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Diverse scaling strategies of energy communities: A comparative case study analysis of varied governance contexts

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ABSTRACT

Energy communities equip citizens with democratic control over their energy assets, help them capture value locally and create a green, just and decentralized energy system. Such energy communities have grown, replicated their experiences and have been institutionalized in diverse settings. In short, there are plenty of empirical examples of energy communities that have scaled. In this article we explore how varied governance contexts contribute to the scaling of community-based energy governance and in effect the actor constellations of diverse institutional settings. Through a comparative case study analysis based on semi-structured interviews and document analysis, we examined 3 distinct cases: Courant d'Air in Belgium, Coopernico in Portugal and Zuiderlicht in The Netherlands. Each case illustrates a different type of scaling journey and a varied governance context - suggesting that multiple pathways towards scaling exist. Our results show that the mixing of cooperative, state and market logics can potentially result in trade-offs between the democratic potential of energy communities and the efficiencies other logics offer to the energy transition. We argue that an institutional logics framework allows for a clearer understanding of the impact governance settings have on the scalability of energy communities as well as the composition of these countries' energy systems.

1. Introduction

The climate crisis has highlighted several governance challenges - amongst them the slow uptake of renewable energy sources in energy systems as well as the democratic deficit in controlling energy assets and the marketization of related institutions. Through growing processes of institutionalization in a European context, there is much hope attached to energy communities. Energy communities are actors, which decide over their energy assets through a one-actor-one-vote principle (Frieden et al., 2021; Cobut, 2021). Energy communities also highlight that the energy transition carries co-benefits to climate mitigation. These include clean air, more resilient energy systems and the democratization of energy production resulting in a more just energy transition (Gui and Macgill, 2018). Democratization can allow communities to capture value with-in their locality, decide on investments in line with their and the energy systems' needs, and ultimately result in a clean and decentralized grid.

The EU's institutionalization of energy communities is underlined by the success-story of multiple initiatives which have attracted members, expanded on their production capacity and have impacted policymaking to their own advantage. In short, there are plenty of examples of scaled energy communities. Here, there is a clear gap in the literature, which has presented a need for better understanding how varied governance contexts contribute to the scaling of such community-based models. The pluralism and heterogeneity characterizing energy communities themselves aptly hints to the lack of a one-size-fits-all approach. For this reason, nuance is needed in understanding the relations between governance contexts and the scaling journeys of individual initiatives. In this article we fill this gap by answering the following question: how do varied governance contexts impact the scaling of energy communities?

Varied governance contexts seem to imply the presence of a number of institutional logics. Every institutional logic has "a set of material practices and symbolic constructions, which constitutes its organizing principles" (Friedland and Alford, 1991, p. 248). Building on Thornton

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et al. (2012), Bauwens et al. (2022) fittingly outline that the growth and uptake of these initiatives means that energy communities, which operate based on a community logic eventually meet other types of logics - resulting in institutional complexity (Bauwens et al., 2022). We argue that past market logic, energy communities also face state logic in this process (Creamer et al., 2018), resulting in a complex institutional landscape. Such complexity may result in trade-offs between the democratic drive of energy communities and the efficiencies other types of logics bring to the transition.

Literature, which productively contributes to explaining these trade-offs analyzes the polycentric governance of climate and energy systems (Jordan et al., 2018; Petrovics et al., 2022). This literature addresses how multi-scalar cooperative logic has emerged in the context of climate mitigation efforts. As our article illuminates, this body of literature becomes relevant for examining the scaling of energy communities as it helps embed small and local-scale initiatives in their broader systems and helps assess how transitions and innovations there-in can purposefully be managed and guided to fruition.

There is plenty of literature on the emergence and functioning of energy communities (Gui and Macgill, 2018; Devine-Wright, 2019; Smith et al., 2016; Seyfang et al., 2014), while studies explicitly focusing on the phase of their upscaling (i.e. when energy communities grow and replicate their experiences) are minimal. Key studies include the aforementioned piece by Bauwens et al. (2022) on the institutional complexity cooperative initiatives face in their scaling journey, research done by Petrovics et al. (2024) on the scaling mechanisms of energy communities, on the conditions that are prerequisites to this scaling (Petrovics et al., 2022a, 2022b) as well as Ruggiero et al.'s contributions on the strategic niche management of the scaling of energy communities (2018).

In exploring the institutional complexity energy communities face in Europe, we examine the relationship between governance contexts and scaling journeys of three distinct cases of energy communities in Portugal, Belgium and the Netherlands through semi-structured interviews and document analysis. Each of the cases illustrates a different type of scaling journey as well as a varied governance context, which feeds into earlier work suggesting that multiple pathways towards scaling individual initiatives do indeed exist (Petrovics et al., 2024). We do so with the aim of expanding on how varied governance contexts and the implied dominant institutional logics impact the scalability of energy communities and in effect the composition of these countries' energy systems.

In the article we first explore key concepts, such as institutional complexity, polycentric governance thinking, deep incumbency in transitions and the scaling of energy communities. Next, we turn to our methodological approach detailing the comparative case study design of our research. This is followed by a detailed description of each of the governance contexts and the scaling journeys of each of the energy communities. Based on this we provide key arguments about the relationships between governance contexts and the institutional logics in relation to scaling. We lay the groundwork for a typology of scaling in relation to actors with three key types of energy communities emerging. Next to this we also provide reflections on dominant theories of scaling.

2. Theory - polycentricity, institutional logics and deep incumbency in scaling

The energy transition is much more than the introduction of renewable energy sources and the decentralization of energy production. Understanding the socio-institutional implications of this transition highlights the importance of how new activities, governance systems and institutions emerge and scale (Loorbach et al., 2017). The story becomes about struggles between new actors and incumbents, routines, and beliefs in a system (Loorbach, 2010; Loorbach et al., 2017). Past the deployment of renewable energy sources, energy communities hold the promise to further energy democracy, a movement, which "offers a set of visionary organizing principles that provide guidance for democratically restructuring the energy and electricity sectors through the processes of shifting from fossil-fuel-based systems to renewable energy systems" (Burke and Stephens, 2017, p. 35).

Towards such transformative effects, Bauwens et al. (2022) propose a framework outlining three main phases for the scaling of energy communities: community volunteerism, niche creation and niche expansion. In this article we explicitly focus on the third phase of niche expansion by examining how three energy communities scaled, and what the impact and effect of their institutional contexts was on this process. The niche expansion phase "takes place when the [energy community] expands to new geographic locations. […] progression through these phases is not prescriptively evolutionary or sequential, and some [energy communities] may arrest their development before reaching the niche expansion phase" Bauwens et al. (2022) p. 142).

The niche expansion of energy communities in the European energy systems is well under way (Petrovics et al., 2022a, 2022b). The EU's definitions of Renewable Energy Communities (RECs) and Citizen Energy Communities (CECs) underline this, with the key differences being that the former focuses on the uptake and (collective) self-consumption of renewables whilst the latter is focused on electricity sharing among participants (EC, 2023). In our understanding energy communities are "associations of actors engaged in energy system transformation through collective, participatory and engaging processes, seeking collective outcomes" (Blasch et al., 2021, p. 3).

The to-date local nature of energy communities (Devine-Wright, 2019) poses questions with regards to how they scale and what types of governance contexts are conducive to scaling. Indeed, recent research suggests that energy communities face multiple barriers in their scaling journeys (Vernay et al., 2023) and that by nature of their local focus they may not at all aim to scale (Mirzania et al., 2019). Nevertheless, successful initiatives do exist, their strategies to scale are multiple (Bauwens et al., 2022), and their scaling can purposefully be planned for and managed (Ruggiero et al., 2018). Results of such scaling include the growth of initiatives or an institutional effect to their advantage (van Doren et al., 2018). The leverage points that underpin successful scaling can also be conceived of as mechanisms (Petrovics et al., 2022a), which can produce observable effects towards a given outcome (Gerring, 2008). Questions remain nonetheless as to how different levels and domains can be connected in such a system.

As of 2005, Elinor Ostrom rekindled the concept of polycentric governance (Ostrom, 2005). She pinpointed the risk of the free-rider problem as climate policies were mostly developed at the international level. She argued for a polycentric approach, engaging various levels, which could increase trust, experimentation, networks, and monitoring at all levels (Ostrom, 2010). Scholars have further argued that polycentric governance could also be characterized by features such as mutual adjustment, self-organization and site-specific conditions (Dorsch and Flachsland, 2017; Jordan et al., 2018).

These conditions become relevant when examining connections between different levels, such as local and national as well as between different domains, for example the community or household and the private sector (Carlisle and Gruby, 2019). In examining the specific conditions at play Petrovics et al., 2024 find eight necessary conditions to scaling energy communities: 1.) formalized and professionalized organization, 2.) leadership roles within initiatives, 3.) initiatives interacting externally, 4.) initiatives learning from each other, 5.) bonding capital, 6.) bridging capital, 7.) openness to novelty, and 8.) continuity of support structures.

A key characteristic of these conditions produces what can be coined as institutional complexity (Bauwens et al., 2022). Institutional complexity refers to "incompatible prescriptions from multiple institutional logics" (Greenwood et al., 2011, p. 317). As mentioned, the underlying logics to institutions constitute organizing principles, which result in a variety of material practices (Friedland and Alford, 1991). Unpacking this complexity and the implied logics helps better

understand how energy communities nest in a polycentric governance system (Jordan et al., 2018; Petrovics et al., 2022). This in effect helps understand how in the process of scaling they face, articulate and manage community, corporate, state and market logics (Bauwens et al., 2022; Wokuri, 2021; Creamer et al., 2018).

Mignon and Rüdinger (2016), have also argued that institutional contexts could have an impact on the upscaling of energy communities, highlighting the role played by the market and the state. In addition, their study shows that other factors such as grid access and the role of incumbents may also play a role in the scaling of energy communities. A closer examination of the conditions that characterize well-functioning polycentric governance systems (Petrovics et al., 2022) provides a basis for analyzing the institutional complexity at play in upscaling energy communities. Indeed, looking at different national contexts that have produced successful (i.e. scaled) cases may shed light on well-functioning governance systems fulfilling both goals of clean energy and energy democracy. This can adhere to the calls to move past the descriptive qualities so typical of to-date polycentric climate governance literature (Jordan et al., 2018).

In examining these governance contexts, the role of incumbent actors also comes to the forefront. According to Stirling the term incumbency may refer to "the occupation of a position of authority" and it "increasingly also applies to more general concentration of influence, privilege and power" (2019, p. 1). Brisbois defines "deep incumbency" as a situation "where state interests become so enmeshed with those of incumbent firms that it becomes difficult to conceptualize a functional regime in the absence of those companies" (Brisbois, 2019, p. 151). The presence of deep incumbency may also explain lock-in mechanisms – obstacles, which present themselves to transformative change (Seto et al., 2016). Such mechanisms entail the ownership of infrastructures and technologies by incumbents, whose interests may be at stake during a shift from market and corporation logic towards energy democracy. Through advocacy and lobbying, incumbents have an interest in pressuring the political system to build institutions that will protect them. Consequently, a clear intention to lock society into a specific system appears (Seto et al., 2016).

Historically there has been little interaction between the few actors of energy systems, and little room for new actors, who could be a source of change. Typically, opening the energy sector to more democracy, actors and interactions is a potential solution, which may unlock this situation. In this sense, the decentralization of energy production can be welcomed as it has the potential to bring new actors, such as energy communities, and new logics such as community logic, into a historically centralized and closed world (Seto et al., 2016).

Bearing this in mind, it becomes more obvious that the upscaling of energy communities is not only conditioned on declared aims but also characterized by the community logic meeting state and market logics, eventually marked by more proximate forces and interests (Stirling, 2019). As Stirling puts it: "the simple point is, then, that even where these neglected alternative pathways are scientifically realistic, technically practicable, economically feasible and socially viable, dynamics of incumbency can prevent them from becoming historically realisable" (Stirling, 2019 p. 1).

All-in-all, by examining three distinct contexts and the empirical reality of successfully scaled cases of energy communities our article makes a number of theoretical contributions to the above literature. By answering the question "how do varied governance contexts impact the scaling of energy communities?" we have four aims. First, we aim to elucidate the situated nature of energy communities in varied settings contributing to literature on the scaling of community initiatives (Petrovics et al., 2022a, 2022b; Bauwens et al., 2022). Second, we cross-pollinate polycentric governance thinking with institutional logics literature (Jordan et al., 2018; Thornton et al., 2012). Third, we highlight the varied roles state logic can take on in scaling community initiatives contributing to literature on institutional logics (Friedland and Alford, 1991; Thornton et al., 2012), and finally we explicate the vested interests, the role of power, and ultimately the trade-offs faced by decision makers when confronted with varied institutional logics thereby also contributing to literature on deep incumbency (Brisbois, 2019; Stirling, 2019; Johnstone et al., 2017).

3. Methods and research context

This study employs a comparative case study analysis building on semi-structured key-informant interviews and document analysis of three energy communities (Courant d'Air, Coopernico and Zuiderlicht). We identified these information rich cases through a purposive sampling approach (Patton, 2014). These cases can be found in a European context and have scaled either by expanding their technical capacity,

Table 1
Sources of data.

Primary Data - Interviews

Energy Community	Type of Stakeholder	(Job) Title	Date	Interview #
Courant d'Air	Energy Community Representative	Energy Engineer	23/02/2021	Interview 1
Courant d'Air	Local Elected Representative	Energy Alderman	09/03/2021	Interview 2
Courant d'Air	Local Elected Representative	Municipal Representative	01/03/2021	Interview 3
Coopernico	Energy Community Representative	Advocacy Officer	14/09/2019	Interview 4
Coopernico	Energy Politics Expert	University Professor	15/09/2019	Interview 5
Coopernico	Energy Community Representative	Energy Engineer	08/06/2022	Interview 6
Zuiderlicht	Energy Community Representative	Founder	28/06/2020	Interview 7
Zuiderlicht	Energy Community Representative	Founder # 2	28/06/2020	Interview 8
Zuiderlicht	Energy Community Representative	Founder #2 follow-up	14/10/2022	Interview 9

Secondary Data

Subject (Jurisdiction / Energy Community)	Source	Type of data
EU	CEC Regulation	EU Directive
	REC Regulation	EU Directive
Belgium	Certificats verts Regulation (Tradable Green Certificates Regulation)	Regional Regulation
	Brasero Program	Regional Regulation
Courant d'Air	Courant d'Air website	Web source on Energy Community
	Online journal articles (L'Avenir)	Regional Newspaper
Portugal	EDP Website	Web source on Energy Community
Coopernico	Communities for Future	Web source on Energy Community
	Coopernico Website	Web source on Energy Community
Netherlands	Regional Energy Strategies	Provincial Policy
	SDE Scheme	National Policy
	SCE Ruling	National Policy
	Hier Opgewekt	Web source on Energy Communities
Zuiderlicht	APEC Charter	Charter of Umbrella Organization

growing their membership base, or by impacting their governance contexts to the betterment of the community energy field. With the dual aims of better understanding differences in governance contexts as well as exploring what commonalities may remain despite heterogenous scaling, we aimed to identify cases from widely differing jurisdictions. This approach allows us to compare successfully scaled energy communities across a variety of governance contexts. This in turn allows us to examine the cross-cutting reality of the conditions needed for energy communities to scale in a European context.

The three communities we examine are in line with the third phase of Bauwens et al. (2022). The cases are embedded in contexts ranging from ones characterized by no support mechanisms (such as Portugal) to ones characterized by a diverse suite of tools available to energy communities (such as Belgium or the Netherlands).

In exploring the scaling journeys of the selected cases, we conducted 9 semi-structured key informant interviews with individuals responsible for the day-to-day management of their energy communities and with different experts who have knowledge of the governance contexts of these initiatives. These individuals possess both detailed knowledge of the cases at hand as well as their governance contexts. The interviews each spanned 1–2 hours and focused on topics such as general enabling conditions, the internal functioning of initiatives, interactions between communities and perceptions of their contexts. This empirical material has been triangulated with document analysis of grey literature as well as the careful reading of relevant policy documentation. Table 1 summarizes the main sources of our analysis.

While analyzing our empirical material, we examined conditions, which are necessary to scaling. We aimed to identify key moments in the scaling journey of the studied cases, which can help better understand how and why energy communities embark on the process of niche expansion (Bauwens et al., 2022). Specifically, we categorized quotes from each of the interviews, which then we compiled into narrative scaling journeys for each case study energy community.

In analyzing our cases we mix deductive and inductive approaches by applying an abductive approach. Deductively we tested the necessary conditions identified by Petrovics et al. (2024), identified empirical examples of the various scaling outcomes in accordance with the framework of van Doren et al., (2018) and explored where varied institutional logics meet based on the work of Thornton et al. (2012) and Bauwens et al. (2022). These specific codes are outlined in the Table 2 below.

Inductively, we also explored further emergent conditions that potentially lie outside of the above frameworks, which can bring an in-depth understanding to the scaling journey of the examined cases and further enrich the said frameworks. Most notably, our findings related to deep incumbency and the types of networks present have been reached inductively by careful examination of our primary data.

As can be seen below, our approach allows us to explore the scaling journeys of energy communities in more detail and to bring a nuance to the overall understanding of conditions needed for scaling energy communities. To better ground these results, we also provide a brief overview of the energy governance in each of the countries alongside reflections on the mechanisms available to support energy communities.

Table 2
Codes used for deductive analysis.

Framework	Theme / Dimension	Code
Necessary scaling conditions of energy communities (Petrovics et al., 2024)	Conditions internal to functioning of community	Formalized organization
		Leadership-roles within initiatives
		Bonding capital
	Conditions related to the interactions of communities and their environment	Initiatives interact externally
		Initiatives learn from each other
		Bridging capital
	Conditions related to the contexts of communities	Openness to novelty
		Continuity of support structures
Scaling outcomes (van Doren et al., 2018)	Vertical Scaling	Institutionalization
	Horizontal Scaling	Expansion
		Replication
Institutional logics (Thornton et al., 2012; Bauwens et al., 2022)	Emergent	Community
	Dominant	Market
		Corporation
		State

3.1. Belgium

In Belgium, energy governance is split between the federal and regional levels. Regions have exclusive authority over renewable energy whilst the federal government is responsible for off-shore wind-turbines and nuclear energy. The deployment of renewables has hardly met the 2020 EU objective of 20 % and the energy system remains centralized around seven nuclear power plants.

Tradable Green Certificates (TGC) were put in place in all three regions between 2002 and 2004 to facilitate the deployment of renewable energy. Such TGCs assign power producers certificates per generated MWh of clean power, which is then sold by electricity retailers to end customers with the aim of accounting for renewable energy targets (Verbruggen and Laes, 2021). In Flanders and in Wallonia, TGCs have had two impacts on renewable energy producers. Firstly, they benefited large-scale renewable energy projects in Flanders (Verbruggen and Laes, 2021) with top-down developments put forward by existing large scale energy producers limiting participatory initiatives (Pepermans and Loots, 2013).

Secondly, the TGC system has opened the electricity market to new actors with independent wind project developers taking a small share in Flanders (Verbruggen and Laes, 2021). In Wallonia, the TGC have mostly benefited the upper middle class that installed solar PV, and, consequently, solar PV enterprises (Collard, 2013). However, Walloon energy communities suggest that TGCs have helped their projects financially. Accordingly, TGCs have helped to stabilize the cooperative project (Cobut, 2024). Furthermore, in Wallonia, there is a fund called “Brasero” that is accessible to energy communities since 2017. This matches each euro invested in a Walloon cooperative (RWDR, 2015).

The Belgian context of renewable energy cooperatives can be described as ambiguous. There is no support mechanism that directly targets cooperatives and TGCs have favored rather large-scale energy producers in Flanders and the solar PV sector in Wallonia. Meanwhile TGCs have still helped energy communities emerge and stabilize, arguably in all regions of the country. Ultimately, energy communities have emerged in all three regions with 17 in Wallonia, 21 in Flanders and one in Brussels.

3.2. Portugal

In Portugal, the second half of the 20th century was marked by significant investment in hydroelectricity, which was responsible for more than 90 % of the total energy production by the end of the 1960s (Madureira and Baptista, 2002). Despite this there is historic oil-dependency in several industrial sectors (Guerreiro et al., 2019). Guerreiro et al. explain that after the revolution of 1974 the “Portuguese electric system was nationalized. Existing private electricity producers – which included large energy producers and cooperatives – were all integrated in the newly formed energy company, Electricidade de Portugal (EDP), which became responsible for the production, transmission, distribution and retailing of electricity”.

It was not before the 1990s that other types of renewable energy sources (RES) were considered and supported by public action. Until 2001, the existing feed-in-tariff (a guaranteed above market price) was source neutral. Then, it was revised to better integrate environmental impacts and better include renewables (Peña et al., 2017). At the same

time, the ongoing liberalization process, which was to unbundle EDP, was slowed down. The Guterres government was "more cautious regarding the liberalization of the sector" and left EDP mostly under state control with a minority percentage of the company to be privatized (Guerreiro et al., 2019, p. 13). The following governments relaunched the liberalization and unbundling processes and revised the feed-in-tariff, to best follow EU market and climate objectives (Guerreiro et al., 2019). The following decade (2004–2014) shows an opening of the Portuguese and Spanish energy markets to one-another. This opening was accompanied by a strategic turn of EDP towards renewables, active in retail and production (Guerreiro et al., 2019). Portugal had developed incentives for mini-producers up to a capacity of 250 kW, which targeted consumers or SMEs rather than energy communities.

These incentives were canceled due to austerity measures in 2013 (Guerreiro et al., 2019). The feed-in-tariff was replaced by a premium feed-in-tariff regime, which tends to favor larger actors (Guerreiro et al., 2019). While support for smaller actors has disappeared, Peña et al. (2017, p. 197) argue that the 2013 premium feed-in-tariff regime was still rather generous with wind power producers, because it ensured remuneration for 20 years. According to Guerreiro et al. (2019, p. 18), the liberalization of the sector "gained new traction" with the economic crisis as EDP was privatized. EDP is now held by foreign investors, with the China Three Gorges Corporation being the main shareholder with 21,08 % and BlackRock with 9,37 % (EDP, 2022). In March 2018, Portugal was the first country to run 100 % on renewables for a complete month (Euractiv, 2018).

The Portuguese context for energy communities may be described as complex as they face liberalization and market dynamics while aiming to implement a cooperative logic. Indeed, while there is a tradition for renewables, the presence of only one incumbent (EDP) does not suggest an opening of the electricity markets to new and small actors. Portugal has also been marked by a dictatorship until 1974 and has seen a severe economic crisis between 2010 and 2012, which sent both the development of renewable energy policy and support mechanisms for emerging actors to the back of long-standing political agendas.

3.3. The Netherlands

The Dutch Climate Act has set Greenhouse Gas emissions reduction targets of 49 % by 2030 and 95 % by 2050 against a 1990 baseline (IEA, 2020). The IEA suggests that the country is not on track to achieve these targets (IEA, 2020). The majority (88 %) of the total primary energy supply of the country comes from gas, oil and coal (Ibid.). That being said, a number of mechanisms have been introduced to support the overall uptake of renewables.

(Regionale Energie Strategies [RES]) (RES, 2022). Many governmental functions have been devolved to the municipal level in the Netherlands, nonetheless energy governance reaches past municipal borders. This in effect has created 30 energy regions in the country, which aim to facilitate decarbonization closer to citizens with the involvement of multiple stakeholders. The main goal of these RES is to reduce GHG emissions by introducing 35 TWh onshore renewables and to outphase gas for heating in the Netherlands.

Regarding specific financing mechanisms, over the past two decades a varied suite of support schemes have been deployed to stimulate the sustainable energy transition (Stimulering van de Duurzaame Energie Transitie [SDE]). The first version of the SDE aimed to support the uptake of renewable energy by financing the difference between the average market price per kWh and the cost price of a comparable installation per kWh with a focus on biomass and wind energy projects. The SDE+, was put in place 2011 onwards to raise the financial efficiency of the subsidies to optimally support a diverse set of technologies (hydro, solar, geothermal, wind and biomass). Due to the focus on financial efficiency this support scheme preferred large-scale installations over the types that dominate energy community projects. From 2020 onwards, with the SDE++ the government further broadened the scope of support from renewable energy to any type of decarbonization project, which also includes carbon capture and storage and low-carbon hydrogen (IEA, 2020).

Next to the SDE suite, the Dutch government has also introduced specific mechanisms targeting energy communities. The Postcode Rose Ruling (Postcoderoos Regeling) offered a partial tax exemption for generated power in postcode areas of installations or those adjacent to them. This scheme ran from 2014 until 2021 and allowed members of cooperatives and owners' associations (VvEs) to access a tax discount on their energy bills. The spatial focus of this subsidy enabled the localization of renewables deployment albeit with certain difficulties in terms of lacking support for the creation of energy communities.

The Postcode Rose Ruling was followed up by a subsidy scheme directly targeting cooperative energy generation (Subsidieregeling Coöperatieve Energieopwekking [SCE]). The SCE is an operating subsidy targeting energy cooperatives and owners' associations. It accounts for fluctuations in per unit (KWh) price and by this offers long-term stability (15-years) for investments made by energy communities in various installations.

Despite the relatively late introduction of support schemes targeting energy communities, in 2021 there were 676 energy communities active with over 100,000 members present in 84 % of the municipalities in the Netherlands (Hieropgewekt, 2022). Three quarters of these communities work on all energy issues - both renewable-based production and energy efficiency - in their neighborhood or city. Most of the communities work with solar PV projects whilst the fastest growing type of renewable energy source is wind with a 35 % increase in production capacity since 2020 (Hieropgewekt, 2022).

The energy community field is at a relatively mature stage in The Netherlands, with know-how, capacity support and the necessary umbrella organizations that facilitate the whole field present at various scales from local to national. The government is growingly aware of the need for tailored support schemes for energy communities by involving multiple stakeholders at multiple scales from national through regional to the local - all with differentiated responsibilities.

4. Results

In the following we describe the scaling journey of three distinct cases: Courant d'air in Belgium, Coopernico in Portugal and Zuiderlicht in The Netherlands. The results are presented in three narrative descriptions and are based on an analysis of primary and secondary data.

4.1. The case of Belgium: courant d'Air

As of 2023, Courant d'Air is an energy community that has 3,300 members and produces 30,000 MWh of energy per year (Courant d'Air, 2023). The community emerged in Waimes in 2009. Its scaling is linked to multiple institutional logics: a wind-turbine park project managed by an SME based on market logic, Mobilae (Interview 1) had the same manager as the founder of the Courant d'Air community. As a member of Courant d'Air explained: "what created the idea was a technical and environmental challenge more than the challenge of citizen reappropriation. […] in the beginning, we wanted citizens to participate but we didn't even know the rescoop [energy community] model" (Interview 1, 2021). Between 2006 and 2009, they met other energy communities from Wallonia and Flanders (Vent d'Houyet and Ecopower), which helped them adopt a cooperative model (Interviews 1 & 3).

In the founding stages, a local association provided support to the new energy community. This association, called Patrimoine Nature, has been active on environmental matters since the 1990s. It was active against burying nuclear waste in the neighboring municipality of Amblève in 1997-98. Later, the organization organized debates on the energy transition, which concluded that a better inclusion of citizens in transition processes was needed (Interview 2). In the scaling process, this association was well perceived by the public of Waimes. An

interviewee clarified that Patrimoine Nature is not exactly amongst the founders of the energy community but eventually became a member and has a "special place" in the executive board (Interview 1).

Besides Mobilae and Patrimoine Nature, a third actor contributed to the scaling of the energy community: this third actor is an individual who has been advocating for environmental matters for 40 years and created a fertile soil for the scaling of Courant d'Air through mediating with existing incumbent actors at the local-scale (Interviews 1 & 3). The individual is an elected representative for more than 25 years, former president of Patrimoine Nature and a member of many local committees that protect the local environment. A member of the energy community further explained: "this person made [sure] that our initiative was not perceived as a revolution when we proposed it. It was supported". He also explained that given the positive image this person had locally, and in the eyes of local incumbents their support of the energy community was an asset (Interview 1). Moreover, the three interviewees all underlined that citizens, local authorities, but also SMEs, have been pushing for transition initiatives locally since the 1990s (Interviews 1, 2 & 3), underlining the presence of multiple institutional logics. A wind-turbine park was built near the village of Chivremont, which counts five turbines and is shared between Mobilae (40 %), Courant d'Air (40 %) and another energy community - Ecopower (20 %) (L'Avenir, 2011; L'Avenir, 2016).

In this case, the relationship the municipality had with the energy community led to mutual benefits. The energy community benefited from a municipality that has been open and supportive since 2005. Together they designed a compensation system that made it possible to waive taxes on the energy community's shares in the wind-turbines. An alderman of Waimes explained "I think it is always a little discouraging to tax citizen wind turbines. So, we started to discuss […] to find other missions for the municipality and start having a relation that went from "taxing authority and taxpayer" to a relation "Waimes and its projects and local actors who can support the municipality in its projects". He continued: "we started to look for alternatives to taxes. It was very difficult [from a legal point of view] because municipalities have to respect many rules, namely on the public market" (Interview 3). The alderman also explained that the municipality as a whole was not fully supportive of this approach. Tensions arose from members of the majority and from the administration who wondered why alternatives to taxing wind-turbines were needed when the red tape for taxing an energy community is minimal (Interview 3). These tensions underline the institutional complexity resulting from multiple logics (state, market and community in this case) present in pushes towards energy democracy.

Later in its scaling journey, the energy community delivered several missions to compensate for the absence of the municipal tax on their wind-turbines. The missions included the installation of PV panels on municipal buildings, education activities in local schools, replacing public buildings' and school's light bulbs with LED bulbs, installing a smart meter for the municipality's heating system and an analysis of data collected by this system. In the period between 2012 and 2021, the municipality only had one employee working in a part-time position on environmental, climate and energy matters. It was clear that the municipality lacked staff to take care of energy matters. The energy community brought its support to the municipality and helped in the design of the sustainable energy and climate action plan (SECAP) (Interviews 1 & 3). All in all, the energy community benefited from a compensation that was less costly than a tax and the municipality benefited from the know-how of the energy community members, who could share their knowledge of energy and electricity systems. This collaborative effort underlines that community initiatives can potentially contribute to the realization of state ambitions and responsibilities.

All in all, in Belgium, Courant d'Air has largely scaled due to the early connections it made both with other local energy communities, the local municipality, and a rooted local environmental association (Patrimoine Nature). These early connections were facilitated by the engagement of a local SME in the wind turbine project that led to the emergence of Courant d'Air. This stands as proof for successful local organization (Jordan et al., 2018) at early stages of the community as it made the first connections with other actors. This allowed the community to quickly adopt the cooperative model, which in effect allowed them to set up a small-scale operational community. Making connections with local decision makers and a local business allowed the community to gain legitimacy in the eyes of (local) incumbent actors as well.

4.2. The case of Portugal: coopernico

There is only one energy community in Portugal: Coopernico, which emerged in 2013. As one of its members explained, Coopernico started "with the aim of harnessing solar power for the benefit of local communities […] Coopernico rents roof-space for its PV panels from socially minded institutions, providing them with extra income" (Communities for Future, 2022). Coopernico started with sixteen people from different areas of Portugal representing different sectors such as academia, NGOs and the private sector (Communities for Future, 2022). Currently, Coopernico operates a national network departing from the local level (Coopernico, 2022a).

An important step in the scaling journey of Coopernico was when the community became an electricity supplier in 2019 (Interview 6). Formalizing this responsibility signifies that the community took on responsibilities traditionally sitting with incumbents. The electricity they produce is 100 % renewable, produced through small plants, and is financed by the cooperative itself, which ensures a local guarantee of origin (Interview 6). Taking the production and supplying activities together, the energy community has 1,772 members, investments of €1.8 million, 2 MW production capacity and 1,179 contracts as of 2022 (Communities for Future, 2022).

This step is substantial in the scaling journey of Coopernico, as the second half of the 20th century can be characterized by the (neo)liberalization of energy markets in Portugal where renewable energy assets have been mostly captured by large corporate players such as the China Three Gorges Corporation and Blackrock. Despite the clear corporate efficiencies driving technological transformations pending contextual conditions, the corporate logic entails value extraction at the cost of a democratic deficit. Coopernico as the sole energy community of Portugal remains a challenger of the status quo, although one that emerged, operates and scaled in a self-sufficient manner. In this sense the liberalization of the power markets in Portugal also allowed for the emergence of a substantial bottom-up initiative operating succinctly with-in a market logic framing.

In its scaling journey, the energy community built local groups that serve as the "voice of the cooperative at the community level and transport Coopernico closer to your concerns" (Coopernico, 2022b). As the community operates nationally, the idea of these groups is to work with members of the community directly. At the local level, members may organize activities, contact local institutions to discuss renewable energy production capacity and suggest the help of Coopernico. These local groups also take advantage of their members' expertise. Indeed, some members have energy expertise from working in energy-related SMEs (Interview 6). These SMEs can be subcontracted but with the stipulation that they become members of the community. This construction underlines how community logic can constructively engage market logic as well – in particular by embedding SMEs in initiatives. Through this they can work with professional service suppliers whilst ensuring a tight connection to the cooperative.

Next to this, the local groups are active in promoting several topics such as "electric vehicles or solar production" at the community level. The organization of events is described as "free from a strict structure", suggesting horizontality in the internal governance of Coopernico (Interview 6). The fact that this energy community operates at the national level is an obstacle for its recognition as an REC or CEC under EU law. Such communities must have a focus on the local level (Interview

4). Nevertheless, being a national player carried several advantages for their scaling. Firstly, the cooperative had the opportunity to work directly with various legislators and to lobby for institutional changes to varying degrees of success (Interview 6), suggesting vertical (institutional) upscaling. Much of these efforts were built on foreign examples, which served as illustrations of working archetypes. Moreover, the partnerships their model depends on could best be built by having higher-scale legitimacy in the eyes of established institutions. This in effect allows the work of local groups to manifest in a more efficient manner.

All in all, in Portugal, Coopernico has done everything itself in its scaling. The community never relied on subsidies or support schemes and managed to build a national-level community with multiple local initiatives operating relatively independently - all along ensuring financial viability and continued growth of the community. By neither having the opportunity to engage with incumbents nor the desire to do so we argue that this community challenges the status quo by experimenting (Jordan et al., 2018) with a new institutional logic (Bauwens et al., 2022) providing a viable alternative to its members without any substantial external support.

4.3. The case of The Netherlands: Zuiderlicht

Zuiderlicht is an energy community operating in Amsterdam. Their principal offer is to connect roof owners with the 'roofless' (e.g., renters) who wish to invest in solar panels. By doing so, the community negotiates long-term leases of roofs and administers the financing of the solar PV installations. In the past years they also began offering training sessions for individual project managers and explored community-funded windmills in the greater Amsterdam area as well.

The community was founded in 2015 by a small group of citizens in a neighborhood (Stadionbuurt) in Amsterdam. Following their first solar PV installation at the neighboring football club (ASV Arsenal) their approach to connect large roof owners with individual investors on a cooperative basis took off. Currently they have over 800 MW of solar PV installed across Amsterdam. Their General Assembly (GA) meets at least once a year, and their Board is responsible for the acquisition and implementation of projects. For major decisions the GA's agreement is needed, which functions on a one-member-one-vote basis.

Initially the cooperative approached projects on a learning-by-doing basis. This was soon replaced by borrowing knowledge and learning from successful cases such as Ecopower in Belgium, suggesting a form of horizontal upscaling (van Doren et al., 2018). Receiving knowledge support to build their cooperative model and by this kick-start projects in a financially viable manner were necessary conditions to the scalability of the cooperative (Interview 7). Past this, it was indicated that the Board gradually adopted a more risk averse attitude as the community grew (Interview 9). This was due to two reasons: on the one hand their initial model proved to work in attracting members and projects whilst on the other hand it also allowed the cooperative to generate a stable and reliable revenue stream.

Zuiderlicht not only received knowledge and know-how from other communities but became active in dissipating knowledge further, suggesting horizontal upscaling processes (van Doren et al., 2018). The cooperative regularly holds project management trainings where members (also of other communities) can learn the details of setting up a solar PV project on a vacant roof in the Dutch context. This program to-date has trained 20 people with 8–10 people actively building projects with-in the cooperative (Interview 9). This is a substantial increase from the initial core executive team of 3 people.

Next to this many of the activities became professionalized including the formalization of the initiative as a cooperative with the relevant authorities. According to the Community's experience (Interviews 8 and 9), having a legal form (as a cooperative) to organize administration, financial flows and to apply for (financial) support from public authorities was also necessary. These aspects underline that in the stage of niche expansion (Bauwens et al., 2022), as community initiatives face institutional complexity they require a capacity to interact with existing (at time incumbent) actors.

Such formalization has also enabled the Community to engage with wider initiatives, which enhance the standing of the community energy field at large. These include joining the APEC (Amsterdamse Producerende Energie Coöperaties), which is a unified organization representing Amsterdam-based energy communities. Their aim is to represent all communities as one and to work stronger with local incumbents, such as the municipality to engage further members, work together with house ownership associations (VvE's) and to share knowledge and experiences further via public authorities.

To a similar end, Zuiderlicht also engages with Energie Samen, the Dutch national umbrella organization of energy communities. This channel allows for the vertical translation of ideas, learning and efforts from the ground up. In effect this has allowed communities in the Netherlands as a whole to influence decision makers responsible for shaping national funding vehicles targeting energy communities. This signifies a vertical (institutional) process of upscaling (van Doren et al., 2018).

A further partnership, which was necessary for the scaling of Zuiderlicht was with the Dutch Transmission System Operator (TSO), Alliander and owner of Amsterdam Distribution System Operator (DSO), Liander. Alliander approached various energy communities with the aim of helping them overcome barriers. In the early days of the cooperative, the incumbent TSO contributed 1/3 of the salaries of the executive members of the community alongside regular coaching and project assistance. Next to this, initially the municipality invested in Zuiderlicht's projects through its Sustainability Fund with a 2/3 stake. This allowed for cheap capital to flow towards projects and allowed for a relatively high return for the investments of members (Interview 7). Next to this the community partnered with Greenchoice which is a licensed power supplier and purchases excess electricity generated from the community.

National support schemes were essential to many of the projects set up by the community. This is primarily true for the SDE+ (since 2020 replaced by SDE ++) and the Post Code Rose Ruling, which ultimately made many of the installations financially viable.

All in all, in its scaling journey, Zuiderlicht was quick to build on local connections and by this launch its first projects. Nevertheless, the community has been an outstanding example of engaging with larger incumbents, such as Alliander. This being said, this engagement may reflect the situated nature of socio-technical transitions in the Netherlands, namely that incumbents are open in this context to experimentation (Jordan et al., 2018). This results in mechanisms that productively engage communities such as is the case with direct financial support provided to executive members in the forms of partial salaries from Alliander.

5. Discussion

Each of these cases scaled in governance systems that can help draw inferences on institutional logics and resulting complexity. Each setting resembles a polycentric energy governance system to varying degrees. Nonetheless, qualitative differences exist both in terms of the dominant institutional logics, and actor constellations resulting in a heterogeneous set of systems (Ostrom, 2010) and pluralist arrangements with-in them (Aligica, 2013). This in effect has implications in terms of the necessary conditions to scaling outlined by Petrovics et al. (2024), scaling outcomes (van Doren et al., 2018) and actor constellations driving processes of scaling. To explicate this in more detail we make five key arguments in this section.

Firstly, varied governance systems result in potential trade-offs between the efficient greening and decentralization of energy systems on the one hand and the civic engagement and democratization of the ownership of renewable energy assets on the other. The

neoliberalization of the energy market in Portugal has brought efficiencies to the deployments of technologies, however at the cost of democratic participation in the energy transition. Coopernico in this sense operates with-in a market framing and delivers services based on community logic from a space of resistance.

In Bauwens et al.'s terms (2022), the community met this type of institutional complexity in its scaling journey and took advantage of it in framing its service offers at competitive prices, whilst offering further social and environmental benefits to its members. In our understanding in Portugal, the institutionalization of energy communities is limited, and the energy system prioritizes its main energy incumbent (i.e. EDP). The State has paved the way for a substantial liberalization of the market. This combination of market, state and (emerging) community institutions suggest a libertarian energy democracy.

In the Netherlands and Belgium in the meanwhile, renewables are the fastest growing energy source in the energy mix and overall transitions are far from out of sight. The opportunity of civic engagement and democratization through energy communities is not only supported through financial support mechanisms in these two countries but to varying degrees institutionalized as well. The standing of energy communities as well as their capacity and success to engage with incumbents and authorities (as can be seen in the case of Zuiderlicht and TSO Alliander or Courant d'Air and the municipality of Waimes) illustrates that these contexts are more apt for engaging citizens in energy democracy and allow for the system and incumbent actors to learn. This also shows that the continuity of support structures as set out by Petrovics et al. (2024) is necessary for the replication of experiences and the institutionalization of energy communities. In these contexts, the upscaling of energy communities is more mature, the combination of market, state and community institutions has a different balance. The state offers more support to energy communities and market liberalization remains more restrained (despite recent years' pushes for liberalization), suggesting more benevolent energy democracies.

Based on this it can also be concluded that market logic carries efficiencies towards decarbonization but does not guarantee the type of resilience and democratic legitimacy community logic does. Next to this, it is growingly clear that scaling micro-scale institutions that operate on the basis of community logic are growingly supported by mechanisms that are applicable with-in a market framing. This means that communities that look to scale will eventually have to adopt some practices that resemble market logic rather than community logic once again meeting institutional complexity (Bauwens et al., 2022). This means that the formalization of initiatives in a manner rendering them capable of entering markets albeit without the cooptation of their community-values is also a necessary condition to their scaling.

Furthermore, the deep incumbency of large power corporations (Brisbois, 2019) is exacerbated in the case of Portugal as liberalization resulting from an economic crisis has further enabled large market actors to consolidate their standing in the power sector. Here energy communities remain niche challengers of the status quo, something quite contradictory to the EU's ambitions.

Secondly, with regards to the scaling of energy communities these varied contexts shed light on differences in terms of types of actor networks and engagement with the energy system in relation to scaling journeys. This points to the qualitative differences of a polycentric governance system's capacity to mutually adjust and the overall framing of individual initiatives through overarching rules (Jordan et al., 2018). In plain language this means that different contexts have produced very different realities for the actors involved in scaling community initiatives, which is summarized in Table 3. Based on this we discuss the types of scaling processes present.

As mentioned, Coopernico stands out as a community that has done everything out of its own power, without reliance on financial incentives put forward by public authorities. Meanwhile, both Courant d'Air and Zuiderlicht have productively engaged with incumbents at various scales both enhancing their legitimacy as well as their operationality.

Table 3
Towards a typology of energy communities in relation to scaling.

	Coopernico	Courant d'Air	Zuiderlicht
Type of polycentricity in relation to energy communities	National energy governance without institutionalized community involvement	Regional energy governance dependent on willingness of local actors to engage energy communities	Regional energy governance with institutionalized support for energy communities
Type of network	Internally built	Externally engaged with local energy governance actors	Embedded in local and national energy governance
Type of actors engaged (past individual members)	SMEs as members and licensed service providers	Local SME, further energy communities and local municipality	Local municipality, national TSO and incumbents
Type of engagement with current energy system	Challenging of the status quo	Opportunistic engagement	Institutional embedding
Type of support mechanisms available to energy communities	None	Tradable Green Certificates	Multiple with specifically tailored support scheme also available (SCE)

In effect the type of interaction reflected by this engagement has cascaded into these communities benefitting from a whole suite of mechanisms, which support the emergence and operation of further communities - and indirectly also support their scaling. This type of community works closely with different types of stakeholders and in effect builds on the strengths of incumbents open to collaboration. This type of context allows initiatives to receive financial support through national-level subsidy schemes (such as the SCE in The Netherlands) and by this, members are guaranteed a financial return on their investment. This context however has also resulted in the financial flows of Dutch energy communities to resemble one another (Barnes et al., 2024). What underlies all three cases in this sense is the necessity for them to interact externally (Petrovics et al., 2024) - be that with potential new members (Coopernico), local actors (Courant d'Air), or incumbent actors (Zuiderlicht).

While Coopernico, in Portugal, has scaled up on its own, Courant d'Air, in Belgium, has benefited from its early and local connections with other energy communities, the municipality, a local SME and a local association. Zuiderlicht, in the Netherlands, has followed a similar trajectory as Courant d'Air but has also engaged with incumbents to support its upscaling process. This shows that if states do not support initiatives, niches may find support elsewhere but with varied results. Indeed, while Coopernico is a good example of a challenger of the status quo, it also underlines why at the time of writing Portugal only counts one energy community while Belgium has 39 and the Netherlands 676 (RESCOOP, 2023; Hieropgewekt, 2022).

Thirdly, with regards to the scalability of community initiatives in all three cases it became apparent that the networks they build and operate in are essential for them to grow and replicate their experiences – primarily in terms of dissipating and accessing information and learnings. This in effect is based on capacity to mutually adjust as can be seen from the above discussion and the trust various actors build with each other (Jordan et al., 2018). Based on the general presence of networks we argue that more nuance is needed for understanding what types are available to energy communities. We briefly differentiate here between three types: 1.) national umbrella organizations tying together individual initiatives, which primarily function as representative bodies and knowledge sharing networks at the national scale, 2.) local-scale platforms that help initiatives represent their interests at the local-scale with

a unified voice and 3.) internally built networks, which resemble these two above with the added benefit of being organized in-house by communities themselves. What is necessary for scaling here is bridging capital (i.e., the capacity to meaningfully engage outside of the initiative) and for initiatives to learn from each other (Petrovics et al., 2024).

National umbrella organizations are commonplace nowadays in jurisdictions with mature energy community fields (Magnusson and Palm, 2019). In the case of the Netherlands, Energie Samen and in the case of Belgium, the Rescoop Vlaanderen and Rescoop Wallonie networks serve as umbrella structures conjoining the interests of energy communities whilst acting as unified interest organizations capable of representing interests towards a variety of stakeholders. These organizations also monitor the overall standing and progress of the energy community field for example in The Netherlands through the annual Local Energy Monitor (Lokale Energie Monitor). These organizations also facilitate learning between initiatives.

Local-scale platforms, such as in the case of Courant d'Air in Belgium, fulfill several purposes towards scaling initiatives. They firstly legitimize the activities of initiatives at an early stage. Second, with other local stakeholders active in the energy, environmental or agricultural sectors, they participate in building platforms for all local actors involved in transition initiatives. Such platforms create wells in which all local transition initiatives exchange and steer each other's projects towards development and ultimately scaling. This is a remarkable example of local action fused with mutual adjustment (Jordan et al., 2018). By doing so, market incumbents propagating the status quo have a more difficult job in countering initiatives' development (Stirling, 2019). Next to this they can also lend capacity support to neighboring and emerging energy community projects.

Internally built networks as in the case of Coopernico may be the result of contexts that lack public support mechanisms and the presence of further initiatives. Considering learning via networks as well as capacity support are prerequisites of individual initiatives to take off (Petrovics et al., 2024), any community operating at scale will have to find the resources to obtain and integrate these elements in their work. The case of Coopernico is illustrative of internal organization as it is the sole community operating in Portugal but at the same time it operates with local chapters in multiple localities. Much of the infrastructure needed, such as those delivered by its solar PV installation members, has been self-organized.

Bauwens et al. (2022) have already underlined the importance of pre-existing social networks within the community at the first stage of upscaling (i.e. community volunteerism). They explain that communities "tend to rely on voluntary resources and, occasionally, on government subsidies" (Bauwens et al., 2022, p. 143). Each of the cases also underline that relying on broader networks is essential for energy communities to grow and replicate their experiences in later stages as well.

Fourth, the three cases also allow for us to better understand scaling outcomes in more detail, which in effect can be translated into the wider embedding of community initiatives not only exclusive to the field of energy. Our analysis supports van Doren et al.'s (2018) differentiation between horizontal and vertical upscaling and shows that it is not only geographical expansion that marks the niche expansion phase of Bauwens et al. (2022). Quantitative, spatial or in other words horizontal expansion is present in each of our cases as both their technical capacity as well as their membership has expanded over time. Next to this each of the cases (to varying degrees and at different levels) have a vertical, institutional impact be that by engaging with local incumbent actors and local authorities (Courant D'Air), national-level incumbent actors (Zuiderlicht) or directly challenging the status quo (Coopernico).

This being said, our cases reflect a new type of scaling outcome, which we characterize as diversification. In each of the cases we can see a diversification both in terms of technologies utilized as well as in terms of the product and service suite offered by communities. Indeed, each of the three communities started out working with a single technology (wind for Courant d'Air and solar PV for Coopernico and Zuiderlicht). This has given way to a whole suite of technologies utilized in each of the communities (solar PV for Courant d'Air and supporting electric vehicles for Coopernico).

Diversification can also be seen in the services offered by the communities. Each of them began solely with the purpose of producing energy at the local scale with cooperative ownership and governance principles in mind. Currently each of the cases has a wider suite of services ranging from assisting with energy efficiency measures, through training members and offering e-mobility solutions to raising awareness and dissipating information about the energy transition. Diversification in these two senses contributes both to the reach and legitimacy of these initiatives in the eyes of members, immediate communities, and incumbents on the one hand; whilst on the other hand it also builds the resilience of the initiatives. It also underlines the necessity of an openness to novelty in a given governance context (Petrovics et al., 2024). In this sense, diversification with-in communities may also indicate the good performance of a polycentric governance system.

We also argue that a late-stage development that indicates the at-scale operation of both an energy community and a supportive context is when an energy community becomes an energy retailer. Acquiring this function indicates three things: 1.) the community has capacity to produce and/or store energy at scale, 2.) an operational executive team and a stable member-base has ensured that financial sustainability is in place, and 3.) the context has allowed for cooperative entities to enter the energy retail market. As can be seen, the resulting institutional settings can be characterized as complex (Bauwens et al., 2022) heterogenous (Ostrom, 2010) and pluralistic (Aligica, 2013).

Finally, our results also demonstrate that in facing institutional complexity (Bauwens et al., 2022), energy communities also encounter the state logic in their scaling journeys; past market and corporate logics in the language of Thornton et al. (2012). This means that in certain jurisdictions, such as in The Netherlands and Belgium, cooperatives will both have the opportunity to benefit from state-led support schemes (for example tax breaks or subsidies) but at the same time their functioning will gradually become dependent on these schemes as well (Barnes et al., 2024).

As regards the limitations of our study the following can be said. Our analysis builds on a limited number of cases, which should not be treated as representative of their regional or national contexts. Rather these cases should be seen as illustrations of scaling journeys, demonstrating the heterogeneity of scaling processes. Next to this, the primary data is based on 9 interviews, which could be considered as a relatively low number in qualitative research. To accommodate this, we also analyzed grey literature and regulatory documents to further enhance our findings. Future research could explore different contexts – for example Central and Eastern European countries with minimal uptake of energy communities or countries in the Global South. There is merit in examining further scaled cases and by this enhance our findings.

6. Conclusion

This study has revealed key features of the scaling journeys of three energy communities. This in turn helps us understand scaling in relation to varied governance contexts. Our analysis has resulted in five key arguments. It appears that energy democracy can take different forms from one country to another. In this sense, varied governance contexts result in different facilitators of upscaling processes: a) energy communities can challenge the status quo, b) municipalities, SMEs and local associations can support local networks, and c) incumbents and state actors can also provide national-level support.

Our results also show that networks play an important role in the last stage of upscaling, that is niche expansion. The concept of networks is central both in polycentric governance and in transitions research. Furthermore, we observe three different types of networks, which are dependent on the governance context of the case studies: (inter)national

umbrella organizations, local-scale platforms, and internally built networks. Moreover, our initial operationalization of scaling included three aspects: growth in membership, growth in technical capacity, and replication of experiences. Our empirical material supports a fourth aspect namely the diversification of offered services.

Perhaps most importantly, our study also shows that states can play an active role in shaping institutional environments in favor of the scaling of energy communities. As our results indicate, the intention of the EU to create a level playing field for energy communities has difficulty in being realized. Indeed, our results show that energy communities rely on support to varying degrees in different governance contexts across these three EU Member States. In the words of Marianna Mazzucato what is needed from state involvement "will require not levelling but tilting the playing field" (Mazzucato, 2018, p. 226) in favor of societally desired (governance) innovation, such as energy communities.

Altogether, we can see that the way state actors manage (the upscaling of) niches varies greatly. Ultimately, our study shows that polycentric governance (Jordan et al., 2018) manifests itself in all three countries to varying degrees and qualities. Meanwhile, transitions research (Loorbach, 2010, 2017) underlines that transitions are the result of complex and coevolutionary processes. With this in mind, what we witness through examining the scaling of energy communities is a diverse polycentrisation of governance, rather than a polycentric governance system with all its features present.

A polycentrisation of governance shows that actors of energy governance are increasingly embedded in institutional diversity, recognizing local experimentation, building trust among stakeholders at multiple levels through different types of networks, learning from and/or with energy incumbents and possibly benefiting from overarching rules. Thinking of polycentric governance as a transition process helps to underline the diversity of pathways as much as the coevolutionary nature of transition governance.

Conflicts of interest/Competing interests

The authors report no conflict of interest.

Availability of data and material (data transparency)

Available upon request.

Code availability (software application or custom code)

Not applicable.

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CRediT authorship contribution statement

Daniel Petrovics: Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Loïc Cobut:** Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Dave Huitema:** Conceptualization, Supervision, Writing – review & editing. **Mendel Giezen:** Conceptualization, Supervision, Writing – review & editing. **Amandine Orsini:** Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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