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# Integrating energy strategies and urban planning: overcoming challenges for collective energy initiatives

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## ABSTRACT

The study advocates for a qualitative research design to address knowledge gaps regarding Collective Energy Initiatives (CEIs), utilising evidence-based research and a maximum variation principle. Focused on EU countries, the study employs desk research and surveys to identify stages of CEI development and explore impactful practices. It examines initiatives aligned with EU Directives and broader energy transition efforts, categorising them by complexity. Through surveys, the study identifies drivers and barriers to coalition phenomena, aiming to enhance understanding of energy policies' impact. This approach responds to the need for comprehensive investigations into energy initiatives' impediments and facilitators, aligning with recent calls for research in this area.

## HIGHLIGHTS

- Investigating the pivotal barriers and facilitators of energy initiatives is essential for effective urban and energy planning.
- The primary barriers faced by CEIs stem from challenges in policy formulation, legislative frameworks, and regulatory landscapes, resonating with broader concerns regarding environmental justice, sustainable resource management, and equitable participation.
- Collective Energy Coalitions (CECs) coordinate activities, advocate for shared interests, and leverage resources to address the demand for renewable energy within urban environments through structured collaboration and cooperation.

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## KEYWORDS

Energy coalition; city energy transition; engaging society; renewable energy community; sustainable development

## 1. Introduction

Despite covering a mere 2–3% of the Earth's land surface (UN - Habitat 2011; Liu et al. 2014) cities are responsible for a substantial 67–76% of global energy use (Lwasa et al. 2022).

The 21st century witnesses a discernible shift towards reinforcing decentralised energy producers, primarily catalysed by the integration of renewable energy resources. In the pursuit of energy and climate goals for resilient and environmentally responsible communities,

human everyday actions play a pivotal role in shaping the urban environment.

In this evolving energy landscape, locally-led and collectively owned energy projects, highlighted by Renata et al. (2022), have emerged as potent catalysts for societal and energy transformation (Hewitt et al. 2019). These initiatives foster collaborations, mobilise resources, develop context-specific technological mixes and governance structures, and influence public consensus (Hoicka and MacArthur 2018a; Berka Anna and Creamer 2018).

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Academic literature has seen a surge in interest in such initiatives over the past two decades, leading to the emergence of various terms without a consensus on their definition (Seyfang et al. 2013; Creamer et al. 2018). Examples include local energy initiatives (LEI) (Soares da Silva and Horlings 2020; Germes et al. 2021; Hasanov and Zuidema 2022), grassroots energy initiatives (GIs) (Blanchet 2015), community energy initiatives (Walker and Devine-Wright 2008; Seyfang et al. 2013; Renata et al. 2022), and local energy communities (LEC) (Otamendi-Irizar et al. 2022).

In Europe, autonomous entities are aligning around common interests, with local energy transition being a pivotal aspect (Schwanitz et al. 2023). These collaborations, pertinent to local and regional contexts, are diverse in terms of internal structures, objectives, geographical scales of operation, participating agents, promoted energy systems, and operational modes. Importantly, they are seldom regulated by national or regional legislation.

Widely assumed among academia and policy-makers, collective initiatives are believed to have diverse impacts in advancing local energy transition (Berka Anna and Creamer 2018; IRENA 2018; Caramizaru and Uihlein 2020; Van der Waal and van der Waal 2020; Roberto et al. 2023). Beyond generating renewable energy, these impacts span social, environmental, and economic dimensions, including enhanced social cohesion, job opportunities, knowledge acquisition, and skills development (Bere et al. 2015; Berka Anna and Creamer 2018; Van der Waal and van der Waal 2020; Bielig et al. 2022).

A decade of studies reveals a glaring lack of empirical evidence on the impacts of such initiatives, urging further research for formalised impact assessments, systemic frameworks, longitudinal studies, and statistical analyses (Walker et al. 2007; UK department of energy and climate change, 2013; Bere et al. 2015; Berka Anna and Creamer 2018; Hoicka and MacArthur 2018b; Van der Waal and van der Waal 2020; Ryan et al. 2021; Germes et al. 2021; Bielig et al. 2022; Backe et al. 2022; Schwanitz et al. 2023). Certain studies suggest methodologies, such as Germes et al. (2021), who recommend considering the motives, objectives, and ambitions of initiatives in impact assessments.

There is also a growing focus on the spatial aspect of energy initiatives, as highlighted by De Pascali and Bagaini (2019) who characterise them as 'socio-spatial projects' and underscore their potential significance.

In response to the increasing demand for comprehensive examinations of the significant challenges and facilitators faced by energy initiatives, as well as their outcomes in various settings (Hoicka and MacArthur 2018a; Schwanitz et al. 2023) numerous analyses have emerged in various contexts that refer to energy coalitions. Some studies have categorised them based on their spatial scope (local, regional, and national) (Hicks and Ison 2018; Moroni et al. 2019), while others have focused on their decision-making processes and internal hierarchies (De Jong 2016; Hicks and Ison 2018; Ryan et al. 2021), as well as the policy and legislative environments in which they operate (Hall et al. 2016; Mah 2019; Hess and Lee 2020; Judson et al. 2020).

The evolving debate on energy initiatives (Di Somma et al. 2020; Dobravec et al. 2021; Hasanov and Zuidema 2022; Caliano et al. 2023) emphasises the importance of local collective actions in realising energy transition goals (Verkade and Höffken 2019; Soares da Silva and Horlings 2020). Additionally, the Covenant of Mayors initiative (link: <https://eu-mayors.ec.europa.eu/en/home>), initiated by the European Commission, encourages local authorities voluntarily committed to achieving a minimum 40% reduction in greenhouse gas emissions by 2030 (Rivas et al. 2022). Nevertheless, to foster inventive initiatives, successful projects, and increased awareness of energy-related issues, active participation from both the public and private sectors is essential to link community development with energy transition (Schenone and Delponte 2021).

Recognising the various stages of development of energy initiatives is crucial not only for addressing global challenges swiftly but also for understanding how urban energy systems and forms are being modified. A clearer comprehension of these impacts can inform policymakers, support energy strategy development, engage communities, and enhance community capacity and resilience in the decentralised and collective energy production debate.

Despite these assumptions, this paper defines Collective Energy Initiatives (CEIs) as encompassing all collective initiatives by prosumers, highlighting their significance as a valuable tool for engaging society and driving local energy transitions.

The paper first seeks to address a primary research question: what are the features of the CEI? Subsequently, it also aims to explore additional research questions: what are the factors driving and

impending CEI implementation? What are their impacts?

The researchers concentrated their efforts on CEIs also investigating if they could be considered as coalitions – inter-organisational collaborations in renewable energy – beneficial for advancing energy transition. Lindberg and Kammermann's study highlights that rather than simply observing the growth or decline of coalitions, the ongoing process involves the formation of new coalitions and alliances (Byskov Lindberg and Kammermann 2021). This evolving trend emphasises the significant influence of different actors in either speeding up or slowing down energy transition, depending on their preferences in energy policy.

The researchers within this paper acknowledged additional formal and informal organised structures comprising diverse actors (not primarily public) that have reached a mature stage of development. Termed Collective Energy Coalitions (CECs), they play a crucial role in meeting green energy needs within urban environments. This study also aims to improve understanding of CECs, which are seen as a more advanced phase of CEIs development. These structures pursue shared objectives, including addressing energy concerns, and demonstrate the capacity to mobilise resources effectively.

The paper is organised as following: the methodological approach presentation (desk research, survey structure, criteria to identify CECs) (section 2); the research results on CEIs (and CECs) investigation including recurrent territorial dimension and legal forms, drivers and barriers encountered during their implementation, CEIs impacts with an emphasis on CECs (section 3); the discussion focusing on both internal/external challenges and opportunities explained by country and according to geographical distribution (section 4) and finally the conclusions that highlights key dynamics and recurring challenges that can inform the enhancement of local energy policies for sustainable development (section 5).

## 2. Methodology

Hence, researchers have advocated for the adoption of a qualitative research design (Hennink et al. 2020) to bridge the knowledge gap. This approach involves implementing evidence-based research on CEIs, grounded in the principle of maximum variation. The study is focused on several EU countries through

a desk study. The data gathered played a pivotal role in identifying the distinct stages of development of the phenomena. Within this framework, a survey was conducted to explore initiatives further, aiming to identify the most advanced and attain a deeper comprehension of the most noteworthy and impactful innovative practices.

Starting from UE definition of Renewable Energy Communities and Citizens Energy Community (Directive 2018/2001 on the promotion of the use of energy from renewable sources (RED II), Directive 2019/944 on common rules for the internal market for electricity and amending Directive 2012/27/EU), the desk research explores both initiatives aligning with EU Directives and those pertaining to energy transition more broadly. These initiatives manifest in various forms, such as collaboration among industrial players in energy transition or stakeholders uniting for research or education on energy transition issues (Rutherford and Coutard 2014). Beginning with the literature review done by Frigione on CEIs (Frigione 2024) the desk research delves into different CEIs. These diverse initiatives were then grouped according to their complexity, indicative of their development stage: starting/early and consolidated/mature.

Through a survey, a deeper understanding of the drivers and barriers encountered in coalition phenomena was gained. This implies identifying and exploring structured collaborations that boost energy policies (Figure 1).

Given the recent calls for comprehensive investigations into the impediments and facilitators of energy initiatives, coupled with their impacts and benefits in varied contexts (Hoicka and MacArthur 2018a; Schwanitz et al. 2023), the methodological approach seeks to enhance understanding of the drivers, barriers, and potential impacts associated with these initiatives.

### 2.1. Desk research

The desk research investigates existing initiatives in Denmark, Estonia, Italy, Greece, Netherlands, Slovenia, Spain, Switzerland following the maximum variation criteria (Palinkas et al. 2015) CEIs were categorised by territorial dimension (district/urban/regional level), energy dimension (renewable energy generation/distribution/supply, energy storage, energy efficiency,



Figure 1. methodological approach.

demand reduction, charging services, energy education/research, etc.), and type of collaboration (structured/not structured).

Moreover, the territorial dimension also considers initiatives at the national level as those capable of operating nationally while maintaining connections to various districts, cities, or regions across the country. The regional level encompasses initiatives that collaborate with groupings of towns or cities linked on a provincial or interprovincial scale or encompassing a rural area of significant size comprising multiple localities. At the urban level are initiatives engaged in municipalities with populations of at least 10,000 inhabitants. District-level initiatives operate within components of urban settings, comprising collections of neighbourhoods with populations likely exceeding 10,000 inhabitants. Individual small neighbourhoods fail to meet this criterion due to their insufficient size.

## 2.2. Survey structure

The survey was carried out by experts, including researchers and consultants, chosen from members of the Institutionalized Integrated Sustainable Energy and Climate Action Plans (2ISECAP). This research project, funded under the European

Union's Horizon 2020 research and innovation programme, places a significant emphasis on studying, enhancing understanding, and pinpointing critical factors related to effectively mobilising citizens and stakeholders to participate as partners in local plan and policy development and implementation, including the establishment of energy coalitions (Tasopoulou et al. 2022).

Following the collection of fundamental details such as names, contacts, and a brief overview of the initiative, the survey proceeds to gather information concerning various aspects. These include internal operations, such as collaboration among coalition members, legal status, governance structure, and day-to-day functions. Additionally, it delves into the broader context within which these initiatives operate, encompassing social, cultural, historical, geographical, environmental, economic, and financial factors (REScoop 20-20-20 project 2020). Furthermore, the survey explores the drivers and barriers encountered at different levels (local, regional, and national) such as legislative frameworks, regulations, policies, and relationships with stakeholders. It also tracks the evolution of initiatives over time, from their inception through startup, scaling up, and maturation phases. Finally, it assesses the impacts of these initiatives on the local energy transition.

### 2.3. Criteria to identify CECs

Given that CECs are a subgroup of CEIs, the latter share the same attributes as CEIs concerning the spatial dimension of their operations, the activities related to energy transition in which initiatives are involved, different actors, the ease with which new parties can join the initiative, their legal status. However, they diverge from CEIs in terms of their stage of development and their reliance on public actors.

### 3. Results

A total of 54 CEIs underwent desk research. The most common mission among the CEIs is education and lobbying for energy transition, with only 10 explicitly focused on renewable energy production. Regarding their territorial dimension, 26 were

formulated at the regional level, 17 at the national level, with only 6 associated with the district level, and the remaining 5 at the local level. Among the investigated CEIs, 37 had a legal form, with the most common being cooperative. Five were in a starting phase and had not yet chosen a legal form, while 12 were structured as informal networks (without a legal form).

Out of the 54 CEIs, 14 initiatives were identified as significant for further investigation to understand drivers, barriers, and impacts. This selection (see [Table 1](#)) offers an initial exploration into the predominant patterns and classifications associated with CEIs and their potential transition into CECs during the energy transition journey. Among this selected CEIs 6 are in a starting/early stage reliant on public sector support while 8 are in a consolidate/mature stage of development and they fully respond to our definition of CECs.

**Table 1.** Selected CEIs after desk research using a maximum variation approach – (CECs in blu).

CEI NAME	SHORT DESCRIPTION
Solar Cooperative Region Biel	A solar cooperative still in its infancy, but growing very fast. Currently working to increase its members and collecting proposals of roof areas on which the cooperative could build plants. Providing a ready to use 'contract-offer' where initial capital investment and works are covered by the coop. A first project is about to be realised.
Self-Consumption Cooperation (ZEV) Erlenmatt Ost (Basel)	The Site 'Erlenmatt Ost' was developed by the foundation 'Stiftung Habitat' with highest sustainability standards. This also included the supply of the 600 inhabitants with self-produced electricity from PV, supplied by the energy cooperative ADEV.
Termonet Denmark	Association with many members across Denmark facilitating and supporting the installation of District heating networks with heat pumps, to be delivered by citizens energy communities (cooperatives) in collaboration with DH companies/suppliers.
EC Avedøre	Energy community active in Copenhagen region. Subjects include Municipality, Private company, District Heating company, citizens organisations, a business centre.
Tartu Housing Association	Housing association in Tartu, providing advice and education to members in the field of building renovation and energy efficiency.
Econactiva	Energy cooperative buying and selling electricity (100% from RE) to their members, investing in RE plants, providing services to members and energy communities, engaged also in education.
Energetica	Energy cooperative buying and selling electricity (100% from RE) to their members, investing in RE plants, providing services to members and energy communities, engaged also in education.
EC Karditsa	A profit citizen energy cooperative, established in 2010 to foster renewable energy in the region. In 2019, the Energy Cooperative was converted into an Energy Community. Focusing on biomass it includes more than 400 members including municipalities, SMEs, associations etc.
EC Minoan Energy	Energy Community in Crete. Structured as a Cooperative of social and solidarity economy, has 230 members including public bodies, private companies, cooperatives, SMEs, households and citizens.
Ènostra	Energy cooperative buying and selling electricity (100% from RE) to their members, investing in RE plants, providing services to members and energy communities, engaged also in education.
Padova FIT Expanded	A consortium of PAs, private and research organisations, aiming to provide a one stop shop for energy efficiency in the residential sector. Early stage.
New Energy Coalition	Network and knowledge organisation. The foundation acts as a catalyst and coordinator to stimulate public-private cooperation, application and sharing of knowledge and innovation.
The Participation Coalition	A coalition representing the interest of local initiatives in the Dutch climate agreement at national level. Facilitates formalisation of cooperation between municipalities and local initiatives, particularly related to heat transition.
Pomurje Regional Living Lab	Regional Living Lab, including private and public members, born with the purpose to generate ideas and connect parties on energy transition related issues, from which specific projects can be developed.



### 3.1. Legal form

The legal structure of the selected CEIs has been categorised into two main groups: the first comprises energy cooperatives, while the second encompasses other legal forms (such as foundations, associations) or more informal coalitions. Analysis of the legal forms reveals that 8 out of 14 CEIs are organised as cooperatives. Two CEIs take the form of foundations (*Swiss Self-Consumption Cooperation (ZEV) Erlenmatt Ost* and *Dutch New Energy Coalition*), and one is an association (*Estonian Tartu Housing Association*). Additionally, 3 CEIs lack a formal legal structure: *Pomurije* operates as a Living Lab, *Padova Fit Expanded* is structured as a Public-Private Partnership (PPP), and The Participation Coalition supports a Government Programme.

### 3.2. Barriers and drivers

Based on the survey results on the selected CEIs, barriers and drivers were broken down into categories. Identification and categorisation of barriers and drivers involves recognising and classifying factors that hinder or promote initiatives. It requires a comprehensive analysis of the various elements that contribute to or impede progress. This approach helps in better understanding the complex dynamics at play and formulating effective strategies to overcome challenges or leverage opportunities. Barriers can encompass obstacles, challenges, or limitations that hinder progress or success. On the other hand, drivers are factors that propel or facilitate progress, growth, or achievement of objectives.

These barriers and drivers include legislations/regulations; public policies; enforcement; incentives to RES or on energy efficiency; political and institutional context and relationships; technology infrastructures and supply chain/technical complexity of the whole process; lack of data and information; awareness related to RES and energy cooperatives; economic/financial issues; energy market & distribution; factors related to the coalition itself; public funding (grants); social issues; supporting actors/networks.

The same widely recognised categories can be interpreted as either drivers or barriers (Figure 2), contingent upon the specific local context in which the CEI operates. This duality is evident in categories such as awareness related to RES and energy cooperatives, legislation/regulation, political institutional context and relationship, technology infrastructures and supply

chain/technical complexity of the whole process, factors related to the coalition itself and enforcement.

From an institutional standpoint, the primary drivers include the presence of public policies, incentives, and grants, as well as factors related to the energy market and distribution. Meanwhile, from the private sector perspective, supporting actors/networks and social issues can be deemed the most crucial drivers.

Therefore, the identification and categorisation of barriers and drivers aids in making informed decisions, devising effective strategies, and creating targeted interventions to achieve desired outcomes (Thollander et al. 2010).

### 3.3. Impacts

It's crucial to note that CEIs with varying functions can arise interest and engagement from local governments. For instance, Danish regions and municipalities utilised technologies promoted by the Danish association *Termonet DK* (that is in an early stage of development) which supports the installation of District Heating Networks with heat pump projects in areas beyond district heating infrastructure, such as clusters of houses/industries in villages or city districts. This impact seems closely intertwined with the broader objective of advancing the diffusion of RESs.

Another example of CEI at a starting stage is *Pomurije Living Lab* in Slovenia, functioning as a Regional Living Lab that successfully brought together local authorities for regional energy planning. It supported them in creating the 'Integrated Sustainable Energy Plan – Action plan of Pomurje region,' which forms the basis for local Sustainable Energy Action Plans (SEAPs/SECAPs) and Energy Concepts. In Slovenia, energy planning is typically managed at the municipal level through SEAPs/SECAPs and Energy Concepts. However, due to the small size and interdependence of municipalities, they struggle to execute successful regional projects. The *Pomurije Living Lab* facilitated networking among these authorities to overcome this challenge.

### 3.4. Focusing on CECs

The possible effects of CECs on the local energy transition (Figure 3) include fostering networking

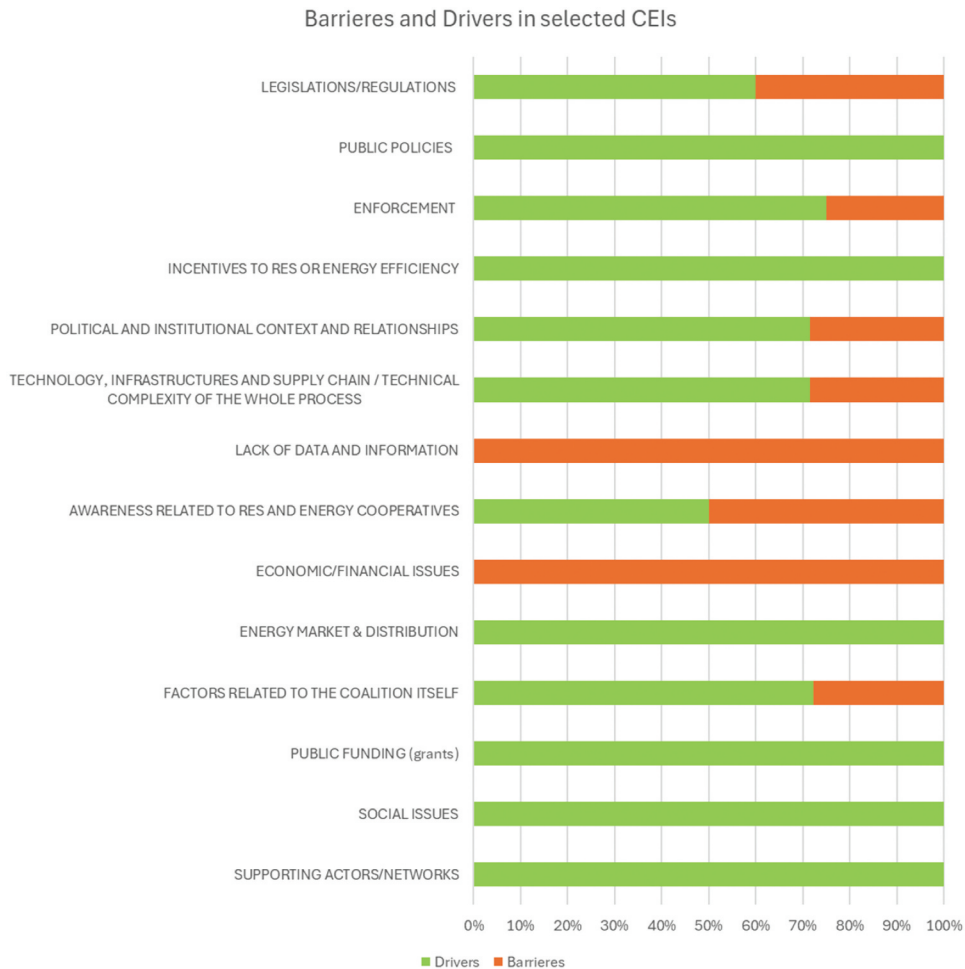


Figure 2. barriers and drivers in selected CEIs.

collaboration for local energy transition initiatives, spreading awareness about RECs, increasing REs diffusion, boosting citizen engagement and awareness about CEIs, cultivating community interest in sustainable energy solutions and technologies offered by CEIs, expanding access to information about CEIs, supporting projects that combine energy efficiency measures with the implementation of REs and providing incentives for RE producers.

The foremost impact is determined by enhancing citizen awareness and participation on CEIs together with promotion of RES and it is strongly supported by CECs that have a formal legal structure, mainly cooperatives. Anyway the variety of legal forms adopted by CECs aligns with local energy transition needs.

#### 4. Discussion

Analysing barriers and drivers across the geographical distribution of CEIs on a cross-national scale offers valuable insights into both commonalities and distinctions within Europe. Therefore, the survey's analytic framework, compiled from data from 14 CEIs, was used to examine both the barriers and drivers, and their prevalence within the countries being studied. This approach enables a comprehensive understanding of patterns and trends that transcend national boundaries. By identifying shared challenges and opportunities, as well as regional nuances, this cross-national analysis aids in formulating strategies and interventions that can address the diverse needs of CEIs across



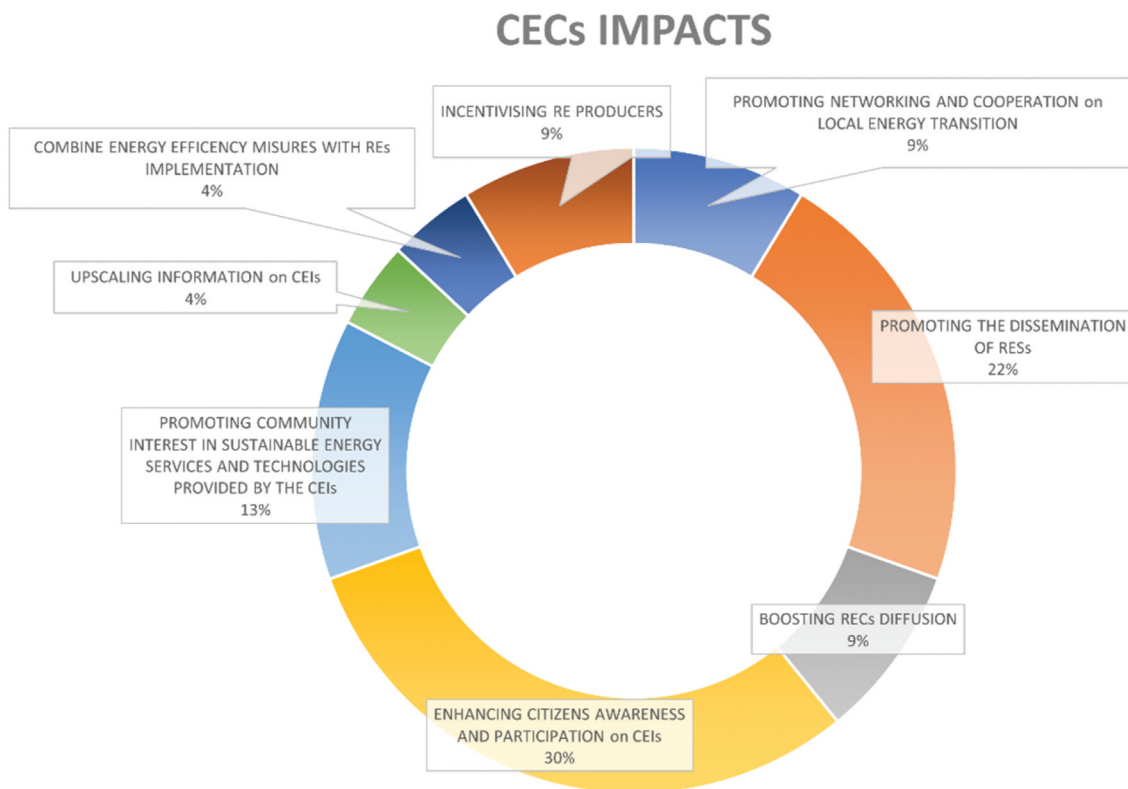


Figure 3. impacts of CECs on local energy transition.

various countries. Among the 8 countries examined (Denmark, Estonia, Italy, Greece, Netherlands, Slovenia, Spain, Switzerland), a majority (6 out of 8) have identified barriers within the legislation/regulation category. Interestingly, it appears that Mediterranean countries (Italy, Greece, Slovenia, Spain) (EEA 2014) face more significant challenges in this regard. These barriers predominantly pertain to policy formulation, prompting a more detailed exploration of this issue. Notably, several surveys have indicated a lack of support or limited backing from national/regional policies and regulations for Energy Communities (ECs) in certain countries (such as Slovenia and Estonia), or for the integration of specific Renewable Energy Systems (RES) (as observed in Switzerland, Slovenia, and Greece). In contrast, fewer barriers appear to be linked to policy execution.

A common issue across these countries is the sluggishness of approval processes and the excessive bureaucratic hurdles associated with the installation

of RES. These challenges have the potential to impede the local energy transition, highlighting the need for streamlined procedures and reduced red tape to facilitate progress at the community level.

EU, national, and regional targets and incentives for energy efficiency and the installation of RES, as well as the early adoption of ECs in national legislation, are considered key drivers not only for the creation of CEIs but also for the upscaling them. It is a noteworthy fact that 3 out of 4 Mediterranean countries experienced barriers related to the coalition itself such as funding models (Netherlands), competition among members (Netherlands and Italy) and lack of skills, capacity and resources (Spain, Denmark and Estonia).

Surveys from Spain and the Netherlands underscore that the employment of a participatory governance model involving energy end-users or coalition members significantly propels CEIs growth.

In 5 out of 8 countries, obstacles arise from technology, infrastructures, and supply chain complexities. For

example, Switzerland faces issues with delayed material deliveries and a lack of skilled labour for power plant assembly, while Spain deals with technical challenges in commercialisation and self-consumption processes. Rapid technological progress also presents hurdles, as seen in Estonia and Slovenia.

While only 3 countries identify the barrier of energy market and distribution, its importance shouldn't be overlooked. Dutch efforts reveal constraints in energy distribution by CEIs, with regional companies exclusively handling distribution, hindering other energy initiatives. Some Dutch entities address this by establishing their own energy companies to navigate legal hurdles.

Barriers are multifaceted, often overlapping in real-world scenarios. For instance, Dutch CEIs face mixed funding models, potentially seen as both economic and financial barriers, primarily linked to internal organisational challenges.

The survey has also identified two distinct sets of factors: internal barriers and drivers intrinsic to CEI structures, and external factors that exist independently of CEIs. Internal barriers pertain to the legal framework, organisational structure, business model, and funding mechanisms of CEIs. Overcoming these barriers may involve enhancing the management capacity within CEIs, providing expertise, guidance, or training to members. Thus, the exchange of knowledge, experiences, and best practices emerges as pivotal in augmenting the influence of CEIs. Notably, the most significant internal drivers are associated with the capacity to establish a network and define clear shared objectives. These elements can be reinforced by members' interpersonal skills in conflict resolution and a pragmatic approach to problem-solving.

On the other hand, external barriers and drivers encompass exogenous factors that are entirely detached from CEI structures. They primarily revolve around policies and the broader (national/regional/local) context in which CEIs operate. Common instances include energy market conditions, policies, legislation, regulations, technology costs, and more. Notably, the energy market is global in nature, while policies, regulations, and legislation are determined at different levels – national, regional, or local. Similarly, technologies are part of a global market, but their application is intrinsically linked to the local context. The effectiveness of a technology is determined not only by its level of innovation but also by its suitability for the specific local and spatial conditions in which the CEI operates.

## 5. Conclusions

The research aimed to identify the primary barriers, drivers, and potential impacts on local energy transition within CEIs.

The study revealed several key insights: drivers and barriers, government involvement, cooperation and networking, flexibility in legislation, literacy on energy and community involvement, dynamic nature of transition.

Most significant barriers for CEIs are in the external realm and connected to the legislation/regulation. The absence of a national legal framework to support Energy Communities (ECs), especially in Estonia and Slovenia, was perceived as a major constraint. A robust national legal framework that promotes ECs can serve as a crucial prerequisite for the emergence and progression of CEIs. Moreover, policy makers should go beyond setting targets and incentives, striving to expedite policy implementation and legislation focused on renewable energy production and CEIs formation. Notably, countries like Switzerland, Greece, and Slovenia identified limited backing for RE within national and regional policies, coupled with slow authorisation processes and excessive bureaucratic hurdles for RE installation.

Government participation within CEIs could substantially support their creation, implementation, and expansion. The Netherlands serves as an example, where collaboration between ministers, national/regional actors, project partners, and funders significantly drove CEI realisation (Hasanov and Zuidema 2018). Although government engagement is crucial, CEIs also raise awareness within communities and assist in establishing EC and installing RES. The study emphasised the role of CEIs in promoting networking and cooperation among various stakeholders. Examples in Slovenia and in Italy showcased how these coalitions foster multi-stakeholder collaboration to facilitate local energy transition. Energy branding at the regional level, as demonstrated by 'Energy Valley' in Dutch provinces, can further stimulate networking and collaborations.

The inflexibility of national legislation on energy market and distribution posed a challenge for Dutch CEIs. However, this constraint prompted creative solutions such as the establishment of independent distribution companies by certain ECs. The study underscores the significance of legislative flexibility in fostering the energy transition, also temporary regulation can be set up to support and facilitate transition (EEA 2022).

CECs significantly contribute to enhancing citizen awareness and participation, even in the face of challenges such as misinformation, poor perception, and lack of support. Training, education initiatives, and social debates promoted by CECs (e.g. *Enoactiva* in Spain) play a pivotal role in increasing community engagement (Tricarico 2015).

Scholars have highlighted that energy transition is a dynamic process (Byskov Lindberg and Kammermann 2021), involving shifts and transformations in sociotechnical systems (Verbong and Loorbach 2012; Geels et al. 2018). The structure of coalitions must evolve over time to accommodate different phases of the energy transition, from initial resistance to active participation and eventually reaching a new equilibrium.

It's reasonable for the public to have a predominant presence during the early stages of CEIs because the Public Administration ensures the protection of the general interest and handles maintenance. Effective coordination with the private sector allows for a rebalancing of the roles of public and private actors. However, there's a risk that, to sustain itself, the CEC may prioritise promoting the transition at the expense of acting more like a private operator, which could overlook fairness in meeting the community's needs within market dynamics.

In conclusion, the research underscores the vital role of CEIs in driving local energy transition by tackling barriers, leveraging drivers, fostering cooperation, and engaging communities. Policymakers are urged to facilitate the upscaling of CEIs into CECs through supportive legal frameworks (both at national and regional level), flexible legislation, and an emphasis on collaboration and networking. The dynamic nature of the energy transition requires adaptable approaches that can evolve over time to accommodate changing circumstances in urban sustainable development.

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