and deliverable D3.1 (Mapping of national polycentric settings), respectively.

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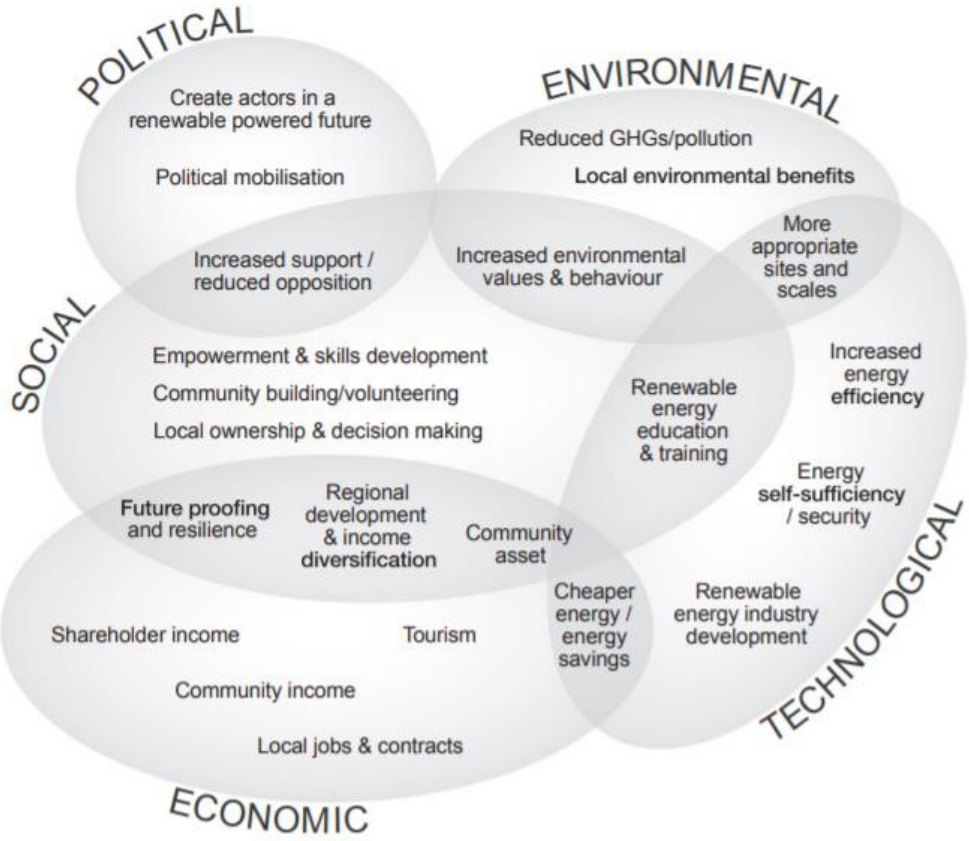

Figure 3.2: Motivations driving energy communities (Hicks & Ison, 2018)

3.2.5 Financial models

With regard to the financing of energy communities and their projects, it is common for members to use multiple sources, including crowd funding, member financing, grant funding, government investment and private investment (Walker, 2008). Many initiatives are still more or less dependent on public funding. Crowd funding is a more recent form of funding adopted by energy communities, which according to Vasileiadou *et al.* (2016), has the potential to fill the gap between funding supply and demand of energy communities due to its dynamic nature. More recently, private investments through partnerships between the private sector and energy communities have become more commonplace (Eitan *et al.*, 2019).

Most recently, Hewitt *et al.* (2019) acknowledged that community energy initiatives today are more diverse than at any time previously, and are likely to continue to act as incubators for pioneering initiatives addressing virtually all aspects of energy. The authors emphasize that decentralized energy generation offers an opportunity for consumers to offer demand-management services through their homes and devices and that this may create new opportunities for citizens to become active partners in the management of energy as a resource, rather than passive "consumers" of energy as a commodity. Interestingly, they also recognise that community energy initiatives may comprise

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communities of place - emphasizing shared values associated with a particular territory or landscape – or communities of practice – emphasizing shared ethics and world views, financial circumstances or problems.

3.3 Energy communities as defined in EU legislation

At the EU level, there are two official definitions for energy communities, which have been established in the context of the EU's Clean Energy for All European package (EC, 2019), namely those for 'Citizen Energy Community' (CEC) and 'Renewable Energy Community' (REC).

A CEC is defined in the provisionally agreed recast Electricity Directive[1] as:

> "a legal entity that (a) is based on voluntary and open participation and is effectively controlled by members or shareholders that are natural persons, local authorities, including municipalities, or small enterprises; (b) has for its primary purpose to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates rather than to generate financial profits; and (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." (p. 67)

A REC is understood in the recast Renewables Directive[2]:

> "as a legal entity (a) which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity; (b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities; (c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits."(p. 103)

According to Roberts *et al.* (2019), there is a fairly clear relationship between these two definitions. At their core, they both describe a way to 'organise' collective cooperation of an energy-related activity around specific ownership, governance and a non-commercial purpose (as opposed to traditional market actors). The primary purpose of both CECs and RECs is to provide environmental, economic or social community benefits for its members or the local areas where they operate rather than financial profits. Both definitions emphasise participation and effective control by

[1] Provisional text adopted by European Parliament legislative resolution of 26 March 2019 on the proposal for a directive of the European Parliament and of the Council on the common rules for the internal market in electricity (recast) (COM(2016)0864 – C8 - 0495/2016 – 201 - 6/0380(COD)) (Provisional Recast Electricity Directive).

[2] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast), OJ L 328, 21.12.2018, p 82 (Recast Renewable Energy Directive).

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citizens, local authorities and smaller businesses whose primary economic activity is not in the energy sector. Finally, participation in such must be open and voluntary.

RECs are essentially considered a subset of CECs (Roberts *et al.* (2019). Although RECs generally follow the same logic as CECs, they have more stringent requirements and should be rooted in local communities (i.e. a 'proximity' requirement).

With its focus on non-commercial purposes of CECs, the definition of citizen energy communities does not prevent the existence of other citizen initiatives such as those stemming from private law agreements, according to the recitals to the Electricity Directive. This means that Member States may allow other types of commercial and non-commercial market actors to establish, own and manage local energy systems (Roberts et al., 2019).

3.4 Energy communities as defined in the NEWCOMERS project

In the NEWCOMERS project, our aim is to focus on new forms of clean energy communities or so-called "newcomers" as compared with conventional clean energy communities. Within the NEWCOMERS project description, it is suggested that so-called "newcomers" are energy initiatives that combine the characteristics of community energy initiatives and new business models, and could be characterized by a greater diversity of participating actors, leading to different types of partnerships and coalitions between citizens, industry and municipalities. Furthermore, they often involve the use of innovative and smart technologies and aim to create new value for their members and society that go beyond the joint production of renewable energy.' (Grant Agreement, p.8). Consequently, these »newcomers« can be visualised as occupying the intersection of community energy and new business models (see Figure 3.3).

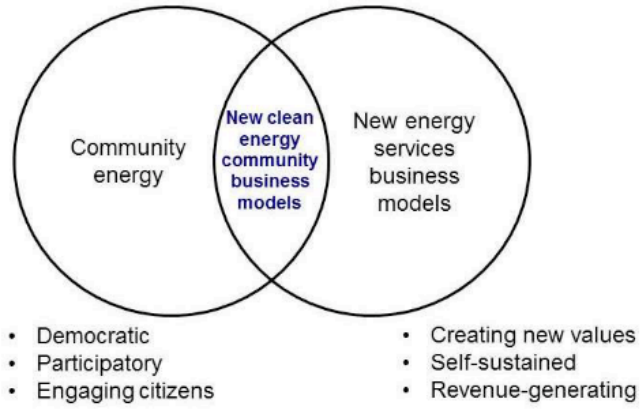

Figure 3.3 Visualisation of the new clean energy community business models that are in the focus of the NEWCOMERS project.

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In the NEWCOMERS project, the emergence, structure and potential impact of new business models as promoted by energy communities will be studied. These new business models are being developed by existing energy companies, start-ups, spin-off companies, engineers, entrepreneurs and municipalities as well communities. What the NEWCOMERS project is particularly interested in, is where these models are compatible with or draw on the strengths associated with community energy.

In order to maintain coherence with prior work on community energy, it is suggested to define 'clean energy communities' as *association of actors engaged in energy system transformation for reduced environmental impact, through collective, participatory, and engaging processes and seeking collective outcomes*. In this same context, 'business models' are *sets of assumptions about how actors produce and distribute value* and 'new business models' can be considered as *emerging business models that provide a service and therefore add value to energy service for energy users, energy companies, energy systems and/or wider society*.

Importantly, the above definition of clean energy communities also provides space for including non-locally bound virtual communities, which are expected to become increasingly relevant in the energy sector in the near future.

However, the criterion that financial profits should not be among the primary benefits pursued needs perhaps some refining. In this respect, Hewitt *et al.* (2019) argue that literature often focuses on the supposed altruistic nature of community energy schemes, and thus may exclude "for profit" organizations, but that such an understanding may risk missing the point of community energy projects – to make money for local people. Interestingly, they conclude that successful community energy schemes are invariably partnerships between community groups, private companies and particularly, local government. They go on to argue that the challenge to decarbonize rapidly may limit the scope for a more deeply re-localized and re-democratised energy supply and distribution which offer so much potential in engaging citizens and facilitate empowering processes in communities.

Eventually, our definition of "newcomers" explicitly includes a possible commercial orientation of new clean energy communities.

3.5 Implications

For the sake of the NEWCOMERS project, this section outlined a number of approaches to conceptualizing energy communities, and in particular *new* clean energy communities. Notably, the project will study new clean energy communities by broadening the scope of definition by including a diversity of actors, which are studied, and by understanding how processes and outcomes relate to their interactions, what the motivation for their establishment is, what legal form they take on, and what types of financial models they function under, amongst others. These aspects will fit in line with the polycentric governance approach, and will allow for an understanding of how these diverse communities emerge, operate, share knowledge, etc. Ultimately taking a broader definition in the above terms will allow for including a broader set of policy relevant learnings to emerge from the project.

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4 POLYCENTRIC GOVERNANCE AND ITS APPLICATION

4.1 Introduction

This chapter aims to give an overview of current thinking about polycentric governance and its application in academic research. Section 4.2 introduces the concept of polycentric governance. Section 4.3 positions clean energy communities in terms of polycentricity. Section 4.4 introduces the main themes of polycentric governance theory that are relevant for studying new clean energy communities. Section 4.5 discusses the implications for the NEWCOMERS project.

4.2 The concept of polycentric governance

The concept of polycentric governance implies that governance in a specific issue-area is simultaneously taking place at several locations (or loci) with their own semi-autonomous decision-making centres. E. Ostrom (2010) elaborated propositions which state/suggest that polycentricity can be advantageous for enhancing "innovativeness, learning, adapting, trustworthiness, levels of cooperation of participants, and the achievement of more effective, equitable, and sustainable outcomes at multiple scales" (p. 25). Additionally, scholars have hypothesised other theoretical benefits of polycentric governance, linked to increased capabilities for learning, better access to local knowledge, closer matching of policy to context, reduced risks of resource failures, enhanced capacity for knowledge transfer, and an increase in adaptive capacity of governance units in response to behavioural and social changes (Marshall, 2009).

According to Jordan *et al.,* (2018), the fact that multiple governing units take initiatives at the same time should not be seen as inefficient and fragmented, but as a reflection of local democracy, as a setting ideal for natural experimentation and thus a welcome opportunity for learning about what works best in different contexts. Institutions looking to develop their own initiatives are aided by the flexibility of polycentrism to adapt to different rules and ideas, permitted by semi-autonomous decision-making mechanisms (Ayers and Forsyth, 2009).

Having overlapping jurisdictions is a common feature of systems of polycentricity, where decision making centres share areas of responsibility (McGinnis and Ostrom, 2011). This is considered beneficial for promoting efficiency and equity through knowledge transfer in networks, enabling each unit to learn from each other (Marshall, 2008). As a result, the adaptability of a polycentric governance system is thought to be higher than of a conventional monocentric hierarchical one.

Despite the emphasis on the highly autonomous character of the various decision-making centres in a polycentric governance system, several scholars have highlighted that the role of central government remains pivotal (Seyfang *et al.,* 2013; Marshall, 2015). For example, government may influence the development of polycentricity through financial incentives, reporting and monitoring, and compliance requirements (Marshall, 2015; Carlisle and Gruby, 2017).

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To support the analysis of governance systems, E. Ostrom (2010) developed the Institutional Analysis and Development (IAD) framework to help explain and predict why some institutions are more successful self-governing systems than others. Figure 4.1 presents this IAD framework. It is also useful for policy analysis of how institutions operate and change over time. By using this framework, E. Ostrom (2010) aimed to generate context-specific questions related to the functionality of self-governing systems to be explored in further research.

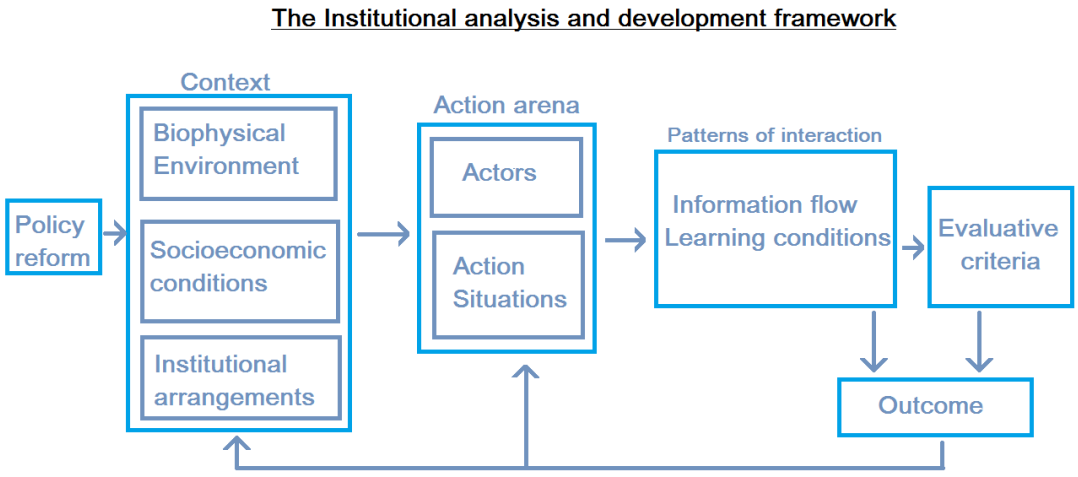

Figure 4.1: Institutional Analysis and Development (IAD) framework (Ostrom, 2005, 2010).

The IAD framework uses a meta-theoretical language, which enables scholars to discuss, compare theories and derive testable conclusions from them (E. Ostrom, 2010). The model helps to explain and predict outcomes of policy reforms, by using a general set of variables to investigate institutional settings and social interactions. Focus areas are based on analysis of the governance structure, the diverse sets of actors' positions, and the sets of formal and informal rules relating to the extraction of common pool resources (E. Ostrom, 2010).

The core of the IAD framework is based around the 'action arena', which combines the types of actors involved and the action situation (e.g. policy debate), which is affected by contextual factors, consisting of the biophysical environment, the socio-economic conditions and the institutional arrangements (rules in use) (E. Ostrom, 2010). As a result, so-called 'patterns of interaction' will emerge, which can be among humans, markets, private firms, families, community, organizations, legislatures, and government agencies among others (Ibid.)

4.3 Energy communities and polycentricity

There is an emerging consensus that the governance of energy systems is increasingly becoming polycentric. Seyfang *et al.* (2013) already recognised that clean energy communities are incorporating polycentric characteristics through their desire to learn, cooperate and transfer knowledge through

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collaborations between a diverse range of actors. Along similar lines, Goldthau (2014) argued that a polycentric approach is a productive way both to conceptualise distributed energy and to imagine a new institutional environment, which is more favourable to distributed energy itself.

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

Moroni and Tricarico (2018) have stressed that polycentrism in the energy sector does not simply mean that energy production units are decentralised (and not centralised), but that they are under numerous, different and autonomous, forms of (local groups) self-governance. They consider the transition from a *passive* energy society to an *active* self-organising one as a crucial element of a polycentric system.

In order to find out if and how new forms of local organisations can provide the crucial catalyst for a new polycentric distributed energy scenario, Moroni & Tricarico (2018) furthermore argue that there is a need to consider in greater depth the organisational and institutional issues involved in local energy systems. In a similar sense, Johnson and Hall (2014) earlier observed that the institutional transformation necessary to support a widespread adoption of community/decentralised energy schemes deserves more attention.

Accordingly, polycentric governance theories allow a fresh entry-point into the study of (new clean) energy communities. They carry potential to explain the bottom-up and self-organized nature of these initiatives, the learning processes involved and can allow for expanding on diffused and local decision-making processes alongside organizational considerations.

4.4 Polycentric governance and its main themes

In their book titled "Governing climate change: polycentricity in action?", Jordan et al. (2018) distinguish five main themes that they consider crucial when studying social phenomena from the perspective of polycentric governance theory. These themes are formulated in the form of propositions that can be tested when doing research in specific domains to help refining the theory and bringing it further. These main themes relate to: local action, mutual adjustment, experimentation, the importance of trust, and overarching rules.

This section aims to explain the five main themes and to focus them more strongly towards the specific characteristics of new clean energy communities. In addition, it proposes related themes that are considered important because of the focus of the NEWCOMERS project on processes of citizen engagement, value co-creation, and learning.

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4.4.1 Local action

Jordan *et al.,* (2018:13) propose that "governance initiatives are likely to take off at a local level through processes of self-organisation". They added to this by stating that local action results in collective changes to the overall system through the steady accumulation of marginal changes by each domain. Local action through energy communities may be beneficial for promoting the social acceptability of new technologies and enabling localized education to promote citizen engagement in renewable energy transitions (Bauwens, 2017).

Enhancing citizen engagement may help improve public understanding of the issues at stake, enable more transparent decision making, and can make central governments coordinate their actions appropriately in response to public participation (Huitema *et al*., 2009). Another advantage is that these local actors may possess unique context-specific skills and knowledge, which gives them the capacity to deal with the challenges at hand (Aligica and Tarko, 2012).

Citizen engagement in energy communities, as well as in energy transitions more in general, is an important focus in the NEWCOMERS project. Such engagement can range from informational supply - to consultations, discussions with the public, co-decision making - to a situation in which the public is in charge of parts of natural resources management (MacArthur, 2016). The bottom-up practices of cohousing - or "intentional communities" like eco-villages, (Daly, 2017), or also called "community-led housing" in a wider sense, (Lang et al., 2019) - are examples of participatory governance, which links household and coexistence management to the use of community-based energy solutions. Often these experiences generate the development of technological innovations from renewable sources for the production, storage and mutualisation of energy consumption. These practices produce benefits for the members of the cohousing/energy community (*mutual benefit*), and they have great potential as social diffusers as well (*public benefit*) of the knowledge and practices of participation (Bauwens & Defourny, 2017). Some experiences of cohousing have produced a significant impact on their surroundings: they have generated some processes of urban regeneration and social inclusion through activities that involve the inhabitants of the neighbourhood (Tummers, 2016).

Furthermore, an important means are the possibilities offered by the new developments in the fields of digitalization and online social networks which have become a major influence for social and behavioural patterns (Douai *et al.,* 2013). For example, Catney *et al.* (2013) found that people are more likely to reduce their consumption of electricity if the information to do so flows from within their social networks. The findings from their study outline the potential effectiveness of social networks for dissipating relevant information to stimulate social and behavioural change. This links well with the dissemination of more sustainable production-consumption systems at the local scale. According to Daly, "intentional communities represent potentially important experiments in developing more sustainable lifestyles and consumption patterns. They are experimental niches, and as the grass-roots innovation agenda highlights, civil society niches can play an important role in successful sociotechnical transitions to more sustainable production-consumption systems" (2017: 1359).

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The energy sector has historically been highly regulated and closed to citizen engagement, but due to the wider diffusion of renewable energy production first rural and later also urban communities have become central actors, due to ownership of land and buildings (MacArthur, 2016). To maximise the benefits for communities and promote up-scaling of successful community energy projects, greater understanding is required about the influential factors enabling and hindering further citizen engagement.

4.4.2 Mutual adjustment

Jordan *et al.* (2018) propose that "constituent units are likely to spontaneously develop collaborations with one another, producing more trusting interrelationships" (p. 15). The associated proposition of mutual adjustment is that individual units in the polycentric system naturally interact with each other and adapt their actions accordingly. Changes made by one unit are fed into the system and are recognised by other units that may choose to adopt the new practice in response. This creates a complex adaptive governance system, which is dependent on cooperation through networks to generate innovative solutions and strategies (Crosby *et al.,* 2017).

Mutual adjustment is a factor that is important for forming effective collective action, through the interconnection of strategies between different units in a collective system (Jordan *et al.,* 2018). Due to the high degree of autonomy at each individual unit in a polycentric system, there is a high level of freedom for individual units to quickly adopt more effective practices (E. Ostrom, 2010). The assumption is that individual units maximise their self-utility by mutually adjusting to more effective strategies, provided through innovations generated by other units experimenting in the system.

However, a key challenge for enabling effective collaboration through polycentric systems are internal conflicts that prevent mutual adjustment (Bruns, 2019). Conflict can nonetheless carry a constructive quality if adequately managed, and can be used as tools to further consolidate a form of decentralized governance (Ibid.). They may assist in making the system improve and progress. Accordingly, further research is needed to investigate to what extent and under what conditions individual units are willing to 'mutually adjust' in the system.

4.4.3 Experimentation

Jordan *et al.* (2018:16) state that the " willingness and capacity to experiment is likely to facilitate governance innovation and learning about what works" (p. 16). Experimentation may be capable of introducing innovative approaches to problems through the generation of feedback systems. There are several variables surrounding experimentation, which influence the effectiveness and equity of outcomes.

For example, the aforementioned cohousing initiatives are also examples of civil participation and local action, which "introduce new everyday living practices and create different relationships within the neighbourhood that are also of a voluntary nature, and are different to those promoted by the third sector, and alternative to the usual Market dynamics. They have entirely distanced themselves from the idea of Market value and are intent on restoring the intrinsic value of relationships based on proximity and neighbourhood life" (Musolino, 2015: 288). Some scholars describe the role of these communities of "collaborative living" as a tool to foster and spread social capital not only within the

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group, but also to the outside. Ruiu (2014: 324) writes: "The declared aim of many communities is to achieve not only a high degree of harmony within itself, but also communication with the outside world to break down the barriers (physical and "psychological") between the "inside" and "outside".

These experiences of collaborative living, despite the absence of a stringent definition shared by all scholars, have nevertheless produced an innovative potential model for the management of housing that arises as an alternative with respect to that relating to modern urbanization. "These grassroots housing models address current challenges in urban development often discussed under the umbrella concept of sustainability, such as social inclusion and cohesion, environmental awareness, and affordability" (Lang et al. 2019:1). Therefore, cohousing communities take a role of developers of three forms of social capital: *bonding*, *bridging* and *linking capital* (Ruiu, 2016; Lang et al. 2019), which helped build stable trust relationships for promotion of participatory values and practices. More specifically, the (relatively) small size of cohousing groups allows the construction of fiduciary (trust) bonds based on face-to-face interactions (Bauwens & Defourny, 2017): this dimension of social capital can be useful for a constant exchange of knowledge, value motivations and practices to other people.

Huitema *et al.* (2018) highlight that in terms of outcomes experiments are not necessarily equal for all participants, and can affect target groups in different ways, where some attain benefits and others incur costs. Therefore, it is vital to pay attention to the motivations and possible vested interests behind the set-up of experiments, the way in which they are conducted and the levels of acceptability among stakeholders (Jordan *et al.,* 2018; Huitema *et al.,* 2018).

4.4.4 The importance of trust

Ostrom (2010) argued that levels of trust among actors directly contribute to levels of cooperation, which may result in net benefits. These benefits in effect lead to new forms of learning and the adaption of altered norms, which can positively affect levels of trust, creating a feedback loop. This process is outlined in Figure 4.2.

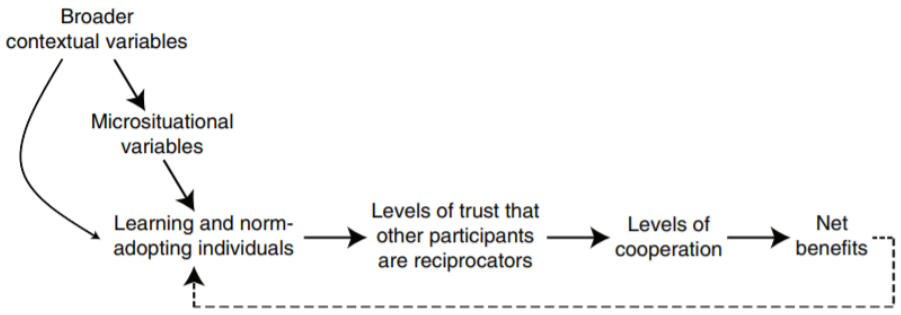

FIGURE 5. MICROSITUATIONAL AND BROADER CONTEXTS OF SOCIAL DILEMMAS AFFECT LEVELS OF TRUST AND COOPERATION

Source: Poteete, Janssen, and Ostrom 2010: 227.

Figure 4.2. Trust in a Polycentric Understanding

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Building on this, Jordan et al. (2018) suggest that "trust is likely to build up more quickly when units can self-organise, thus creating collective ambitions" (p. 18). This is particularly true at the local scale as in this case actors have the opportunity to interact face-to-face. Nonetheless, they propose for processes of trust building to take place at all levels and units of governance. Next to this, they underline the importance of direct participation, information sharing, the establishment of monitoring and evaluation systems, and the conscious choice of what body evaluates what activities, and based on what criteria.

Finally, Bäckstrand et al. (2018) link trust to legitimacy, which is put forward as a governance challenge by Jordan et al. (2018). In this context, there is still space to empirically substantiate to what extent trust leads to cooperation, and by this how it contributes to sociological legitimacy.

4.4.5 Overarching rules

Jordan *et al.* (2018, p. 19) propose that "local initiatives are likely to work best when they are bound by a set of overarching rules that enshrine the goals to be achieved and/or allow conflicts to be resolved." Rules are considered important for *inter alia* enhancing mutual adjustment, reducing the level of discord between units and providing a way to settle conflicts. Moreover, the role of an overarching set of rules can serve to protect the diversity of local action (Jordan *et al.,* 2018).

In contrast, E. Ostrom (1998) argued that a well-functioning polycentric system should not rely on hierarchical methods to hold actors accountable, but instead should rely on building transparency, through mechanisms of trust and reciprocity. Later, she specified this by stating that a strong understanding is required for individual decision-making centres not to take actions that would negatively impact another self-organising semi-autonomous centres.

In referring to wind energy, Fournis and Fortin (2016) have focused their attention on conditions that affect local acceptance, and have found that multiple overarching components contribute, such as psychological aspects, governance structures, participation processes, and market structure.

In terms of participation processes and in particular linked to the relation between the involvement of citizens and social acceptance, some scholars have studied the mechanisms, which engage the members of a community towards accepting renewable energy systems and environmental solutions that can foster progress towards the energy transition. Tricarico (2018) claims that an essential condition for fostering social acceptability and functionality is to involve local actors who have to be investors too. He terms them as "community investors". Nonetheless, he highlights a critical issue in the dynamics concerning community engagement in this context: dependent on the community agreement, on the one hand, this could be a means to improve the communities' socio-economic conditions, whilst on the other hand, in certain contexts, it could cause the marginalization of certain social groups, creating inequalities and conflicts.

For this reason, he believes that three specific competencies are fundamental: first, there should be a capacity of "systematizing": setting up a framework in which, through specific contractual provisions, the rules are drawn in order to share responsibilities and regulate the relationships between the members of a local community; second, to provide sustainable investment plans in which there is a full sharing of social capital among local actors and entrepreneurial participation of citizens who have

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to play a central role in planning the services and spaces of the local community; third, the capacity to manage the different priorities and interests of people, whilst taking into consideration the needs and expectations in the decision-making processes - in particular if there is a concern regarding the distribution of benefits arising from the use of community assets.

4.4.6 Social acceptance

Social acceptance is important for gaining support and developing greater citizen engagement for renewable energy projects (MacArthur, 2016). Overall, social acceptance is a salient issue, and an important proposition to test, as it looks to uncover mechanisms to enable the wider diffusion of renewable energy technologies. Importantly, clean energy communities may have the potential to stimulate social acceptance through their attributes of citizen participation, networked cooperation, semi-autonomous decision making centres and co-benefit generation (Bauwens, 2017; Bauwens and Devine-Wright, 2018). Wüstenhagen *et al.* (2007) identify three interdependent dimensions of social acceptance: socio-political acceptance, community acceptance and market acceptance. Figure 4.3 presents these dimensions in a triangle of social acceptance of renewable energy innovation.

Figure 4.3 Triangle of the three dimensions of social acceptance of renewable energy innovation (Wüstenhagen et al., 2007).

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Socio-political acceptance relates to the most general level, which constitutes public acceptance towards policies and technologies (Wüstenhagen *et al.* (2007). Community acceptance refers to specific acceptance of decisions and renewable energy projects by local stakeholders, such as local authorities and residents. Market acceptance directly applies to how the market facilitates or hinders the diffusion and wider spread adoption of a new service or product.

Ellis and Ferraro (2016) underline the importance of understanding the interactive relationship between these three elements: the contrasts at the level of community acceptance could affect socio-political acceptance in turn leading to changes in the policies that would increase risks for investors and therefore would affect market acceptance. For this reason, they define social acceptance as a "multi-dimensional, context specific and dynamic phenomenon". Referring specifically to wind energy, they argue that neither market acceptance nor socio-political acceptance are the main constraints; but in reality it is community acceptance.

According to Lennon et al. (2019), to achieve a sustainable energy transition, participatory and inclusive governance structures are necessary. It is necessary to involve citizens as full stakeholders and allow them to receive resulting benefits. Therefore, it is important to foster and support cooperative processes in order to empower local people and for this purpose it should be a priority aim for politicians to provide citizens with political, financial and business tools to access the resources available for new RES technologies in an equitable manner. Unfair power structures, rules that hinder citizen participation, lacking transparency in decision-making procedures, are all major obstacles that can have a negative impact on the community-level acceptability of projects that envisage the implementation of renewable energy plants or solutions. Wider social acceptability can be achieved within a local community, following the establishment of democratization and participation pathways.

In line with this they also highlight how some interconnected factors, such as energy, justice and social inclusion, play an important role when a community has to decide to accept or refuse a RES project to be implemented on its territory. Accordingly, new business models and delivery schemes are required in order to create a broader sense of value for community stakeholders. The instilled business models have to ensure not only a return on investment, but should both reduce potential negative impacts and deliver benefits in a fair manner amongst the community members.

4.4.7 Multi-level learning

As explained in Chapter 1, there are three main types of learning, including cognitive, normative and relational. A polycentric network is considered to have the potential to facilitate the development of cognitive learning, by enabling the diffusion of relevant knowledge to be transferred to a variety of stakeholders, involved in semi-autonomous decision-making centres (E. Ostrom, 2010). Knowledge transfer can facilitate fast-paced learning and result in horizontal up-scaling of energy projects, where the replication of successful activities involved within renewable energy initiatives are adopted at larger geographical scales (Seyfang *et al.,* 2014: van Doren *et al.,* 2018). Normative learning can be facilitated, where stakeholders learn and embrace changes of new perspectives, goals, or priorities, which is important for the development of collective action solutions and developing a strong clarity of purpose (E. Ostrom, 1998: Haug *et al.,* 2011: Sovacool and Van de Graaf, 2018).

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Relational learning may also be facilitated by a strong polycentric governance network, in which actors can develop trust, and are enabled to cooperate with other stakeholders (Haug *et al.,* 2011). This helps to increase the acceptance of new innovative management approaches and community acceptance for clean energy projects (Wüstenhagen *et al.,* 2007: MacArthur, 2016). A system that facilitates relational learning requires high levels of trust among stakeholders, to generate strong relations (Cole, 2015).

The NEWCOMERS project will investigate where learning takes place in interactions of energy communities with other stakeholders, how these processes develop and which types of learning are involved. Specific attention will be paid to the role of intermediaries (e.g. consultancy industry) in these processes as well as of government and where there would be scope for improvement.

4.4.8 New business models

A system of polycentricity is assumed to offer potential to generate innovative business models through its positive attributes, in particular a high adaptive capacity to deal with socio-economic changes (Marshall, 2009; Marshall, 2015). "Business model innovations are considered key to delivering greater social and environmental sustainability, as they can »create significant positive and/or significantly reduced negative impacts for the environment and/or society, through changes in the way the organisation and its value-network create, deliver value and capture value (i.e. create economic value) or change their value propositions" (Bocken *et al.*, 2014: 44).

Figure 4.4 highlights the key elements of a business model: the value proposition (service offerings, customer relationships), value creation and delivery (activities, resources, partners, distribution channels and co-benefits) and value capture (cost structure, revenue model) (Bocken *et al.,* 2014). Typically, value creation is at the heart of any business model, and it is where firms can differentiate from each other to offer competitive advantages.

Figure 4.4: Key elements of new sustainable business models (Bocken et al., 2014).

Several studies have found that where co-benefits are generated for the community, public acceptance and participation are likely to be greater (Rogers *et al.,* 2008; Warren and McFadyen,

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2010; Hewitt *et al.,* 2019). This highlights the importance to provide equitable outcomes, and to create awareness of the potential co-benefits for participation in a polycentric system.

4.4.9 Value creation

E. Ostrom (2010) hypothesised that in a polycentric system of governance, actors would come up with their own innovative solutions to generate public values, such as improved human health, cheaper energy prices and improvements to air quality. Such co-benefits could also relate to improvements to public services such as educational, health and infrastructural developments. Similarly, the recent perspective of the Foundational Economy shows that the complex relationships between global commons and social and environmental sustainability may require multilevel and polycentric solutions. In this light ,the Foundational Economy can be the basis for developing new practices of citizenship that revolve around the management of local commons (Barbera, et al. 2018; Barbera & Jones, forthcoming, p. 27).

In this respect, Jordan *et al.* (2015) have argued that an improved understanding of co-benefits generated from a polycentric system is important for overcoming public acceptability concerns and may help providing a strong political case for innovation. At this point it is necessary to distinguish between the terms *value* and *values,* as they should not be used interchangeably. Some scholars – such as Ostrom (2010), Haug et al. (2011) and Jordan et al. (2018) – discuss *values* in terms of normative predispositions, attitudes, and beliefs of actors. Others such as Bocken et al. (2014) designate *value* as linking to the core activities of business models, namely value proposition, value creation and delivery and value capture.

Other scholars have also linked polycentrism as beneficial for public value creation, where co-benefits can be generated for local communities and society (Bryson *et al.,* 2016). However, a current challenge for policy analysis is the need for better ways to define, track and monitor co-benefit generation. Wierling et al. (2018) suggest lending from the idea of accounting for ecosystem services to account for social system services.

The types of value created, the effects they produce and distribution scales remain highly dependent on the types of actors involved (Bryson et al., 2016). The same authors add to this by highlighting that the combination of a diverse set of relevant actors, with entrepreneurial spirit, strategic action and leadership are key components for effective and equitable value creation. Moreover, since value is considered as interactive relativistic preference experience of individuals (Holbrook, 1999, p. 5), Moeller et al. (2013) argue that value creation cannot be accomplished without collaboration of consumers. Value creation is determined by the activities-based perspective. Hence, consumers are not only "producers of meaning" of different types of value, which is in itself an important driver of behaviour (Zainuddin, 2013), they are active participants, creators and co-creators of value in the new clean energy communities (Kotilainen et al., 2016).

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The benefits associated with community energy are considerably diverse. In the wider literature on community energy the following categories of benefits have been identified, including (European Commission, 2015; European Commission, 2016; IRENA Coalition 2018; Bauwens and Devine-Wright 2018; Bauwens 2017; Seyfang et al., 2013; Roberts et al. 2014):

- Environmental benefits, such as carbon reduction, and improving local environment.
- Economic benefits, such as income generation, income retention, saving money on fuel bills, tackling fuel poverty, supporting the local economy, local job creation, and skills development.
- Social benefits, including increasing social cohesion, increasing trust, improving community wellbeing and health, improving education, social inclusion, increasing energy literacy, fostering changes in practices and behaviour, and creating volunteering opportunities.
- Political benefits, such as greater public engagement, awareness raising, community empowerment, influencing sustainability/energy policy, and community leadership.

Despite a growing body of work on community energy, there is no consensus over the benefits it brings as yet (Brummer, 2018). How to measure, validate or reward environmental, social or political benefits is also unclear. What could be said is that different community initiatives lead to different outcomes, depending on the structures employed, processes followed, and activities pursued. This has important implications for how to study new community business models.

4.4.10 Potential for up-scaling

A system of polycentric governance may offer the means to identify successful initiatives that could be replicated and eventually up-scaled. Based on a study by Van Doren *et al.* (2018), horizontal and vertical pathways for up-scaling can be distinguished (see Figure 4.5).

The first mechanism for up-scaling is based on horizontal pathways (van Doren *et al.,* 2018). The main factor leading to this type of up-scaling arises from spatial growth, resulting in a scale expansion of the initiative to a larger geographical area. Other factors that result in horizontal up-scaling are the replication of activities within the initiative or the transfer of initiatives to other cities or areas (within a country or abroad) (van Doren *et al.,* 2018). The benefit of this type of up-scaling is that the coverage is extended, where more citizens are reached and engagement levels are increased.

Interestingly, in the context of energy communities, intermediary energy organisations offer a crucial role in facilitating actors to develop knowledge. These organizations have become highly conditional for the development and operation of clean energy communities, as they offer project management, funding, development support and administrative services to local community organisations (Seyfang *et al.,* 2013; Bush *et al.*, 2017; Lindvist *et al.,* 2019). In this regard, further research is needed to what extent the knowledge demands of energy communities are met and what mechanisms for transfer of knowledge and skills work best.

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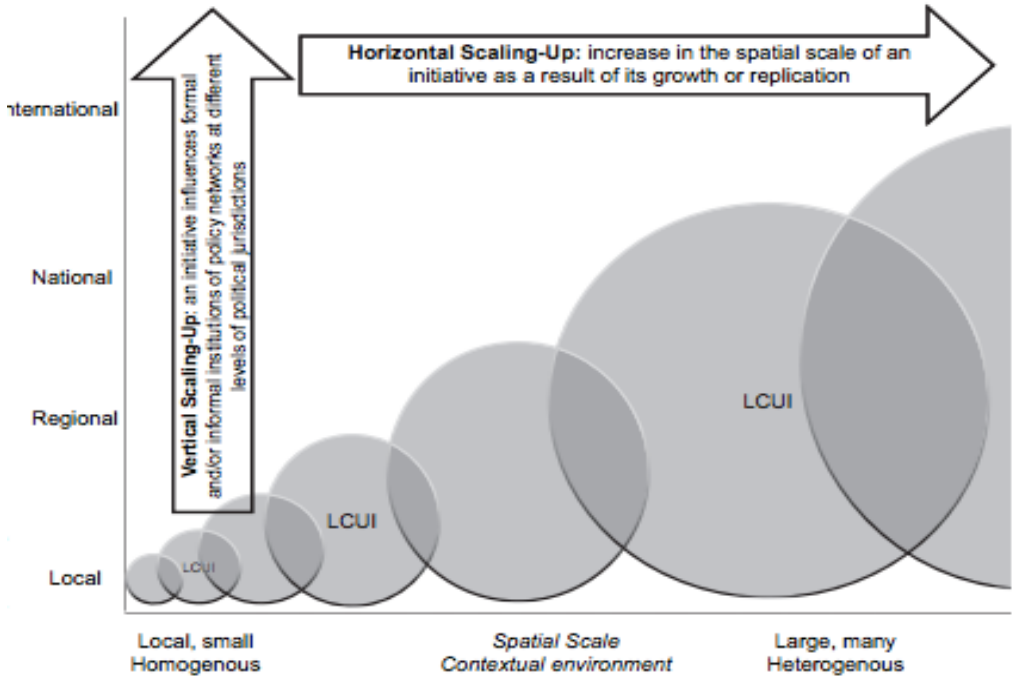

Figure 4.5: Horizontal and vertical mechanisms for up-scaling of initiatives (van Doren et al., 2018).

The second mechanism for up-scaling is sustained through vertical pathways. This refers to a process where knowledge (ideas, values, and lessons learnt through experimentation) is transferred to higher organisational levels (local – regional – national – international) (van Doren *et al.,* 2018). The assumption is that knowledge accepted at higher organisational levels has the potential to be used to greater impacts and scales. The knowledge transferred efficiently and equitably through a cooperating network of actors has been reported to be able to "change the institutional roots of carbon-intensive development" (van Doren *et al.,* 2018).

4.5 Implications

In the past decades, governance in many policy areas has evolved from mostly hierarchical to network systems, involving a variety of new actors. Such governance systems are considered beneficial for tackling complex problems, which span across national boundaries with global impacts. Several scholars assume that systems of polycentric governance are the most suitable to tackle these challenges, as one of their advantages is that they may stimulate learning in complex policy contexts.

However, the effectiveness of polycentric governance systems is highly dependent on a variety of institutional, regulatory and social factors. Contrasting contexts of governance in different countries will have conflicting variables influencing the effectiveness of polycentricity. Through the application of E. Ostrom's institutional analysis and development framework (IAD), these variables can be compartmentalised into context, action arena and patterns of interaction. As a result, the enabling

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and hindering factors for polycentrism in various contexts can be identified and options explored how to facilitate the further development of new clean energy communities.

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5 RESEARCH PROPOSITIONS

5.1 Introduction

The NEWCOMERS project will analyse new clean energy communities from the perspective of polycentric governance theory and more specifically it will explore its central themes as explained in the previous chapter. In order to give guidance to the analytical work, this chapter will operationalize these themes into a set of research propositions.

5.2 Set of propositions

Based on the literature review as provided in the previous chapters, Table 4.1 presents the research propositions to be tested in the NEWCOMERS project with regard to energy communities in general and new clean energy communities more specifically.

The first five propositions are similar as those proposed by Jordan *et al.* (2018), but reformulated to make them applicable to energy communities. The next seven are indirectly based on the same publication and focus more specifically on the aspects of citizen engagement, processes of learning and value creation that are central in the NEWCOMERS project.

Table 4.1 Propositions to be tested in the NEWCOMERS project

Themes	**As defined in the literature**	**As defined in the NEWCOMERS project**
Local action	Governance initiatives are likely to take off at a local level through processes of self-organization (Jordan et al., 2018).	Place-based energy communities, and especially newcomers, are likely to take off at a local level through processes of self-organization by citizens.
Mutual adjustment	Constituent units are likely to spontaneously develop collaborations with one another producing more trusting interrelationships (Jordan et al., 2018).	Energy communities are likely to spontaneously develop collaborations with one another, and engage in processes of mutually adjusting to each other.
Experimentation	The willingness and capacity to experiment is likely to facilitate governance innovation and learning about what works (Jordan et al., 2018).	Energy communities' willingness and capacity to experiment is likely to facilitate governance innovation and learning about what works.
The importance of trust	Trust among actors is likely to build up more quickly when units can self-organise, thus increasing collective ambitions (Jordan et al., 2018).	Trust is likely to build up more quickly when energy communities can self-organise, thus increasing collective ambitions. Trust requires people that are acknowledged to be trustworthy, and rules to safeguard community members if there are breaches of trust (people not behaving in a trustworthy way).

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Overarching rules	Local initiatives are likely to work best when they are bound by a set of overarching rules that enshrine the goals to be achieved and/or allow conflicts to be resolved (Jordan et al., 2018).	Energy communities are likely to work best when they are bound by a set of overarching rules that enshrine the goals to be achieved, define or shape processes for achieving them, allow for conflict resolution and set penalties for actions that compromise the effective working of the community.
Governance for new business models	A system of polycentricity is assumed to offer potential to generate innovative business models through the devolution of powers in line with the subsidiarity principle and collaborative community-based governance, and in particular a high adaptive capacity to deal with socio-economic changes (Marshall, 2009; Marshall, 2015).	Polycentricity is likely to lead to the emergence of new business models used by energy communities in the field of low carbon energy.
Social acceptance of renewable energy	Social acceptance of technology is important for gaining support and developing greater citizen engagement for renewable energy projects (MacArthur, 2016).	Energy communities are likely to stimulate through citizen engagement the social acceptance of low carbon energy technologies, new business models and energy transition policies.
Embeddedness of technology in society	Energy systems are socio-technical in their characterization, meaning that both the material and social/human parts of a system need to be considered to understand its functions and possible development paths (Palm, 2006).	Energy communities are subsequently hindered or facilitated by local social, political, cultural and geographic factors that collectively amount to local 'technological styles' (Hughes, 1987).
Potential for up-scaling / Transfer of knowledge, skills, and practices	Up-scaling can take form in horizontal and vertical pathways – the former describing spatial expansion and the later institutional embedding (van Doren et al., 2018). Understanding the interactions of actors within a system of polycentric governance may offer the means to identify why certain initiatives were successful.	Transfer of knowledge and skills between and within energy communities and through intermediaries is likely to enhance the potential for up-scaling, both in horizontal and vertical pathways.
Multi-level learning	A polycentric network is considered to have the potential to facilitate learning, by enabling the diffusion of relevant knowledge to be transferred to a variety of stakeholders (E. Ostrom, 2010).	Energy communities are likely to provide opportunities for learning by their members at the cognitive, normative and relational levels.

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Value creation and distribution	In a polycentric system of governance, actors will come up with their own innovative solutions to generate value for local communities and society (Bryson *et al.,* 2016)	Energy communities are likely to generate value for local communities and society
Virtual communities	(Energy) communities can be organized without being place-based and with a single- or multi-issue focus differentiating between scopes of activities (Moroni et al., 2018).	Energy communities can also be created to deliver benefits to individual participants and to energy systems in a virtual manner, deviating from traditional place-based models.

5.3 Final remarks

This deliverable developed a novel theoretical framework based on polycentric governance theory, combined with elements from socio-technical systems theory and social innovation theory. Through the empirical work to be executed in the WPs 3, 4, 5, and 6, we aim to test the twelve propositions formulated above in order to better understand how polycentric governance is functioning in the field of energy communities and low-carbon energy, as well as to identify associated enabling and disabling factors. The outcomes of this assessment will be used in WP7 that aims to synthesize the research results and formulate policy recommendations.

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References

Aligica, P.D., and Tarko, V. (2012). Polycentricity: From Polanyi to Ostrom, and Beyond. *An International Journal of Policy, Administration, and Institutions* 25, (2), 237-262.

Ansell, C. (2008). The Governance Dilemma. *European Political Science,* 7 (4), 460-471.

Asmus, P. (2010). Microgrids, Virtual Power Plants and Our Distributed Energy Future. *The Electricity Journal*, 23 (10), 72-82.

Ayers, J., and Forsyth, T. (2009). Community based adaptation to climate change. *Science and Policy for Sustainable Development*, 51 (4), 22-31.

Bäckstrand, K., Zelli, F., & Schleifer, P. (2018). Legitimacy and Accountability in Polycentric Climate Governance. In: A. Jordan, D. Huitema, H. Van Asselt, & J. Forster (Eds.), *Governing Climate Change: Polycentricity in Action*? (pp. 338-356). Cambridge: Cambridge University Press.

Barbera F., Jones I. R., (forthcoming). The Foundational Economy and the Civil Sphere. In: Barbera F., Jones I. R. (Eds.), *The Foundational Economy and Citizenship: Comparative perspectives on civil repair,* WISERD Civil Society, 13-37.

Barbera, F., Negri, N., and Salento, A. (2018). From individual choice to collective voice. Foundational Economy, local commons and citizenship'. *Rassegna Italiana di Sociologia*, 2: 371-391.

Barnes, J. (2019). The local embedding of low carbon technologies and the agency of user-side intermediaries. *Journal of Cleaner Production*, 209, 769–781.

Barbour, E., Parra, D., Awwad, Z., and González, M. C. (2018). Community energy storage: A smart choice for the smart grid? *Applied Energy.* (212): 489-497.

Basurto, X., and Ostrom, E. (2009). Beyond the tragedy of the Commons. *Economia delle fonti di energia e dell'ambiente*, 69 (7): 35-60.

Bauwens, T., Gotchev, B., and Holstenkamp, L. (2016). What drives the development of community energy in Europe? The case of wind power cooperatives. *Energy Research & Social Science,* 13, 136-147.

Bauwens, T. (2017). Polycentric governance approaches for a low-carbon transition: The roles of community-based energy initiatives in enhancing the resilience of future energy systems. In: N. Labanca, (Ed.), Complex systems and social practices in energy transitions. Framing energy sustainability in the time of renewables. Springer. 119-145.

Bauwens, T. and Defourny, J. (2017). Social Capital and Mutual versus Public Benefit: The Case of Renewable Energy Cooperatives. Annals of Public and Cooperative Economics 88(2), 203-232.

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

Bevir, M. (2012). Governance: A very short introduction. UK: Oxford University Press.

Bird, L., Wüstenhagen, R., and Aabakken, J. (2002). A review of international green power markets: recent experience, trends, and market drivers. *Renewable and Sustainable Energy Reviews*, 6 (6), 513–536.

Birkland, T.A. (2014). An Introduction to the Policy Process: Theories, concepts and models of governing. *Politics and International Relations*, 3, 12-34.

Bocken, N.M.P., Short, S.W., Rana, P., and Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production,* (65), 42-56.

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

Bryant, S. (2016). An energy market feast - Innovative business models eating into energy market value chain. Blogpost: https://www.engerati.com/blogs/energy-market-feast-%E2%80%93-innovative-business-models-eating-energy-market-value-chain

Bryson, J., Alessandro S., Benington, J., and Sørensen, E. (2016). Towards a multi-actor theory of public value co-creation. *Public Management Review* 19(5), 640–654.

Brummer, V. (2018). Community energy – benefits and barriers: A comparative literature review of Community Energy in the UK, Germany and the USA, the benefits it provides for society and the barriers it faces. *Renewable and Sustainable Energy Reviews*. 94: 187-196.

Bruns, B. (2019). Practising Polycentric Governance. In: A. Thiel, W. Blomquist, & D. Garrick (Eds.), *Governing Complexity: Analyzing and Applying Polycentricity* (Cambridge Studies in Economics, Choice, and Society, pp. 237-255). Cambridge: Cambridge University Press.

Bush, R.E., Bale, C.S.E., Powell, M., Gouldson, A., Taylor, P.G., and Gale, W. (2017). The role of intermediaries in low carbon transition – Empowering innovations to unlock district heating in the UK *Journal of Cleaner Production,* (148), 137-147.

Carlisle, K., and Gruby, R.L. (2017). Polycentric Systems of Governance: A Theoretical Model for the Commons. *Policy Studies Journal,* 1-25.

Cole, D. (2015). Advantages of a polycentric approach to climate change policy. *Nature Climate Change*, 5(2), 114–118.

Creamer, E., Taylor Aiken, G., van Veelen, B., Walker, G., and Devine-Wright, P. (2019). Community renewable energy: what does it do? Walker and Devine-Wright (2008) ten years on. Energy Research & Social Science, 57, 101223.

Crosby, B.C., Hart, P., and Torfing, J. (2017). Public value creation through collaborative innovation. *Public* Management *Review,* 19 (5), 655-669.

David, P. (1988) Path-dependence: putting the past into the future. Technical Report No. 533, Stanford University, Institute for Mathematical Studies in the Social Science.

de Haan, F., and Rotmans, J. (2018). A Proposed Theoretical Framework for Actors in Transformative Change. *Technological Forecasting and Social Change*. (128): 275-286.

Douai, A., Rudyk, B., Auter, P.J., and Wedlock, B. (2013). The influence of social media in the early 21st century: A meta-analysis of a decade of research. *Global Media Journal*, 3, 90-111.

Ellerman, D.A., Marcantonini, C., and Zalkan, A. (2015). The European Union emissions trading scheme: ten years and counting. *Review of Environmental Economics and Policy*, 10(1), 89-107.

European Commission (2015). A framework strategy for a resilient Energy Union with a forward-looking climate change policy. COM (2015) 80 final, 25.2.2015. Brussels.

European Commission (2018). A clean planet for all: A European strategic long term vision for a prosperous, modern, competitive and climate neutral economy. COM 2018 (773) final, 28.11.2018. Brussels.

Fröhlich, J., and Knieling, J. (2013). Conceptualizing climate change governance. In: Knieling, J. and Leal Filho, W. (Eds.) Climate Change Management. Springer-Verlag Berlin Heidelberg.

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

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

Gillingham, K. and Palmer, K. (2014). Bridging the Energy Efficiency Gap: Policy Insights from Economic Theory and Empirical Evidence. *Review of Environmental Economics and Policy,* 8(1), 18–38.

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

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

Hewitt, R.J., Bradley, N., Baggio Compagnucci, A., Barlagne, C., Ceglarz, A., Cremades, R., McKeen, M., Otto, I.M., and Slee, B. (2019). Social innovation in community energy in Europe: A review of the evidence. *Energy Systems and Policy – Frontier Energy Research* 7, 31.

Hicks, J., and Ison, N. (2018). An Exploration of the Boundaries of 'Community' in Community Renewable Energy Projects: Navigating between Motivations and Context. *Energy Policy,* 113, 523-534.

Hodson, M., and Marvin, S. (2009). Cities mediating technological transitions: understanding visions, intermediation and consequences. *Technology Analysis and Strategic Management*, 21, 515–534.

Hoffman, M.J. (2011). Climate governance at the crossroads: experimenting with a global response. New York: Oxford University Press.

Hughes, T.P. (1983). Networks of Power: Electrification in Western Society 1880 – 1930. Baltimore: John Hopkins University Press.

Hughes, T.P. (1986). The Seamless Web: Technology, Science, Etcetera, Etcetera. *Social Studies of Science*, 16 (2), 281-292.

Huitema, D., Mostert, E., Wouter, E., Moellenkamp, S., Pahl-Wostl., and Yalcin, R. (2009). Adaptive Water Governance: Assessing the Institutional Prescriptions of Adaptive (Co-)Management from a Governance Perspective and Defining a Research Agenda. *Ecology and Society* 14(1):26.

Huitema, D., Jordan, A., Munaretto, S., and Hildén, M. (2018). Policy experimentation: core concepts, political dynamics, governance and impacts. *Policy Sciences,* 51(2), 143-159.

Interreg Europe (2018). Renewable Energy Communities. A policy brief from the Policy Learning Platform on Low Carbon Economy. European Union. [Online] Retrieved from: https://www.interregeurope.eu/fileadmin/user_upload/plp_uploads/policy_briefs/2018-08-30_Policy_brief_Renewable_Energy_Communities_PB_TO4_final.pdf.

IRENA Coalition. 2018. "Community Energy : Broadening the Ownership." http://irena.org/-/media/Files/IRENA/Agency/Articles/2018/Jan/Coalition-for-Action_Community-Energy_2018.pdf?la=en&hash=CAD4BB4B39A381CC6F712D3A45E56E68CDD63BCD&hash=CAD4BB4B39A381CC6F712D3A45E56E68CDD63BCD

Johnson, V., and Hall, S. (2014). Community energy and equity: the distributional implications of a transition to a decentralised electricity system. *People, Place, and Policy,* 8(3), 149-167.

Jordan, A., Huitema, D., and Hildén, M. (2015). Emergence of polycentric climate governance and its future prospects. *Nature Climate Change*, 5(11), 977–982.

Jordan, A., Huitema, D., Schoenefeld, J., van Asselt, H., & Forster, J. (2018). Governing Climate Change Polycentrically. In: A. Jordan, D. Huitema, H. van Asselt, & J. Forster (Eds.), *Governing Climate Change: Polycentricity in Action?* (pp. 3-26). Cambridge: Cambridge University Press. Doi:10.1017/9781108284646.002.

Keane, J. (2009). The Life and Death of Democracy. *New York: Simon and Schuster.*

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

Koirala, B. P., van Oost, E., van der Windt, H. (2018). Community energy storage: A responsible innovation towards a sustainable energy system? *Applied Energy*, (231): 570-585.

MacArthur, J.L. (2016). Challenging public engagement: participation, deliberation, and power in renewable energy policy. *Journal of Environmental Studies and Sciences,* 6 (3), 631-640.

Marshall, G.R. (2009). Polycentricity, reciprocity, and farmer adoption of conservation practices under community-based governance. *Ecological Economics,* 68: 1507–1520.

Marshall, G.R. (2015). Polycentricity and Adaptive Governance. *Conference* Paper presented at the 15th biannual International Conference of the International Association for the Study of the Commons, Edmonton, Canada.

McFadgen, B., & Huitema, D. (2017). Experimentation at the interface of science and policy: a multi-case analysis of how policy experiments influence political decision makers. *Policy Sciences,* 1-27.

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

McGinnis, M.D., & Ostrom, E. (2011). Reflections on Vincent Ostrom, public administration, and polycentricity. *Public Administration Review* 72 (1), 15-25.

Moroni, S., & Tricarico, L. (2018). Distributed energy production in a polycentric scenario: Policy reforms and community management. Journal of Environmental Planning and Management, 61(11), 1973–1993. https://doi.org/10.1080/09640568.2017.1379957

Moroni S., Alberti V., Antoniucci V., Bisello A. (2018.) Energy Communities in a Distributed-Energy Scenario: Four Different Kinds of Community Arrangements. In: Bisello A., Vettorato D., Laconte P., Costa S. (eds) Smart and Sustainable Planning for Cities and Regions. SSPCR 2017. Green Energy and Technology. Springer, Cham.

Morrison, T.H., Adger, W.N., Brown, K., Lemos, M.C., Huitema, D., Phelps, J., Evans, L., Cohen, P., Song, A.M., Turner, R., Quinn, T., and Hughes, T.P. (2019). The black box of power in polycentric environmental governance. Global Environmental Change, 57, 101934.

Ostrom, V., Tiebout, C.M and Warren, R. (1961). The organization of government in metropolitan areas: a theoretical inquiry. *The American Political Science Review,* 55 (4), 831-842.

Ostrom, E. (1998). A behavioral approach to the rational choice theory of collective action. *American Political Science Review*, 92(1), 1–22.

Ostrom, E. (2005). Understanding Institutional Diversity. New Haven, USA: Princeton University.

Ostrom, E. (2009). Polycentricity, reciprocity, and farmer adoption of conservation practices under community-based governance. *Ecological Economics,* 68 (5), 1507-1520.

Ostrom, E. (2010). Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change,* 20, 550-557.

Palm, J., and Wihlborg, E. (2006). Governed by technology? Urban management of broadband and 3G systems in Sweden. *Journal of Urban Technology*, 13 (2), 71-89.

Parag, Y., and Janda, K.B. (2014). More than filler: Middle actors and socio-technical change in the energy system from the "middle-out". *Energy Research & Social Science*, 3, 102–112.

Rhodes, R.A.W. (1997*). Understanding governance: policy networks, governance, reflexivity and accountability. Public Policy & Management,* Philadelphia, US. Open University, 2(4), 252.

Rhodes, R.A.W. (1999). Control and power in central-local government relationships. Routledge, 240 p.

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

Roberts, J., Bodman, F., and Rybski, R. (2014). Community Power – Model Legal Frameworks for Citizen-Owned Renewable Energy. London: Client Earth.

Roberts, J., Frieden, D., and d'Herbemont, S. (2019). Energy community definitions. Explanatory note. H2020 project COMPILE, 12 p.

Rogers, J. C., Simmons, E. A., Convery, I., and Weatherall, A. (2008). Public perceptions of opportunities for community-based renewable energy projects. *Energy Policy,* 36, 4217–4226.

Sabatier, P. (1988). An advocacy coalition framework of policy change and the role of policy-orientated learning therein. *Policy Sciences,* 21, 129-168.

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

Seyfang, G., Hielscher, S., Hargreaves, T., Martiskainen, M., and Smith, A. (2014). A grassroots sustainable energy niche? Reflections on community energy in the UK. *Environmental Innovations and Social Transitions,* 13, 21-44.

Smith, A. (2007). Emerging in between: The multi-level governance of renewable energy in the English regions. *Energy Policy,* 35 (12), 6266-6280.

Smith, A., Stirling, A., and Berkhout. F. (2005). The governance of sustainable socio-technical transitions. *Research Policy* (34): 1491–1510.

Sovacool, B., and De Graaf, T. (2018). Building or stumbling blocks? Assessing the performance of polycentric energy and climate governance networks. *Energy Policy,* (118), 317-324.

Stewart, J., and Hyysalo, S. (2008). Intermediaries, users and social learning in technological innovation. *International Journal of Innovation Management.,*12, 295–325.

Termeer, C., Dewulf, A., and Lieshout, M. (2010). Disentangling scale approaches in governance research: comparing monocentric, multilevel, and adaptive governance. *Ecology and Society,* 15(4), 29.

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

Vasileiadou, E., Huijben, J. C. C. M., & Raven, R. P. J. M. (2016). Three is a crowd? Exploring the potential of crowdfunding for renewable energy in the Netherlands. *Journal of Cleaner Production*, *128*, 142–155.

van Doren, D., Driessen, P., Runhaar, H., and Giezen, M. (2018). Scaling-up low carbon urban initiatives: Towards a better understanding. *Urban Studies,* 55(1), 175-194.

Walker, G., and Devine-Wright, P. (2008). Community renewable energy: what should it mean? Energy Policy, 36(2), 497-500.

Walker, G. (2011). The role for 'community' in carbon governance. *Wiley Interdisciplinary Reviews: Climate Change*, *2*(5), 777–782.

Warbroek, B., Hoppe, T., Coenen, F., and Bressers, H., 2018. The Role of Intermediaries in Supporting Local Low-Carbon Energy Initiatives. *Sustainability*, 10, 2450.

Warren, C. R., and McFadyen, M. (2010). Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland. *Land Use Policy,* 27, 204–213.

Wierling, A., Schwanitz, V.J., Zeiss, J.P., Bout, C., Candelise, Ch., Gilcrease, W., and Sterling Gregg, J. (2018). Statistical evidence on the role of energy cooperatives for the energy transition in European countries. Sustainability, 10, 3339, 1-25.

Wolsink, M., (2006). Invalid theory impedes our understanding: a critique on the persistence of the language of NIMBY. *Transactions of the Institute of British Geographers,* 31, 85–91.

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Wüstenhagen, R., Wolsink, M., and Bürer, M.J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. *Energy Policy,* (35), 2683-2691.

Zhang, C., Wu, J., Long, C., and Cheng, M. (2017). Review of Existing Peer-to-Peer Energy Trading Projects, *Energy Procedia*, (105), 2563-2568.

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