GRETA
GREEN ENERGY TRANSITION ACTIONS

D5.1
Taxonomy of geographical levels and drivers for energy citizenship emergence

Prepared by: UNIBO
Contributions from: TNO, GESIS

Deliverable nature	Report
Dissemination level (Confidentiality)	Public (PU)
Delivery date	2022-01-31
Version	1.0
Total number of pages	87
Keywords	Energy citizenship, energy community, geographical levels, proximity
Cite as	Massari M., Boulanger S.O.B., Longo D., Turci G., Pagliula S., Coleandro G.F., Ruggieri B., Abel D., Schlindwein L. (2022). Taxonomy of geographical levels and drivers for energy citizenship emergence. D5.1 of the Horizon 2020 project GRETA, EC grant agreement n°101022317, Bologna, Italy
Project contact	Danila Longo, email: danila.longo@unibo.it

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101022317.

Disclaimer and acknowledgement

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101022317.

Executive summary

The overall objective of WP5 is to investigate the relationship between geographical levels and the main factors influencing the emergence and growth of energy citizenship and to examine under what conditions energy citizenship contributes to broader decarbonization policy goals.

Task 5.1 aims to provide a taxonomy to identify and describe the main levels and the embedded drivers and barriers of energy citizenship emergence and interaction.

This deliverable oversees the definition and description of the geographical levels where energy citizenship emerges, as well as their categorization and determinants but also the drivers and barriers preventing the emergence. Geographical levels for GRETA should expand the representation into local, regional, national, and supranational layers, by re-drawing the analytic dimensions where energy citizenship may occur, act and be recognized.

The deliverable is structured in four parts: a first part presenting the results of the literature and policy review on the geographical dimension of energy citizenship and its links with the findings of WP1; the second part that analyses the GRETA case studies, through their geographical levels, features, levels of engagement, and type of energy citizens involved; the third part establishing the domains, dimensions of the geographical levels in a taxonomy, and a final discussion and conclusion part.

Project information

Grant agreement No.	101022317
Acronym	GRETA
Full title	GReen Energy Transition Actions
H2020 Topic	H2020-LC-SC3-2020-NZE-RES-CC
Project URL	www.projectgreta.eu

Document information

	Number	Title
Deliverable	D5.1	Taxonomy of geographical levels and drivers for energy citizenship emergence
Work package	WP5	Community Transition Pathways for decarbonization across geographical levels
Task	T5.1	Taxonomy of levels for the emergence of Energy Citizenship

Delivery date	Contractual: M9, Actual: M9
Nature	☒Report ☐Other ☐ORDP
Dissemination level	☒Public ☐Confidential
Authors (partners)	Martina Massari, Saveria O. M. Boulanger, Giulia Turci, Serena Pagliula, Giada Coleandro, Beatrice Ruggieri, Danila Longo (UNIBO), Dennis Abel (GESIS), Luise Schlindwein (TNO)
Reviewers (partners)	Dennis Abel (GESIS)
Summary (for dissemination)	The taxonomy of geographical levels and drivers for energy citizenship emergence provides a framework for the definition of the emerging characters of energy citizenship at different geographical levels: local, regional, national, supranational and the transversal virtual level. The context of emergence of energy citizenship entails several proximity domains and dimensions. The taxonomy shows that different geographical levels play important roles in triggering the birth of different forms of energy citizenship but mostly in supporting citizens' engagement to grow and proceed in this pathway. It represents a multi-layered structure of relations and interdependencies that need to be considered while approaching the topic. This suggests looking at energy citizenship in a local-global networking perspective. This is useful to connect leveraging mechanisms, to provide solutions to barriers and bottlenecks and, finally, to contribute to better policy recommendations.
Keywords	Energy citizenship, energy community, geographical levels, proximity

Version	Date	Description
0.1	2021-07-27	First draft
0.2	2021-11-15	Second draft

Version	Date	Description
0.3	2022-01-17	Third draft sent to internal review
1.0	2022-01-31	Final version

Table of contents

List of figures

List of tables

Abbreviations and acronyms

CEC: Citizen energy community

CoM: Covenant of Mayors for Climate and Energy

DHW: Domestic hot water

DoA: Description of Action

EU: European Union

ICT: Information and communication technologies

LAU: Local administrative unit

NGO: Non-governmental organization

NUTS: Nomenclature of Territorial Units for Statistics

PAW: Dutch national program on natural gas-free neighbourhoods

PV: Photovoltaic

REC: Renewable energy community

SME: Small and medium-sized enterprise

SSH: Social Sciences and Humanities

TMN: Transnational municipal network

WP: Work package

1 Introduction

1.1 Description of the deliverable

The call under which GRETA was funded — LC-SC3-CC-1-2018-2019-2020: Social Sciences and Humanities (SSH) aspects of the Clean-Energy Transition — mentioned the necessity "to understand in what kind of environments collaborative goal setting and commitment can take place, how relevant decisions are made and any trade-offs between competing goals are addressed" in order to answer to the question "Is energy citizenship more likely to emerge locally, or at regional, national or supranational levels? For what reasons?". The DoA describes the Task 5.1 role as it identifies and describes the different geographical levels of Energy Citizenship emergence, as analytic dimensions entailing several determinants (e.g., climate, demography, planning, technologies, morphology, governance, policies and incentives, economy, finance, European and global agendas and trends) organized in a transversal taxonomy that will identify levels and describe the major drivers (D5.1). Geographical levels will be described as dimensions (not only administrative ones) where energy citizenship occurs, going beyond the standard division into local, regional, national and supranational and including more complex dynamics.

1.2 Glossary with key definitions used in the deliverable

This section will list key terms and definitions tailored to the GRETA and the WP5 purposes (e.g., a "driver": a factor, applicable and/or present in multiple levels, which positively influences the emergence of energy citizenship at such geographical level).

Geographical level
Analytic dimension (not only administrative one) describing the context where energy citizenship might occur. It answers to the "where" of energy citizenship, how activities are distributed across the space (physical and virtual). The geographical dimension of energy citizenship allows to understand the choices of the actors engaged, what influences them, and the leverage that triggers them to operate towards energy efficient behaviours or activate to champion energy transition.

Transnational network
It entails a dynamic of interaction that goes beyond the geographical aim of the terminology. It distinguishes from supranational, a term that implies geographical scope and dynamics that are wider than the national.

Proximity
Proximity indicated the closeness (or distance) of two or more variables. In this case it involves how close or distant is the interaction between citizens and energy. This

allows to observe the context of action and reaction of energy citizenship according to several domains.

Domains
Thematic division that allows to group the different variables of energy citizenship deployed in different geographical levels. They entail social, spatial, technological, economic, policy and governance elements.

Dimensions
Analytical expressions of the different domains, characterizing the components of the energy citizenship system that is multidimensional and in constant transformation.

Descriptors
The markers that can be taken as a reference to be quantified for impact evaluation. They are referred to the dimensions, that in turn are clustered into different domains.

1.3 Scope of the deliverable

The Deliverable 5.1 is a direct result of the work performed in Task 5.1. This document aims at providing a framework that defines and characterizes aspects of structural and dynamic emergence of energy citizenship at different geographical levels. It addresses multiple questions such as: where does energy citizenship occur? Why is energy citizenship more likely to occur in specific places? How does energy citizenship develop in different geographical contexts? What is the importance and role of relationships at different spatial scales that can foster energy citizenship processes?

This Deliverable follows closely the theoretical framework outlined in WP1, where the definition of energy citizenship is provided and its determinants, barriers and drivers are made explicit (T1.1). It is also linked with WP3 that deals with data gathering and background studies on the six case studies (T3.1); it identifies elements for energy citizenship emergence at a more general level (T3.2) as a first analysis that will lead to the definition of the survey (T3.3). Finally, in T3.4 there will be a synthesis on case study results, including statistical elements and model validation. In Task 5.1, case studies (GRETA's and other EU experiences) are necessary to identify what are the different geographical levels, the commonalities, the discrepancies, and attention points. Task 5.1 provides the basis for the entire project for dealing with geographical levels. In particular, these will be considered by WP4 in order to implement them in their modelling phase.

1.4 Methodology

Task 5.1 follows a mixed methodology approach (see also Figure 1) composed of:

Theoretical background on geographical levels, scale and dimensions where energy citizenship emerges. This analysis is based on literature on energy citizenship and behaviours, and on policy documents at the EU and global level.

Purpose: this part of the work frames energy citizenship as differentiating phenomena occurring in different geographical domains. Drawing from literature on energy communities and behaviours, the review aims at highlighting deductions about geographical levels.

The policy analysis at the EU level comprehends a review of the most significant documents collecting empirical evidence on energy citizenship, case studies of energy communities or collective energy initiatives from EU projects, which can provide insights to understand the individual and collective level of energy citizenship (Annex A). Sources are the EU COM JRC publication "Energy communities: an overview of energy and social innovation" and the JPI Urban Europe 'Positive Energy Districts Case Studies Booklet'. Detecting determinants and conditions for EC in each geographical level, this section explores the EU-wide context of geographical levels of emergence of energy citizenship.

Purpose: drawing knowledge from empirical evidence and case studies around Europe on positions of the energy citizens according to different geographical levels and identification of which kinds of levels are more relevant to be highlighted.

Knowledge gained through the in-depth preliminary ontology activities of WP1.

Purpose: linking the geographical levels, their specific dimensions, the levels of engagement to the identified ontological categories from WP1 on energy citizenship.

Case study analysis, highlighting the geographical levels in which energy citizenship, as defined by the WP1 framework, emerges and is recognized. A selection was made on the GRETA case studies, based on the relevance of the case study and the amount of information acquired by the partners at the time the deliverable was written.

Purpose: analysing each case study according to the levels of engagement, to the identified ontological categories from WP1 on energy citizenship, linked to the geographical levels and their specific dimensions.

This theoretical and empirical basis is enriched with a clustering activity of the results of the brainstorming sessions among partners involved in WP5.

Purpose: having a recurring feedback loop on the work done and insights from different participants on the task.

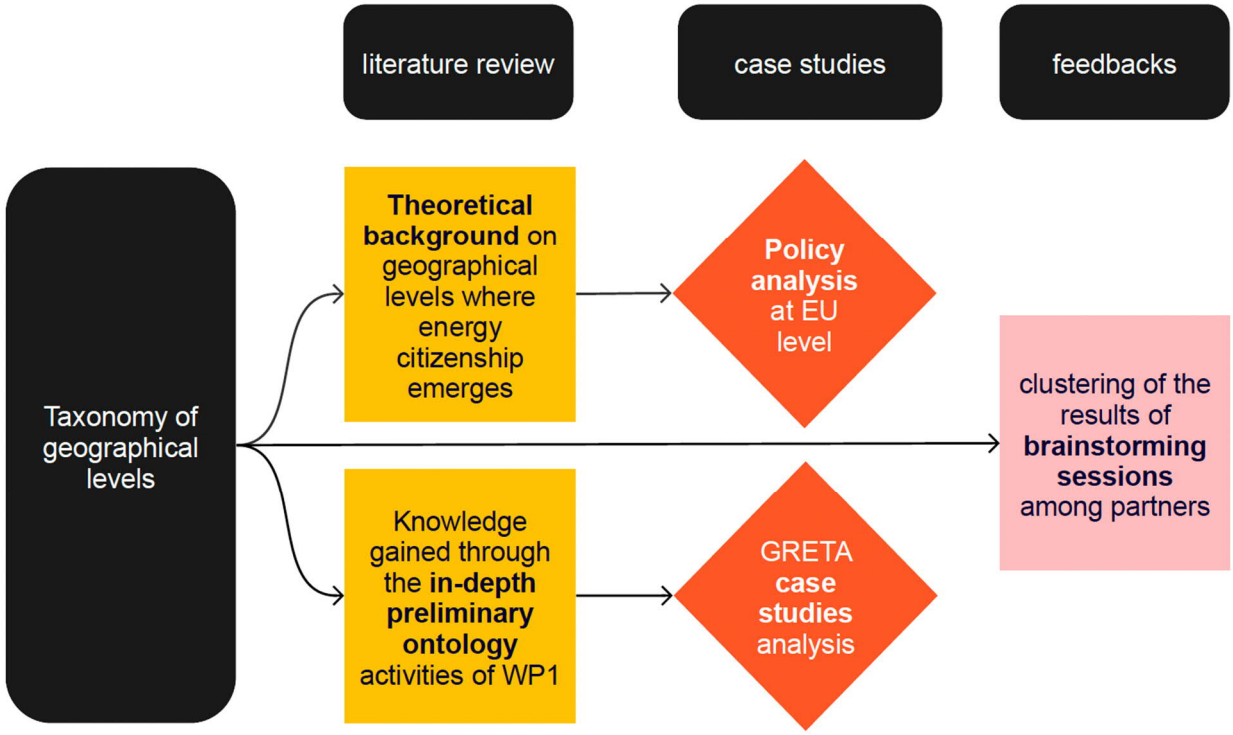

Figure 1. Scheme of the methodology for the development of the taxonomy of geographical levels

2 Energy citizenship emergence and its relationship with geographical levels

2.1 Key finding from WP1

This part summarizes the preliminary knowledge acquired in WP1 linking it as preliminary knowledge for the work in WP5 and in this deliverable.

The framework presented in WP1 aims to assess the conditions upon which the emergence of energy citizenship might arise in specific settings. This is particularly relevant to conduct case studies and to enable the testing of at what level of geographical aggregation energy citizenship might emerge. In general, WP1 aimed to raise awareness on energy citizenship within the EU by highlighting the different meanings of energy and citizenship, the differences between centralized and decentralized energy systems as well as the types of energy citizens and related behaviours. To this end, a better understanding of the human dimension of energy citizenship is needed. The investigation conducted in WP1 helps to provide recommendation for policy design but also to understand what the multiple connections between energy citizenship and energy justice are. In this regard, D1.1 provides a definition of energy citizenship and identifies the main enablers and barriers towards its emergence. Furthermore, D1.2 explores under which conditions the energy transition might reproduce unjust dynamics and outcomes (distributive, procedural, recognition) within different forms of energy citizenship (above all in the establishment of energy communities). Many connections lie between WP5 and WP1. Specifically D1.1, which provides the theoretical framework of energy citizenship, supports D5.1 in investigating the relationship between geographical levels and the factors influencing the emergence of energy citizenship (barriers and drivers); moreover, D1.2 provides D5.1 with information and data regarding energy justice (e.g. distributive justice, a central aspect to consider when approaching the energy transition through a geographical lens contextual dimensions, geographical levels, case studies…) focused on the multiple scales of interaction entailed by energy citizenship and more decentralized energy systems.

2.1.1 Energy citizenship emergence

A preliminary definition of energy citizenship in D1.1 is contingent on the level of engagement that people might have (or not have) in actions supporting the energy transition. These actions are defined in specific behaviours that manifest differently across different types of individual and collective energy citizen. Without suggesting a clear distinction between them, six types of energy citizen have been established based on their involvement in the energy system (i.e., consumers, prosumers and prosumagers, participants in protests and movements, policymakers, energy communities and business entities). For each type of energy citizen, cognitive,

normative, instrumental, emotional, and socio-demographic determinants were found in the literature (see Table 1 for an overview).

Table 1. Overview of determinants per type of energy citizen

Energy citizen	Determinants	
Consumer	Cognitive	Attitude; Awareness of consequences; Comfort; Convenience; Safety; Moral obligation; Loss aversion; Ascription of responsibility; Environmental benefits
	Normative	Subjective Norm; Personal Norm
	Instrumental	Awareness/ Knowledge; Perceived behavioural control; Costs (time, money, etc.); Infrastructure/ geographic factors; High service quality
	Emotional	-
	Socio-demographic	Gender; Age; Occupation; Household income; Education level; Household size; Subsidies; Population density
Prosumer & prosumager	Cognitive	Environmental awareness; Awareness of local benefits; Insights in energy consumption; Health concerns; Privacy concerns; Comfort; Sustainability; Energy conservation; Energy self-sufficiency
	Normative	Social norm; Social cohesion; Legislation/ Regulations; Economic and institutional support/ permissions
	Instrumental	Relevant information; Technology; Management; Financial benefit; Cost; Local control; Bargaining power; Independence from grid; Innovation control of device; Electricity market participation; Energy supply reliability; Product Quality
	Emotional	-
	Socio-demographic	Financing options
Participant in protests and movements	Cognitive	Pro-environmental attitude; Interest in environmental issues; Cognitive dissonance; Sense of community; Efficacy beliefs (collective and individual); Belief in power of citizenship; Political ideology
	Normative	In-group norm; Social identity (Identification as environmentalist); Group identification
	Instrumental	Action-related subjective knowledge; Salience of environmental issues; Catastrophic events; Considering future consequences; Locus in control
	Emotional	Moral emotions (e.g., guilty conscience)
	Socio-demographic	Age; Type of living area; Education level; Occupation; Religiousness; Membership in environmental organizations and other groups; Reading the newspaper, party manifesto and other literature; GDP/ economic affluence
Policy Maker	Cognitive	Social outcomes; Economic and political outcomes; Corporate lobbying
	Normative	Political pressures; Community pressures
	Instrumental	Institutional capabilities; Organizational capabilities
	Emotional	-
	Socio-demographic	-
Energy Community	Cognitive	Environmental concern; Ethical and environment commitment; Sense of purpose; Self-sufficiency; Energy insecurity; Social gratification; Civic gratification; Desire to influence policy outcomes
	Normative	Social norm; Social cohesion; Collective commitment

	Instrumental	Technical know-how; Ownership; Local control of resources and load management; Emergence of new technologies and infrastructure; Lower energy costs; Social media
	Emotional	Disappointment in government and policymaking; Trust
	Socio-demographic	Local economic development; Economic incentives; Financing and the pooling of funds; Increase in job opportunities; Local investment and income generation; Strong cooperative enterprise history and tradition in the region; Supportive policy environment for cooperative enterprise; Sufficient average regional personal income and/ or wealth; Supportive policy environment for renewable energy system deployment
Business entity	Cognitive	Attitude; Awareness; Willingness to compete; Organizational learning; Technological appeal; Environmental risk; Economic risk
	Normative	Subjective norm; Social norm; Market pressure; Community pressure; Regulatory pressure; External collaboration/ competition; Image (green/ improved); Voluntary agreements; Strategic alliances; External cooperation
	Instrumental	Knowledge of non-energy benefits; Technological capabilities; Perceived behavioural control; Public and social rewards; Long-term energy strategy; Availability, clarity and trustworthiness of information; Information about real costs; Financial gains; Management with ambitions; Management support; Staff with real ambitions; Efficiency due to legal restrictions; External energy audit/ submetering; Technical support; Cost reduction from lower energy use
	Emotional	-
	Socio-demographic	Economic reductions; Economic conditions; Access to capital: private or public investment subsidies; Public investment subsidies; Increasing energy tariffs; Private financing; Programs of education and training

Next to being determined by cognitive, normative, instrumental, emotional, and socio-demographic aspects, the above-mentioned types of behaviours identified (e.g., investments, consumption, storage, pursuing efficiency, using specific technologies and practices, etc.) are all context-specific.

Understanding why people might engage (or not) in the use of green energy technologies and in the adoption of greener practices is raising great interest and it is one of the key-aspects to address great societal challenges such as energy transition and climate change. According to D1.1 and the research agenda of energy transitions, the inclusion of behavioural topics in many EU projects is relevant to focus on the role that citizens engagement plays in decarbonizing fossil-fuelled economies and societies. Specifically, D1.1 has shed light on the interplay between the individual and the collective actions and practices, a point often neglected by energy transition studies. In this regard, the three-staged model elaborated in D1.1 aimed to gain a deeper understanding of individual behavioural drivers and motivations, interactions between actors and emerging patterns (Schlüter, et al., 2017). This model will give support in filling three major gaps: 1) which factors encourage different actors to engage in sustainable energy behaviour; 2) which interventions can be effective to encourage different actors and which factors can enhance their effects to engage in sustainable energy behaviour; 3) which factors affect public support for energy policy and changes in energy systems. By looking into the structure and dynamics of energy

citizenship, D1.1 will contribute to explore the systemic interdependence among different actors and contexts in the energy transition, thus enabling a deeper understanding of how energy citizenship functions and emerges.

2.1.2 Energy citizenship and energy justice

Contextually, D1.2 investigated the role that energy justice has in the emergence of energy citizenship with the aim to establish an energy citizenship-based Energy Union. More specifically, as a broad literature acknowledged, since energy systems have complex social and cultural dimensions other than technical and economic ones, this deliverable sought to apply justice principles to energy-related issues to address important new concerns (social, economic, political, environmental…) raised by the process of decarbonization. Indeed, if at the core of a just transition lies the foundation that promoting community energy will increase multi-level justice, it is also important to acknowledge that not all societal groups are equally positioned to benefit from community-oriented policies. To address the justice dimension of the energy transition, the Energy Justice Framework explained in D1.2 contributed to devise further effective ways of involving citizens in the energy transition, thus leading to greater social acceptability of the many transformations required as well as more durable governance arrangements and socio-economic benefits. Moreover, a further key-point of D1.2 is the identification of energy justice as an ongoing process and a social movement advancing renewable energy transition in a fair, equitable and just manner (Szulecki and Overland, 2020) by including efforts to resist, reclaim and restructure energy systems.

To understand the impact of context, a structural analysis of the emergence of energy citizenship at different geographic levels is provided. It answers to the "where" of energy citizenship is being established, addressing multiple questions such as: why is energy citizenship more likely to occur in specific levels? How does energy citizenship unfold across different geographical contexts? What is the importance and role of relations at different spatial scales for energy citizenship processes?

2.2 Theoretical background based on literature and gap detection

This section aims to briefly analyse some of the main contextual aspects entailed by energy citizenship, with a specific focus on energy communities and cooperatives. The theoretical background is structured as a synthetic literature review. It is divided into sub-sections giving key insights on different specifications: starting from a more general overview of the energy communities' definitions that consider the different values and forms that these experiences take, to an overview of the main contributions on geographical levels, ending with a conclusion giving evidence of the presence of a "proximity" concept. The underlying objective is not only to understand the relations among the different concepts but to understand in which geographical levels energy citizenship is triggered, emerges, and is eventually consolidated.

To approach the topic, a brief literature review is provided on the concept of energy citizenship in the energy community form, providing brief definitions of the used terms and linking them to the geographical levels.

There is a necessity to clarify and better understand in which geographical levels energy citizenship is triggered, emerges, and is eventually consolidated.

2.2.1 Overview of energy citizenship in the energy community form

Energy is widely recognized as one of main leverages to act upon fighting climate change in the long run and achieving the ecological transition. According to several contributions and the European Commission approaches, such transition will be fostered only in a collective and shared way with citizens as partners and active participants in its implementation (Vainio et al. 2020). Energy research is then becoming more and more interested in understanding how citizens can be active participants in the energy system, thus being recognized as energy citizens. As stated in WP1, GRETA interprets Energy Citizenship as a shared collaboration on fair, equal and right-based set of actions to address decarbonization through energy behaviours and initiatives. Energy citizenship entails that *"the public is conceived as active rather than passive stakeholders in energy system evolution and where the potential for action is framed by notions of equitable rights and responsibilities across society for dealing with the consequences of energy consumption, notably climate change"* (Devine-Wright, 2004, p.71). In the reviewed literature, different forms of citizen participation are proposed to directly empower people in acting on climate change issues, especially on the energy topic (Hoff and Gausset 2015; Brink and Wamsler 2018, 2019).

Energy citizenship is an emerging, yet promising concept in the energy transition theoretical framework as well as in its practical manifestation. The concept represents the human dimension of the energy system, whose decarbonization goals necessarily demand the inclusion of citizens into energy-related decision-making processes [from T1.1]. However, to understand the motivations behind the engagement of citizens in such processes, the context of operation of these actors should be investigated. The state of research shows an existing gap on geographical analysis when exploring the determinants of energy citizenship (it is usually more focused on social aspects and policies; see also the review of determinants presented in D1.1). However, this aspect is paramount, as it affects how people act in their own territory and the possibilities for them to act. One of the advantages of a geographic lens, is that it allows an appreciation of how activities are distributed across space. This is essential not only for policies to be territorialized, but also in terms of energy justice (Catney et al 2014). The contextual dimension of energy citizenship allows to understand the choices of the actors engaged, what influences them, and the leverage that triggers them to operate towards energy efficient behaviours or activate to champion energy transition. The context of action and reaction of energy citizenship entails several scales of interaction, socio-economic variables, and levels of governance (Šćepanović et

al. 2017; Balest et al. 2018) varying from national to local contexts and among countries within Europe (Heiskanen and Matschoss, 2017). The geographical dimension allows to better understand the dynamics of the energy citizenship emergence, not only in relation with people behaviours (covered by WP1 and D1.1) but more in relation with contextual factors, such as policies, technology readiness and other factors which are further explained.

The contextual dimension of energy citizenship allows to understand the choices of the actors engaged, what influences them, the leverage that triggers them to operate towards energy efficient behaviours or activate to champion energy transition. In a nutshell, which contextual factors trigger the rise of forms of energy citizenship.

2.2.2 Energy community definitions

Formally, two types of energy communities are included into the EU legislation with the names of "citizen energy community" (CEC) and "renewable energy community" (REC) (see also D1.1). CEC and REC are both legal entities based on voluntary and open participation and effectively controlled by their members (individual citizens, local authorities, small enterprises); hence, they are based on creating a group of people that get an agreement with clear and common goals. Both have as primary purpose to provide environmental, economic or social community benefits to their members and to the context where they operate. CEC may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members (Palm & Kojonsaari 2020).

REC is autonomous, and is effectively controlled by members that are situated in proximity of the renewable energy projects that are owned and developed by REC. While CECs emphasize the social dimension to energy, RECs are more connected to a geographic dimension, in fact they connect the community with a proximity relationship to the energy source (Boulanger et al. 2021). One of the interesting aspects of energy communities is their capacity to go beyond the hierarchical structure of networks, entering into competition with the large energy market, generating a reduction of costs for the final consumers (Hansen & Coenen 2015; Heiskanen & Matschoss 2017).

Beyond the definitions provided by the EU legislations, there is a growing scientific literature exploring this concept and trying to provide deeper meanings. According to several authors, in fact, energy communities can be defined as organized groups of users (private, public, or mixed) actively engaged and/or cooperating in developing innovative forms of energy sharing (Walker and Dewine-Wright 2008; Tricarico 2018; Koltunov and Bisello 2021). According with Koirala et al., they usually *"share common interest and/or attitudes in services provided by energy communities (e.g., activities of generation, storage, consumption and sale of energy). Energy communities are supported by a*

legal framework or are a legal entity" (Koirala et al., forthcoming, p.27). They are based on the expectation that by 2050, almost half of EU households should produce renewable energy (CE DelfT, 2019). They have been introduced with the aim to give more options to people in producing and sharing renewable energy locally or at a larger urban scale. The idea lies in the potentiality to shift towards a decentralized energy system, one that gives people the chance to own their decisions on the type of energy they should use and whether to share it. According with Moroni and colleagues (2017; 2019a; 2019b), energy communities are groups of individuals united by particular interests, ideals, purposes, who "*voluntarily accept certain rules for the purposes of shared common objectives, in particular, energy related ones".* This purpose-orientation generated new types of organizations, as shown by Roberts and colleagues (2019), which are much more oriented towards value redistribution among participants, framed by specific types of governance, structures and purposes: cooperatives, foundations, limited partnership, housing associations, non-profit customer-owned enterprises, public-private partnerships or public utility companies are only some of the varieties of forms that energy communities are taking. One of the most used organizational forms is the cooperative one, as it is perceived as one of the best forms of associations, giving participants the opportunity to set their collaborations in several ways and with a certain amount of freedom and decision making. Cooperatives are economic organizations with decision-making procedures based on democratic principles rather than on voting schemes proportionate to equity. With respect to these considerations, behaviour of individuals in cooperatives is characterized by the so-called cooperative spirit rather than by the idea of a homo economicus (Yildiz et al. 2015). Therefore, community projects entail more dimensions than the financial aspects. Yildiz (2014) emphasizes the multi-dimensional targets of civil participation in energy projects which are based on public welfare considerations. Cooperatives in various sectors like banking, agriculture or forestry existed in the EU countries for many decades but the structures are highly diverse, and these path-dependencies affect the emergence of energy cooperatives as well. In Germany, for example, energy cooperatives in the early 20th century ensured the provision of electricity in rural areas. Energy cooperatives are geographically unevenly distributed between and within member states and therefore play different roles in the EU energy transition (Wierling et al. 2018; Lowitzsch & Hanke 2019). For example, in Germany, many communities' renewable energy projects are currently backed by cooperative banks, which developed blueprints for funding of energy projects themselves. Toke et al. (2008) also argue that in some European countries like Denmark, Germany and the Netherlands, agricultural cooperatives also engaged in wind power projects.

Energy communities can be defined as organized groups of users (private, public, or mixed) actively engaged and/or cooperating in developing innovative forms of energy sharing, united by particular interests, ideals, purposes, who "*voluntarily accept certain rules for the purposes of shared common objectives, in particular, energy related ones".*

2.2.3 Energy communities and geographical levels

As it is possible to see in the former definitions, both in the scientific and grey literature, there is a strict connection among the values of the "community" and the use that this makes of energy. Inside the word "community", there is a constellation of meanings, going from shared trust, values, objectives on a personal dimension, to support and improvement of lifestyles and the environment on a territorial dimension. This last point seems to be interesting as energy communities are often linked with a specific territory, piece of land, district, building or other forms of space. There is a growing literature working on the contextual dimension of energy communities. These experiences, in fact, are mostly site-specific. However, how the communities relate to the territory is more complex. Several are, in fact, the dimensions in which those experiences take form: from local to regional to national; and several are the specificities of these geographical dimensions. Not to mention that sometimes they can also be virtual grouping people from different territories and cities or supranational aggregations.

A distinction is given by Moroni and colleagues (2019), where the authors distinguish between *place-based* and *non-place-based* communities. As the term clearly states, place-based communities are strictly linked with a specific territory, while non-place-based communities are detached from the territorial dimension, being mainly energy purchasing groups or people with shared energy objectives. The relation to the territorial dimension entails several consequences, especially in relation with the main factors for creating a community, such as the presence of common values, social rules, trust, technologies, awareness, and the effects on the territory and its landscape and land use itself. As Moroni and colleagues affirm, "*in place-based communities it is always also a specific idea of local development*" (p.50). However, it is important to specify that the place-based communities considered in most parts of the literature are mainly related to the local dimension. They go "*from condominiums to city districts, to wider territorial contexts on the basis of cohabitation rules and shared local objectives*" (ibid.). The non-place-based communities cited by the authors are referred to forms of organization based on national boundaries. The question is now if those types of communities are effectively detached from the territorial dimension or if they are just covering a wider extension, as the national one. Moroni and colleagues give two examples of non-place-based communities, *Retenergia* and *Abbassa la Bolletta*. Both are Italian experiences born in the early 21st century, in which people can buy energy from renewables produced in plants spread across the national territory. Of course, both manifestations can be and are considered virtual as there is not a specific benefit return on a delimited geospatial scale, as, for example, it happens in communities more linked with a district/street dimension.

However, it is possible to better understand the geographical dynamics of energy citizenship emergence, by also looking at other typologies of experiences than energy communities. For example, an interesting perspective is given by transnational municipal networks (TMNs) and grassroot climate initiatives. In the next section a brief overview of these organizational forms is provided.

2.2.4 Transnational municipal networks and energy citizenship experiences

In the attempt to understand in which geographical levels energy citizenship seems to emerge and grow, a reference to networks and climate initiatives should be done. In fact, in the last decades several experiences have been born, partially in a bottom-up perspective, grouping several actors across the climate and energy topic. Among all those initiatives, special attention must be given to transnational municipal networks (TMNs) and some grassroot initiatives. These experiences provide an interesting example of the transnational level, both at the European and worldwide level, of energy initiatives. According to several authors, TMNs are key initiatives in creating a framework for political actions. They, in fact, give the opportunities to cities to group themselves into transnational networks active on a specific theme or objective. In particular, they tend to directly target cities' mayors, as key actors in starting a process of change. In this direction, TMNs can be seen as enablers of energy citizenship emergence, targeting policy-makers. A first example of this, can be recognized in the Covenant of Mayors for Climate and Energy (CoM). Launched in 2008 by the European Commission it has been one of the reference networks for European cities, having *"the objective of engaging and supporting mayors to commit to reaching the EU climate and energy targets".* In their manifesto, the CoM asks cities to be frontrunners in taking action on energy and climate related topics. Renewable energies and CO_2 reduction are specifically addressed. The initiative was born at the European level, but the network is currently extended beyond European boundaries, providing a wider regrouping of cities. While the CoM is an example of EU-level top-down dynamics to structure and harmonize local climate action, grassroot initiatives can be interesting, as they embody bottom-up movements that, also through non-institutionalized and non-conventional methods, show the spread of energy and climate commitment across people, especially youth. One of the most famous examples is the movement Fridays for Future that used social media and a virtually gathered community to spread their message. This movement is a prime example of new forms of networked global social movements with sophisticated virtual network patterns on social media. At the same time, Fridays for Future is strongly anchored in local activism, organized around territorially closely-linked schools, leading to complex "glocal" dynamics (Terren and Soler-i-Martí 2021).

Far from being structured as energy communities, these experiences are considered as part of energy citizenship initiatives, while analysing their geographical levels of emergence. They provide examples of virtual communities that have effects on territorial levels (especially TMNs) or on people's awareness and participation (Boulanger & Massari, forthcoming).

2.2.5 Geographical dimension and the proximity concept

The interaction with these contextual systems allows citizens to choose to engage (in different forms) in energy actions. In this regard, the geographical dimension of proximity emerges as a cross-cutting element. In this scenario, the concept of proximity (Torre and Rallet 2005; Boschma, 2005) appears critical to the emergence, stabilization, and growth of energy citizenship. It can help move beyond viewing the "where" of energy initiatives as physical or social sites, containers within which technological

change occurs (Walker et al. 2021), moving toward geographic levels with both physical and socio-technical qualities. Proximity does not only mean physical contiguity, but can have a relational meaning, as organization, welfare, cultural and temporal one (Fortier 2010). It is the dimension where knowledge is exchanged (Morone et al 2004) and learning among different actors is enhanced. The literature usually emphasizes the advantages of proximity, as an important precondition for mutual learning, organization, knowledge sharing and transfer and the diffusion of ideas and technological innovation (Gertler, 1995; Rogers 1962). However, proximity of ideas, positions, may have negative effects due to a lack of openness and flexibility (Boschma, 2005); therefore, it seems necessary to rely on a certain degree of flexibility, diversity and even "distance" of positions, in order to foster change and transition.

Operating on proximity to recognize energy citizenship is paramount since it relies on a geographical dimension (Bridge et al. 2012; Hicks and Ison 2018), applied to the geographical level, not only urban, but also in those places that suffer the lack of reconnection policies (e.g., rural, island territories). It also relates to a social dimension, in seeking to reduce barriers between citizens and institutions. In these stances, proximity is necessary to explore the boundaries of energy citizenship context (Hicks and Ison 2018), to enhance trust, to reduce information imbalances and attenuate social barriers (Servet 1996). It is evident that proximity of the socio-technical system can be the leverage force of interaction, which appears as the basis upon which energy citizenship arises.

3 Case studies overview: lessons learned

3.1 GRETA case studies

This section contains specific information from the selected GRETA case studies starting from the background information provided by the work of T3.1 and T3.2.

An explanation of the territorial context in which these cases are embedded helps to understand the role of different geographic levels. This clarifies the spatial drivers and barriers for the decision-makers in the single cases. Ultimately, studying the context of the case studies allows for a more informed choice of cases and more precise comparability of results. The case studies analysis provides a link from the geographical level to the types of energy citizens defined in WP1. Furthermore, it identifies the levels of engagement of the different categories at the initial phase of the project, the case studies' features, drivers and barriers to overcome.

3.1.1 Renewable Energy District – Bologna Pilastro–Roveri, Italy

The area is a mixed-use district, located in the north-east part of Bologna. It was built from the '60s as a response to the growing need of social housing, for locating immigrants. The district is composed of two areas: Pilastro (residential), and Roveri (industrial). Pilastro was originally conceived as an autonomous 'village' with neighbourhood services and some artisanal activities. Unfortunately, these have not been built creating a mono-functional residential neighbourhood, which became a source for social and economic issues. The municipality confirms that the area is hit by energy poverty emergencies. The Roveri area hosts a variety of companies in multiple sectors (e.g., packaging, mechanics, and electric vehicles). In this context, a financed project from the European Institute of Innovation & Technology (GECO – Green Energy COmmunity) is working to create the first energy community of the city. This community is under construction and some participatory meetings were started before the beginning of the 2020 pandemic. The energy community will benefit from the presence in the area of the CAAB-FICO industrial partners, which has the EU's largest PV plant on industrial roofs. Highlights from the Pilastro-Roveri case on the different levels are shown in Table 2.

Table 2. Highlights from Pilastro-Roveri case on the different levels

Type of energy citizen		Description
Local Level		
Consumer and user	Engagement phase	Unaware / Interested
	Features	Residents of Pilastro and workers of Roveri have different commitment degrees concerning energy. The Pilastro inhabitants are mostly unaware of possible actions to increase energy efficiency in their homes, but they are willing to participate; Roveri staff is aware and interested but as individuals, it is difficult to frame as a community
	Opportunities	Presence of large number of associations, active citizenship, social cooperatives, local gatekeepers (library, schools, cultural spaces)

	Risks	Community fatigue, as Pilastro-Roveri area has been subject to several activities concerning sustainability, climate change, etc. without tangible results
Business entity	Engagement phase	Involved
	Features	Business entities such as CAAB-FICO are involved in GECO (900 businesses in the area) and considered as prosumagers and are part of the conversation of shaping the energy community
	Opportunities	EU largest PV plant on industrial roof
	Risks	Privatization of interests on energy production
Local energy initiative, energy community, collective	Engagement phase	Advocate
	Features	The area hosts many associations, initiatives on sustainability, welfare, inclusion
	Opportunities	High level of engagement of citizens thanks to the long-lasting tradition of collaboration on several policy issues
	Risks	Energy is not a topic that has been taken into consideration by the associations so far, the risk is to exclude parts of the already engaged population in community activities
Policy maker	Engagement phase	Advocate / championing
	Features	The municipality of Bologna, together with its city agency Foundation for Urban Innovation are championing the creation of energy communities in the city (the municipality has now a deputy mayor specifically for that).
	Opportunities	Political will and commitment through planning tools (the new urban plan and the strategy for climate adaptation) are pivot steps for the consolidation of energy citizenship in the city (and also at the metropolitan level)
	Risks	The critical point is represented by the regulatory and normative aspects related to the "big" energy market, a regulatory ecosystem based on operators, production and centralized networks that does not lend itself to the particular needs of local initiatives.
Regional Level		
Policy maker	Engagement phase	Active - Frontrunner/sponsor
	Features	The Emilia-Romagna Region published the *Patto per il Lavoro e per il Clima*, a commitment to generate quality work, combat inequalities, promote the ecological transition towards the goals of the 2030 agenda for sustainable development
	Opportunities	Commitment of the Regional policy makers around climate and energy issues, includes a financial help to the formalization of energy communities in the region
	Risks	The Pact foresees a shared commitment of several third sector interest groups, which were unsatisfied with the draft and produced their own policy document
Participant in protest and movements	Engagement phase	Advocate - championing
	Features	*Rete Emergenza Climatica e Ambientale dell'Emilia-Romagna* is a coordination of local organizations joining to act against the climate emergency
	Opportunities	Counter proposal for the *Patto per il Clima e per il Lavoro*, by adding more coercive commitments for municipalities about energy and an extensive use of self-production and energy communities
	Risks	The action of this group of association could remain in the foreground if not extensively taken into consideration by policy makers
National Level		
Policy maker (public law body)	Engagement phase	Active sponsor
	Features	ENEA, National Agency for New Technologies, Energy and Sustainable Economic Development), a public law body dedicated to research, technological innovation and the provision of advanced services to businesses, public administration and citizens in the fields of energy, the environment and sustainable economic development.
	Opportunities	Engagement of a prestigious research agency allows open national opportunities for the case, both in knowledge and in economic terms
	Risks	The national scope of the agency might be a deterrent on local citizens engagement

Remarks and insights on geographical levels
Pilastro-Roveri shows the most interesting energy citizenship features at the local level. The community in Pilastro area was formed through a "place-oriented" process, meaning that the local physical proximity became the substrate on which the community is created. Here we find strong ties, based not so much on cultural homogeneity, but on shared existential conditions, values and beliefs, assiduous frequentation, trust and a sense of belonging. In the case of Roveri, on the other hand, we find informal relationships, based on rationality, on needs, on functional interdependence. In both cases however, the energy behaviour and activation emerge and organize in the local dimension. A crucial role is played by policy makers at the municipality level, where they appointed a specific sector to the support and creation of energy communities. At the same time, local associations and city agencies are the gatekeepers towards the existing and future communities. The collaboration with third sector association is a traditional way of politically operating in Bologna, which is now tested extensively on the energy and climate change topic.

3.1.2 Natural Gas-Free Neighbourhood program – The Netherlands

Fuelled by increasing earthquakes in the vicinity of Groningen gas field, the Netherlands has decided that all its neighbourhoods will become natural gas free by 2050. The most significant challenge has a social nature, as building owners and residents must be engaged so that they accept and invest on the renovation of the built environment. Municipalities are given the responsibility to ensure this sustainability transition. In 2019, the Dutch national program on natural gas-free neighbourhoods (PAW) provided subsidies to 27 pilot neighbourhoods to develop natural gas-free heat infrastructures so that the learnings can be used for the rest of the Netherlands. In 2021, approximately 25 additional pilots started.

These pilots are focused on the residents of the neighbourhoods who must adapt to the changes in the provision of the heat: all electric or sustainable district heating. Often these pilots are organized in the form of co-operative, who co-design this transition together with residents and with the techno-economic support from the municipality. Highlights from the Natural Gas-Free Neighbourhood case on the different levels are shown in Table 3.

Table 3. Highlights from the Natural Gas-Free Neighbourhood case on the different levels

Type of energy citizen		Description
Local Level		
Consumer and user	Engagement phase	Aware
	Features	Residents are part of the local cooperative engaged in transitioning the pilots into Natural Gas-free Neighbourhood
	Opportunities	Existing proximity supporting networks (associations, local active citizens); the decision to end gas extraction in Groningen and climate change is a driving force for commitment
	Risks	Unequal access to resources; limited citizen/consumer agency; transition can feel like an obligation if imposed by the government; lack of clarity about reasons and cost for gas disconnection

Business entity (building owner)	Engagement phase	Involved
	Features	Building owners are part of the cooperative managing the process
	Opportunities	Involve owners in the conversation as gatekeepers towards inhabitants
	Risks	Lack of openness to inhabitants needs, requirements and assistance
Policy maker	Engagement phase	Advocate - championing
	Features	Municipalities have the responsibility to orchestrate the initiative; in some pilots they are part of the cooperative; they receive information through an online platform and via Knowledge and Learning Programme; through the Learning Cycle they engage with citizens in several meetings
	Opportunities	Intra-municipality networking through exchange platform improves the awareness on strategies, bottlenecks, and issues in the transition. Inter-municipality networks through nationally financed Living Labs and stable meetings with the citizens
	Risks	Integrated cooperation appears to be new and sometimes (too) complex; no one form of participation that is appropriate everywhere; (technical) knowledge and expertise gaps; regulatory complexities and administrative delays
Local energy initiative, energy community, collective	Engagement phase	Advocate leadership
	Features	The local cooperative was the gatekeeper to start and manage the process
	Opportunities	More trust from residents; residents' cooperative can give advice on suitable, competent contractors
	Risks	New social roles and responsibilities that require significant public support; higher implementation costs than expected; implementation and coordination of the activities appears to require more time and capacity
Regional Level		
Local energy initiative, energy community, collective	Engagement phase	Active
	Features	“Sustainable Coalition” of local stakeholders at regional level (housing corporations, grid managers and (representatives of) companies and residents)
	Opportunities	The coalition accompanies the transition until it is adopted by the municipal executive and council. It is a control entity for the consistency of the process
	Risks	Reduction of involvement in the moment of the transition adoption by the municipality.
National Level		
Policy maker	Engagement phase	Advocate - championing
	Features	PAW will support all Netherlands neighbourhoods to become natural gas free by 2050, hence they are financing the transition of 27 pilot nhoods (2019) + 19 additional pilots in 2020
	Opportunities	As an inter-administrative program, it allows for different government sectors to be involved. The monitoring activity allows to reframe actions by gathering qualitative and quantitative data
	Risks	Implementation gap from the National policy provision to the local implementation
Virtual Level		
Consumer and user	Engagement phase	Involved
	Features	Webservice "Home Energy Savings Explorer" has been developed to make homes more energy neutral. Several guides and roadmaps developed by Milieu Centraal to a sustainable and energy-efficient home
	Opportunities	Support at domestic scale
	Risks	Lack of digital literacy from the users
Policy maker	Engagement phase	Active
	Features	Support for TVHs and district implementation plans: preliminary analysis of PBL and the Guide for Local Analysis of ECW
	Opportunities	Provision of a space for training, support and stable knowledge-making
	Risks	-

Business entity	Engagement phase	Advocate (knowledge centre)
	Features	ECW supports municipalities technically, economically and in terms of sustainability in the heat transition of homes and buildings
	Opportunities	Clear communication strategies on their platform to develop heat transition; dashboard provided to municipalities to monitor the end costs of heating strategies
	Risks	-

Remarks and insights on geographical levels

This case is exemplary of a multi-level approach. Even though the trigger for the ecological transition came from a regional level (Groningen region gas fields), this case study shows clearly a national-wide political will and power to enable energy citizenship; at the same time, energy citizenship emerges locally, as interactions happen between residents, building owners and municipality members. The latter are crucial gatekeepers towards the National government as they are also meant to be the directors of the heat transition according to the draft Climate Agreement. The levels of emergent of energy citizenship are plenty. From the national, the level that kicked off the process, where the decarbonization policies are territorialized and governed; the local dimension, with Living Labs managed by the municipalities, which hold large responsibility for the success of the process and for solving bottlenecks; the virtual dimension with the Knowledge and Learning platform involving the municipal level in sharing drivers and barriers. The monitoring system (PAW Monitor) is tailored to a local level, foreseeing different data collection methods (interviews in the local Living Labs, monitoring, scientific analysis) which are mainly focused on the dimension of the neighbourhood and its gatekeepers or active communities.

3.1.3 Coopérnico – Renewable Energy-Driven Cooperative, Portugal

Coopérnico is a renewable energy cooperative with pioneering features for Portugal. It is a non-profit institution that crowdfunds solar PV installations and partners with a supplier to sell virtual solar electricity to members at competitive rates (Nordholm and Sareen, 2021). The Cooperative supports the development of new renewable energy power plants financed by its members and it provides green electricity, delivering energy services to citizens and SMEs.[1]

Its members are generally well informed as to matters linked to sustainability, energy efficiency, and renewable energy. By integrating this renewable energy cooperative, geared towards societal economic and environmental benefits, and by adopting home energy management systems, which allow them to monitor and better understand

[1] https://www.smart-energy.com/start-up-zone/portuguese-communities-go-green-with-novel-energy-cooperative-model/

their energy behaviours, Coopérnico's citizens already take a citizenship-active approach.

Coopérnico's vision, however, is to reshape the energy sector entirely, gradually increasing the number of citizens engaged in a more decarbonized and socially just society. Therefore, Coopérnico relies on spillover and network effects stemming from its growing customer base, and on its national lobbying and community engagement activities. Thus, this case study's goal is to inform on processes that may lead already energy-active citizens into even bolder community action towards the clean energy transition, towards what could be considered an activism-like level of engagement. Highlights from the Coopérnico case on the different levels are shown in Table 4.

Table 4. Highlights from the Coopérnico case on the different levels

Type of energy citizen		Description
Local Level		
Citizens (supplier and member at the same time)	Engagement phase	Advocate - championing
	Features	The Cooperative was funded by 16 pioneer citizens in 2013 with the idea to support a sustainable development. Citizens are both customers and owners of energy cooperative Coopérnico.
	Opportunities	A lot of citizens decided to join the Cooperative after 2013. Nowadays the Cooperative counts for 2295 participants that take a citizenship-active approach.
	Risks	Competition mechanisms between members of the community; benefits-duties balance within the cooperative; knowledge gap of members of the cooperative
Small-medium enterprises (members)	Engagement phase	Active
	Features	The project integrates also small and medium enterprise as members of the Cooperative.
	Opportunities	Interaction with SMEs enables possible co-funding mechanisms of the cooperative
	Risks	Privatization or commodification of the profit of the cooperative
National Level		
Policy maker	Engagement phase	Advocate
	Features	Support the development of similar experiences in Portugal. Coopérnico is seen as a pilot successful project that can support a spillover and network effect.
	Opportunities	Reshape the Portuguese energy sector gradually, increasing the number of citizens engaged in a more decarbonized and socially just society
	Risks	Subsidiary mechanism that risks not to lead to a real policy change
Supranational Level		
European federation of citizen energy cooperatives (REScoop)	Engagement phase	Active - sponsor
	Features	Coopérnico is part of REScoop project that supports citizens, businesses and local authorities that work on community energy.
	Opportunities	Exchange of knowledge, experiences, shared agendas
	Risks	Remain at the level of agendas, proposition, without formalizing a territorial commitment

Remarks and insights on geographical levels

The Coopérnico system works both the national and the supranational level of energy citizenship emergence and operations. The structure of the cooperative is polycentric and distributed, through its members, as gatekeepers towards heir different

communities. However, the local level is where the main active members of the cooperative act, seen more as where energy citizenship operates and produces results, rather than emerges. At the same time, the target of Coopérnico lies in the restructuring of the energy system, which for this case study engages the national level as the main subject of their lobbying action. In fact, Coopérnico was started out of inspiration from cooperatives in other parts of Europe, most significantly from Som Energia in Spain, but also out of observing the huge need for change, fairness, and democracy in the Portuguese energy sector.

3.1.4 UR BEROA – Energy efficient-driven cooperative, Spain

UR BEROA is an energy cooperative formed by the residents of a small neighbourhood of San Sebastian, Spain. It supplies domestic hot water (DHW) and community heating to its members. It was established in 1985 by the neighbours, when they acquired the private company that was providing those services until that moment. The cooperative is currently made up by 570 members and it supplies its services by district heating based on a cogeneration system.

Along the years since its foundation, UR BEROA has evolved towards cleaner and more efficient energy solutions and technologies: from using fuel oil and gas to introducing the cogeneration engine, along with energy meters in order to measure the consumption of each household. The next step taken was towards the introduction of cleaner energy sources, with the deployment of a biomass boiler. Other measures related to energy efficiency were also taken, such as performance improvements in the main plant and substations and the upgrading of monitoring systems. With regards to the future plans, the cooperative is in negotiations to offer its services to a group of 237 households close to the neighbourhood, analysing how to implement collective self-consumption and how to generate other energy services and infrastructures for the community (e.g. e-mobility). Highlights from the UR-BEROA case on the different levels are shown in Table 5.

Table 5. Highlights from the UR-BEROA case on the different levels

Type of energy citizen		Description
Local Level		
Consumer and user	Engagement phase	Active - frontrunner
	Features	Residents are the core of the community
	Opportunities	Reduce emissions and saves money while minimizing environmental impact; High income neighbourhood, low unemployment
	Risks	Exclusion of some inhabitants' categories
Business entity (residential building owner)	Engagement phase	Involved
	Features	The cooperative is in negotiations to offer its services to a group of 237 households close to the neighbourhood
	Opportunities	Implement collective self-consumption and generate other energy services and infrastructures for the community
	Risks	Lack of commitment in the needs of the residents
Policy maker	Engagement phase	Involved

	Features	San Sebastian Municipality looks at the experimentation of UR BEROA with the desire to replicate it in other urban areas
	Opportunities	Political commitment to upscale the process by learning from the specific case
	Risks	Replication without proper contextual analysis might lead to enforce measures to areas which might not be ready for these changes
Policy maker	Engagement phase	Involved
	Features	"Fomento de San Sebastián SA" is a municipal public company dedicated to the promotion and economic and social development of the city through innovation, all under sustainability criteria.
	Opportunities	Intermediation and negotiation action for translation of needs on both community and institutional level
	Risks	-
Local energy initiative, energy community, collective	Engagement phase	Advocate - championing
	Features	The Community, UR BEROA S.Coop formed in 1985, is managed by the neighbours and made up of 584 associates.
	Opportunities	Presence of a very active neighbourhood association (Grouping of Communities of the Polígono de Bera Bera); bring the best possible economic conditions so that the compensation of the partners is adjusted to the cost of services and supplies, and the general costs of the cooperative
	Risks	High investment is needed to renew the facilities (2 million euros). In this context the union with the technological company Giroa Veolia was born in 2017; cooperative's social capital is made up of the mandatory or voluntary patrimonial contributions of the partners
Regional Level		
Policy maker	Engagement phase	Active - sponsor
	Features	Service in energy-related matters at the Department of Economic Development and Infrastructure of the Basque Government.
	Opportunities	Ente Vasco de la Energía provided financial support for several of the investments
	Risks	-
National Level		
Policy maker	Engagement phase	Active - sponsor
	Features	National strategies, in line with EU Commission, need for a more reliable, cost-effective and secure supply of energy, combined with growing concerns over climate change.
	Opportunities	Territorialization of national agendas
	Risks	Shift of commitment based on larger policy agendas (e.g. economic or sanitary crisis) or political orientation and change.
Supranational Level		
Local energy initiative, energy community, collective	Engagement phase	Advocate
	Features	UR BEROA is member of the Spanish National Research Team (NRT) of H2020 COMETS, aimed at developing a joint understanding about the development of Collective Action Initiatives
	Opportunities	Benefit from the networking and learning that arise from the questions of other members of European project networks; gain increased visibility and recognition.
	Risks	Reduction of attention when the projects are over

Remarks and insights on geographical levels

UR-BEROA is an historical experience of energy community in Spain. Its geographical relevance is evident at the local level, where the energy community was set, and is currently acting as gatekeeper for the residents. The case, however, can count on a

high-income neighbourhood, with reduced social mix and low unemployment. These data indicate a community which is likely to have high scholarly and technical levels, with young inhabitants, hence a favourable environment for climate issues to be accepted and embraced (the richness in renewable technologies in the neighbourhood demonstrates it) as shared challenges. But also, an area in a good position when it comes to invest in the cooperative and a frontrunner in collaboration, thanks to the extensive presence of a long-lasting legacy of associationism and participation, both in social and energy issues (e.g. Consumer Groups, neighbourhood associations). Overall, this case shows promising insights when it comes to understanding socio-cultural mechanisms triggering interest in energy from residents of a specific neighbourhood. The variety of EU projects that took this case study as a reference, contributed to strengthening its supranational platform, providing additional resources, connections and knowledge.

4 Taxonomy of energy citizenship emergence in different geographical levels, barriers, and drivers

4.1 Energy citizenship and geographical levels

This part identifies the relations among energy citizenship and geographical levels and why it is important to assess them.

After a preliminary introduction this section provides a categorization of each defined geographical level, their proximity domains, the dimensions behind, what elements describe them, the drivers, and barriers.

This work stems from the premises that energy citizenship is the result of interaction between the different categories of energy citizens (see WP1) arising from the unique, contextual, place and policy-specific combinations of forces (Storper 2011) that cannot be modelled but can be captured in descriptive typologies. This interaction is triggered by proximity (Torre and Rallet 2005; Boschma, 2005; Melkas et al. 2016), intended as “concentration” and “closeness” as elements that enable links and stimulate collaboration networks thanks to daily (or sporadic) contact and exchange. Proximity is a reference lens from which to describe the levels of energy citizenship emergence. It can be manifested in very different ways depending on the type of relationship to which it refers and the level at which these relationships are taking place: spatial proximity, social proximity, policy proximity, technological proximity, economic proximity. However, the common thread lies in the content, the purpose of the relationship that determines the level of proximity: this assumes fundamental importance in the interactions for the emergence of energy citizenship.

The nature of socio-technical transition processes (Raven et al. 2011) over the years has been increasingly marked by a relevant poly-centric orientation (Ostrom 2010a; Ostrom 2010b) that has produced profound implications on spatial, political and social structures (Soja 2011). This orientation is evident in the European context, where it is also expressed through a detachment of 'new' units of governance from the 'old' administrative areas enclosed within institutional boundaries, which sometimes triggers phenomena of institutional renewal and territorial regeneration caused by the emergence of new public/private actorship.

Energy citizenship appears to be strongly linked to the possibilities opened by these new geographical aggregations, produced by interaction between citizens (active or not), between citizens and institutions, between citizens and the environment, building community ties that lead to collaborate to respond to collective goals (lower consumption, lower energy expenditure, to name a few).

In this regard, this taxonomy does not necessarily create closed perimeters for the detection and analysis of energy citizenship. The boundaries among different levels are porous, ready to be opened and to interact among them, in the multi-level perspective logic (Raven et al. 2011; Coenen et al. 2021). For example, energy citizens might be influencing and active outside their own geographical level (e.g., a local energy community can be taken as a national good practice to persuade others to engage in this initiative). Therefore, the distinction among levels should be intended for the purpose of ease of description and not as a fixed categorisation parameter.

However, administrative distinction and differences (also in classification) must be taken into consideration, as they contain useful variables to differentiate one context from another when it comes to domains for energy citizenship emergence. For comparability reasons, the European territory is formally classified into regions at three different levels (NUTS 1, 2 and 3, respectively, moving from larger to smaller territorial units). This classification allows for cross-border statistical comparisons at various regional levels. Furthermore, a system of local administrative units (LAUs) allows to localize statistic data, to be compatible with NUTS. LAUs include municipalities and metropolitan cities in the European Union.

The following Figure 2 shows the connections among levels, domains and dimensions.

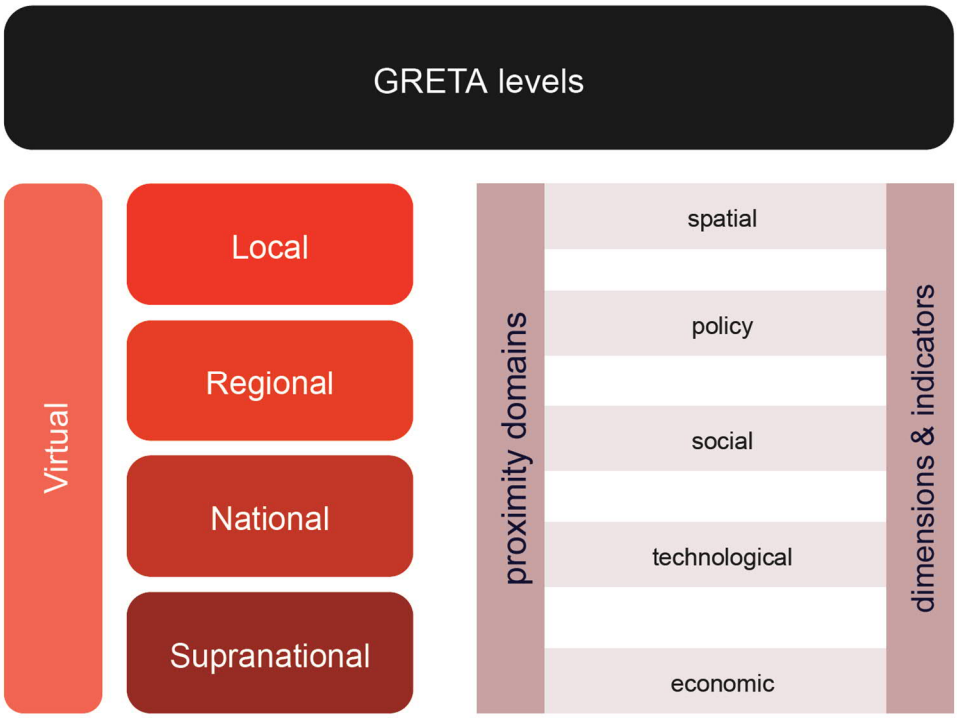

Figure 2. Scheme of the taxonomy of geographical levels

The domains are described as follows:

- The spatial domain describes the physical proximity between people, and between people and the sources of energy (mainly related with availability), and the interdependency between the municipality, its underlying (infra)structures and citizens. Different urban and rural morphologies can benefit or limit energy citizenship through the connection with their contextual characteristics. Proximity between people is enhanced by the spatial clustering dimension of their living environment (buildings, blocks, neighbourhood), as well as spatial morphology. Furthermore, the spatial dimension includes a reflection on the natural environment and ecosystem of a specific context which can include different types of resources for energy production, while the networked nature of the energy system itself produces diverse geographies (Bridge et al. 2013); space has also to do with the climatic dimension, when dealing with energy, this is important for the type of energy used and their efficiency.
- The policy and governance domain defines management and planning measures (along with more general measures such as taxation and technological innovation) that are taken at the institutional level. The political dimensions provide guidance to establishing and supporting energy citizenship, including the overall regulatory framework, enabling, or hampering the free association of people, the decentralisation of the government structure towards subsidiary outposts, the presence of institutional innovations such as green public procurements – in short, all input and output dimensions of good governance. This entails also institutions decentralizing energy pathways; it also entails the proper development of financial incentive schemes which favours small-scale production over centralized approaches.
- The social domain identifies the relationalities connecting the members of local communities considered as energy citizens, as well as the proximity between people and institutions. It closely relates to determinants established in D1.1, such as social identity, social cohesion, and group identification. These relational ties are therefore shown to frame the modalities within which energy citizenship forms and grows. They can be intentional, issue-oriented (Ryghaug et al. 2018), purpose-, project- or practice-led. This indicates the coexistence of a group of individuals, with like-minded interests and behaviours in a communal space, who interact not just in a defined geographical area but mutually identify as a group which shares competences born from common interests, values, resources, projects (i.e., ad-hoc communities, communities of practice re-shuffling according to the topic of interest). They can thus be transient. This relational local level is more likely to consider loose and weak ties among people, opening up the possibility to consider also local/grassroots initiatives dealing with sustainability not only directly related solely to energy (single purpose) but also including a variety of environmental and societal aspects (multi-purpose and transversal). Proximity in energy-related values is in many instances spatially differentiated as well – e.g. drivers like anti-nuclear attitudes or desires for self-sufficiency vary across regions (Laes et al. 2014; Toke 2011).

- The technological domain entails the proximity with technologies and digital solutions. ICTs are often leveraged to involve people in setting up an energy community, informing with data better energy behaviours, enabling small-scale smart solutions, and capitalizing on investments made in renewables; furthermore, the degree of technological progress can provide space or not to further energy development and the diffusion of innovations, by aggregating them into smart platforms. ICTs and cloud-based solutions also enable the aggregation of small-scale energy producers into virtual power plants which can operate on the electricity market as larger actor.
- The economic domain, with the market, sustainability, and economic factors, expresses the conditions of convenience for the energy system, utilities, and end-users, supported by the proximity among producers, distributers, consumers. The economic domain also entails the accessibility to the system of incentives and support to foster energy transition inversion as well as to enable the aggregation of individuals to tackle energy issues. A final remark regards cluster economy mechanisms, which are deemed pivotal in promoting new culture of cooperation (as well as competition), where diverse stakeholders have the same rights and obligations.

These domains are further deepened for the deployment of the taxonomy of geographical levels that follows.

4.1.1 Local level

The local geographical level can be described through several domains. Neighbourhood, blocks, buildings, streets, are spatial poles of interaction enhancing exchange, agency, and conviviality, which have in the physical proximity their operative dimension, but also their social recognizable unit. These local units are portions of the city where complex dynamics of several distinct elements of the socio-spatial system manifest and are most likely to be visible.

Local level is meant as the social set-up which constitutes the background in relation to which collective actions become possible and acquire meaning; it enables links and stimulates collaboration networks thanks to daily contact and exchange. It is relational, based on trust, recognition, strong ties, reciprocity, and direct exchange. It gives shape to a community of people sharing ideas, perspectives, cultural values, and identities on a daily basis. It describes a specific site in a specific time, whose knowledge is identified as a "non-verbal […] that evolves from meeting to interacting with someone (or someplace) over time" (Yanow 2004; Durose 2009).

In the GRETA case of UR-Beroa, the local dimension of the energy community is paramount. It was born in a context where high level of engagement of citizens derives from a long-lasting tradition of collaboration and engagement on several local policy issues, including energy. Another factor is the wealth of the neighbourhood that matches with the increased chances of its inhabitants in getting involved in energy sustainable behaviours. These factors show that, on a social domain, the local community of UR-Beroa is characterized by strong ties, common norms and high network density.

The local knowledge is both contextual and contingent and reflects expert understanding from action and reaction (Balest et al. 2018) of actors in their lived experience. This level of locality enables the construction of shared intentions but might prevent the necessary acquisition of further knowledge, if information is not transferred to other actors, also with different knowledge interests.

This geographical level takes advantage of the potential for small-scale power generation—home-scale devices, like *Rooftop wind turbines, solar panels, heat pumps, bioenergy, micro-hydro*—which could co-evolve towards a more engaged and aware public. The local dimension in fact, is where technological interventions (micro-generation plants, domestic devices) can raise awareness on energy issues in everyday life, closing the current knowledge gap between personal energy consumption and the consequences for climate change (Devine-Wright 2006). One of the main factors influencing the contextual conditions for energy citizenship operation is strongly linked to the local plants' installation used for the renewable energy supply. The closeness (or distance) to such energy plants influences both the engagement of local communities, but also contributes to making the energy topic "visible".

In the cases of Svalin (Denmark), Magliano Alpi (Italy), Melpignano (Italy) and Banister House Solar (UK) the plants are mainly photovoltaics installed on neighbourhood buildings. The local plants that produce renewable energy can also be solar collectors, supplying collectively owned district heating networks, as the case of Marstal Fjernvarme (Denmark), or the case of the Solbyn co-village (Sweden) with the integration of photovoltaic and wind shares.

The local level allows to see directly some potential benefit such as the economic ones, as it is thought to enable the peer-effect (Heiskanen & Matschoss 2017), where an individual example might influence neighbours to take actions and invest in both individual and collective energy efficient behaviours.

The discourses on energy citizenship, share the assumption that local projects are more likely to succeed in engaging citizens to participate (van der Schoor and Bert 2015) and end-users to successfully exchange their practices. However, this assumption does not directly indicate that bringing energy systems geographically closer to people will generate more public participation and engagement (Walker et al. 2021). Walker et al. (2021) highlight the risk lying in the presence of a project funded from central government, where there might be ambiguity in "local" priorities (Catney et al 2014), which are influenced by national or international interests.

The Pilastro-Roveri case, for example, is enriched by the presence of a large number of active citizens, associations, NGOs, but also renewable sources of energy (PV panels) and a district heating system. Despite the proximity of the energy source to the inhabitants however, the participation of the neighbours did not happen easily, as the local energy community process still needs to be strongly guided by policy-makers, while inhabitants might undergo "community fatigue".

Here, the role of policies and policy-makers is key. Local governments, through their planning framework, contribute to describing and committing to the set of public decisions, and the corresponding system of actions, to solve collective local issues and to orient the action of the actors. The local policy domain in fact requires to "both deliver policy and build networks and relationships within the local community" (Rhodes 1996), by generating change in the engagement and networking of diverse actors. This is done primarily through the provision of participatory processes, which include local welfare issues, and help generate change and build networks.

Drivers and barriers to local energy citizenship emergence

The relatively high amount of trust, common aims, language, and values triggered by the local level, can make citizens activation and awareness easier and provide them a platform to interact on energy issues. Closeness, however, does not always mean social and cultural homogeneity, but divergence and conflict could be easily recognized and addressed in the local dimension. In fact, raised awareness might also suggest new potential for more self-interested energy behaviours (Devine-Wright 2006). At the same time, strong local ties could even prevent innovation and activation towards new emerging societal issues, creating a barrier in the emergence of organizations around energy. As Andersson indicates (2001), in case of low or no diversity and change in local ties, people are less likely to adapt to new trends or directions (Andersson, 2001). In fact, outside members contributing with innovative ideas (Burt, 1992) and diverging point of view to the status quo, could help citizens at the local level to organize and act towards a shared goal.

Furthermore, the local level should not only voice the needs or operate at district or municipal scale, but it needs to have a metropolitan perspective. This foresees to engage competitive communities, aimed at strengthening the international role of local environments by also pursuing economic growth. This municipal dimension allows to

open to a multiplicity of dynamics, concerning peripheries, vulnerable environments, smaller fractions, rural areas or mountain areas.

4.1.2 Regional level

The regional level is the most common dimension where energy citizenship, especially energy communities, have been put forward. The regional level in fact, has been better tailored to develop coherent energy development visions (Späth and Rohracher 2010) for the future as well as to translate them into practical strategies focusing on an exploitation of multi-level energy potentials.

The spatial domain of regions at EU level corresponds with their various forms of institutional aggregations: climatic regions, including trans-regional agglomerates, outermost regions like islands, archipelagos, mountain, sparsely populated areas and land territories; they are *administratively identified* as: intermediate level between State and cities (Italian, French, etc.), sub-statal entities (Germany "Länder") or federal autonomies (Spanish "Comunidades Autónomas", rumenian "voivodati"). Following processes of globalization, urban agglomeration, and economic development, the space of the regional level has been also including large trans-metropolitan spaces (Soja 2014; Harrison and Hoyler 2015) merging metropolitan areas into "more flexible, networked, and smart forms of planning and governance" (Zimmermann et al. 2020), new expressions of territorial cooperation and conflict around issues and agendas of collective provision, such as energy.

The regional level is evident also from the different energy sources around which energy citizenship emerges.

At regional level, plants are both large photovoltaic plants installed on roofs or in rural areas, as the case of SAS Ségala Agriculture et Energie Solaire Cooperative (France), a company created to install solar PV on agricultural buildings. Biomass plants supplying district heating network characterize at regional level the cases of Tirano (Italy), Thessaly (Greece) and Basque Country & Navarra (Spain).

On the policy domain, this level entails forms of multilevel governance, linking initiatives from the bottom-up with institutional actors, as well as multi-interest stakeholders, towards a common goal, in a more networked governance (Blasch et al. 2021). The regional level seems to enable the implementation of energy citizenship through the formation of an efficient combination of control and flexibility. This level allows to highlight interesting public procurement mechanisms for territorial partnership towards the goal of energy efficiency and engagement. For instance, the large strategic dimension of regional planning, with its orientation framework, allows to embed private-led, bottom-up initiatives and regional stakeholders in its schemes and arrangements. Pioneering regions can create incubation chambers for energy community innovations – e.g. the regional government of North Rhine-Westphalia in Germany introduced an incentive mechanism for renewable energy in 1987, called the Rational Use of Energy and the Use of Renewable Energy Sources support programme,

which was very suitable to the needs of small-scale project development (Breukers & Wolsink 2007).

On a regional policy level, some experiences are worth to comment.

France for example, has introduced a *territorial development strategy for renewable energies*, jointly designed with all the stakeholders to facilitate the development of agreed, cooperative projects. Under the proposed method, the scheme would operate through energy transition committees, bringing in elected representatives, socio-economic actors and citizens. Thanks to public involvement, choices have been guided by the needs expressed by local populations, making it easier to ensure ownership of the new challenges.

The Region Emilia-Romagna (Italy) produced the *Labour and Climate Pact* together with the local authorities, universities, enterprises, trade unions and non-profit sector, to agree to full employment and green transition. The next European Structural Funds and European Social Fund 2021-2027, and other regional national and EU funds, will be programmed based on the Climate and Labour Pact that will engage all regional stakeholders to build a green transition. The permanent Pact Forum will ensure the broad participation and concertation of all regional stakeholders.

Also, the Netherlands with the *National Regional Energy Strategy (RES)* Program helps regions to achieve the phase-out of natural gas. The RES establishes how the sustainable generation of energy can fit into the spatial planning and the electricity network, and how support for the measures can be created in society. The national RES Program supports the regions in creating these RESs by supporting and sharing knowledge. It further connects parts/initiatives, highlights risks and threats and identifies linkage opportunities.

The regional economic domain of energy citizenship emergence can take advantage of a better control of structural funds distributions (e.g. through Cohesion funds), and is also crucial within a link with the *Smart Specialization Strategy* (S3), an "innovation policy concept designed to promote the efficient and effective use of public investment in regional innovation in order to achieve economic growth" (Cebolla and Navas 2019).

The regional dimension allows to bridge the proximity gap to the territories and at the same time to offer a privileged dialogue with energy providers and the national system of policies and norms. The regional social domain of energy citizenship emergence, can count on the collaboration mechanisms facilitated or hampered by regional schemes or processes.

Drivers and barriers to regional energy citizenship emergence

The diversity of the regional administrative boundaries at European level reflects the challenges posed by energy efficiency mechanisms and consequently the issues

concerning energy citizenship to emerge and operate at this level. Despite their administrative diversity though, these sub-state institutions in-between the national level and local governments seems to be the best candidate to get proper data on actors' attitudes, on policy frameworks and regulations, on financing mechanisms and opportunities.

Some of the barriers that can be identified, are related to the different meaning of regional level in the European context: the NUTS and LAU classification for instance, provides a differentiated pattern of the administrative boundaries of such level. This makes it difficult to have a clear picture of the available data and might even cause an overlap between different levels of energy policies (De Vidovich et al. 2021). Nevertheless, this variety also allows to intercept different factors that might influence the emergence of energy citizenship in a regional dimension, creating trans-national interest groups, climatic homogeneous areas, economic-functional clusters, that transcend the administrative border, but might enable cooperation when it comes to energy actions. This dimension is valuable in its acting as a bridge to the national and supranational levels on the one hand, and to the local on the other. On a policy dimension, this allows to territorialize some national normative framework on energy, as well as some international agendas and objectives. On the other hand, however, it is not yet clear how the regional level could voice the local instances towards the other levels. For example, diverging trends of decentralization/autonomy versus centralization of the regions, are difficult to consolidate in a local strategy. In this regard, this level might achieve a high degree of value towards fostering a networking dimension, where social cooperation mechanisms are achieved thanks to bond and exchanged via digital infrastructures and platforms.

The following parts seek to unravel the dimensions to which the regional level relates regarding energy agendas: the national and the supranational levels.

4.1.3 National level

The national level of energy citizenship emergence has mostly to do with the different countries' policies and political commitments but also with economic incentives and lobbying. National policies oversee the definition of priorities to achieve energy balance and efficiency between use and supply, to comply with global targets set. In this sense, the European Commission through the Clean Energy Package for all Europeans required the adoption of a National Energy and Climate Plan (NECP) for each EU Member State (EU Commission 2019). The Plans established national goals by 2030 focusing on energy efficiency, on renewable energy production and CO_2 emissions reduction as well as the goals on energy security and market competitiveness. At the same time, some national legislations are starting to recognize (and encourage) citizens associations (like energy communities) for improvement of energy consumption, as keys for the national strategy for resilience.

This has much to do with the current transition from centralized production sites to more decentralized and distributed systems (Ryghaug et al. 2018) that will open the opportunity for energy to be easily produced individually.

This is the case for example of Enercoop in France, an experience of regional collaboration, but managed by a national entity. Enercoop is a social enterprise cooperative, made up of 11 separate regional renewable energy cooperatives. The cooperative status allows it to lead a collective, united, and democratic project, working closely to the challenges of the territories so that the energy transition is citizen-led, but nationally sustained.

The national energy measures take advantage of the strategic national policy directions, including for example the Recovery Plans strategies and the national energy plans (if present). These national strategic policy frameworks include widespread reflections on the natural resources and energy systems technologies. The presence (or absence) and the degree of clarity of a national energy strategy, as well as of a political commitment towards energy issues (reduction of energy poverty, for example) is a clear indication of the possibility for citizens to engage with energy, at a national level. The distribution of energy technologies and the natural resources on which they are deployed across space often depends on their inclusion in a system of national policies and goals that are also tied to spatial legacies (including contested ones, see Bridge et al. 2013). The deployment and geographic spread of new and more efficient technologies plays a central role in energy citizenship emergence and deployment, and it finds in the national level its privileged dimension of investigation.

The national level action towards energy citizenship is expressed also through support and funding. National policy programmes enhancing energy cooperatives and communities (e.g., Dutch PAW, Italian energy communities and financial incentives to support built environment retrofitting, UK Community Renewables Initiative) are oriented towards the decentralization of energy production and broader goals of collective effort in the country decarbonization. The introduction of the Electricity Feed-in Act in Germany in 1991 and its successor, the Renewable Energy Sources Act, in 2000 are described in the literature as major drivers for community energy in Germany (Breukers & Wolsink 2007). Stable feed-in tariffs and a long-term perspective (20 years) were seen as major pillars providing planning security for smaller actors in the market. The reform of the German incentive schemes in the following years, which was accompanied by strong criticism from the representatives of the community projects, highlights how changes in the individual instruments and the policy mix as a whole can affect energy citizenship engagement in both ways. Mirzania et al. (2019) present further evidence on the sensitivity of energy community projects towards policy change in the UK.

Together with political support and commitment, the National level provides the rules and the space for action. This allows some experiences foreseen by a national legislation to also accomplish political goals, even though acting on a local dimension.

The GRETA case of Natural Gas-free Neighbourhoods in the Netherlands, is evidence of a national strategy to foster energy citizenship, showing the potentialities of a political decision (the Netherlands deciding that all its neighbourhoods will become natural gas free by 2050) and the operative territorialization of such political orientation through funding (they are financing the transition of 27 pilot neighbourhoods).

As an example, in Italy energy community initiatives have already shown how they can go beyond the simple interest of energy self-consumption or energy sharing indirectly reducing the energy expenditure of the individual, outlining for example interventions to combat energy poverty and foster a positive shift in energy consumption behaviours, or to promote the repopulation and the value increase of some areas of the country (like in the case of Magliano Alpi). On a similar note, the possibility granted by the incentives at national level for the energy efficiency of old blocks or homes provided by Italian Recovery Plan (e.g., Superbonus 110%), combined with business and governance models tailored according to local context and specific users' needs (e.g., One-Stop-Shop, Turnkeys, Public-Private Partnership), is bringing homeowners to take action upon energy consumption as well as to reflect on housing issues and criticalities.

Drivers and barriers to national energy citizenship emergence

The national level of energy citizenship emergence highlights mainly policy and economic domains of investigation. National legislations have the power to provide a political agenda into practice, by also operating some incentive mechanisms to encourage private participation in energy production, storage or even just better energy behaviours.

However, in light of contemporary globalization processes, it is urged to move beyond trying to drive energy transition processes from a narrowly defined national agenda. Indeed, geographic reality has become more interconnected, and the global scale is developing rapidly. Trans-local and trans-national network relationships and institutional interdependencies (Coenen et al. 2012) must be recognized even though they may extend beyond their sphere of influence. In this regard, the Supranational level seems to embrace this perspective as described in the following section.

4.1.4 Supranational level

The supranational level provides proximity mechanisms mainly through a policy action that is distributed throughout different countries and levels. It concerns the European and global agendas and goals to be achieved, energy-related agreements leading to international commitment towards energy behaviours, European pacts and agreements, as well as energy awards.

Included in the supranational dimension is the policy perspective provided by global and European framework on citizens' engagement in energy. Europe, in particular, set

its goal of becoming a global model in accelerating and facilitating the collective energy transition.

Energy citizenship and communities for instance, are increasingly being recognised by European policies as strategic assets contributing to reach the decarbonization goals. One of the main frameworks is the New Green Deal, which, among its main pillars, declares that forms of engagement in the energy domain are key determinants in meeting the 2050 goals of resources consumption and efficiency. Since 2019, energy communities formally appeared in the Clean energy for all Europeans package where they were put forward as legal resources for a long-term European strategy. Citizen participation and empowerment with respect to energy issues, is defined in detail by EU directives. These are concerned with implementing an appropriate legal framework, defining mechanisms for citizen participation in the energy market, how to share energy (collectively and individually), as well as storage facilities and means.

The principles expressed in the Green Deal have been further reinforced by the Fit for 55 (Renewable Energy Directive) packages, which calls for a 55 percent reduction in greenhouse gas emissions by 2030 and corrects the percentage of required renewable energy produced by 2030 from 30 percent to 40 percent. To achieve this collective goal, energy citizenship must be promoted as a complementary force that can contribute a large share of renewable energy production.

At the same time, the supranational level includes several initiatives – both part of formal government policy (C40, Covenant of Mayors) and outside of it (e.g., Transition Towns, climate movements) – that seek to strategically territorialize energy transition. Advocacy, lobbying, sensitization and support – but also dissent and conflict - of the political action are the goals of these experiences. A distinction can be made among networking supranational initiatives: institutional network-based coordinated actions and non-institutional, insurgent ones (Kern & Bulkeley 2009; Heidrick et al. 2016; Nielsen & Papin, 2021; Fisher & Nasrin 2021). The first group includes for example cross-national policies, cities networks, also called transnational municipal networks (TMNs), and climate initiatives such as the Green City Accord, the Smart City initiatives and others. The latter considers bottom-up led experiences such as Fridays for Future, Extinction Rebellion, and others.

These are considered key initiatives in creating the framework for political actions against climate change, boosting horizontal learning, which seems to improve urban adaptation measures. Some of them push political leaders to take specific steps

towards the development of planning processes for mitigation and adaptation, containing targets, actions and implementation strategies.

> The Covenant of Mayors (or Global Covenant of Mayors), for instance, requires its member to provide a Sustainable Energy (and Climate) Action Plan within two years from entering in the network. Furthermore, a unique feature of the CoM is the establishment of best practice and compliance mechanisms which are guided and monitored by the Commission's Joint Research Centre (JRC).

The advocacy action of organized or insurgent supernational networks, their lobbying efforts and political influence are strongly directed at acting to direct policy-makers, to produce operational guidelines, and to enable the largest access to shared knowledge more generally on the sustainability topic. Even though they cover broader aspects of climate change challenges, it should be noted that they shed light on several aspects of energy as well as support with guidelines, toolboxes, and data the possibility for citizens to activate and engage into any type of action, including advocacy one (Huybrechts et al. 2018).

> RESCoop.eu is the network of renewable energies cooperative, aggregating and supporting different experiences through Europe. The network allows to have a collective voice when interacting with the European policy makers as well as with the local public administrators or local energy managers. Furthermore, it provided a mentoring system and a toolbox to foster the engagement of citizens and local actors in renewable energy projects.

Taking a supranational perspective on energy citizenship allows for a better range of evidence regarding many citizens, including vulnerable categories and under-represented actors. Looking at this level is an opportunity to understanding the international, trans-local nature of energy transition dynamics.

Drivers and barriers

The supranational level of energy citizenship emergence is interpreted here as the level where transnational cooperation takes place. This cooperation has been recently materialized through transnational city networks for climate change adaptation, but also through international activism movements starting from the bottom-up and growing globally. Highly successful practices bringing urgent issues to the mainstream attention, they however might hide some barriers. Firstly, a large international network, might produce disparities between participants that are part of high-capacity and wealthier regions, compared to lagging ones. This risks to further exacerbate the distance in participation on energy matters, between citizens. The voluntary nature of these initiatives, however, seems to see a higher participation from policy-makers that are lacking national support, in terms of planning instruments and policies, turning these networks into unique chances to engage and be involved in energy issues.

Similarly, the supranational nature of climate activism initiative hides some possible barriers to energy citizenship emergence. They might risk excluding some specific

targets, geographically distant ones, fragile and vulnerable ones, which do not have the means to access the tools and the communication means provided. Moreover, the extent and dimension of such networks might tend to an excessive generalization of the issue, acting only as an informative level, rather than an operative one, especially concerning energy.

As a final remark, the supranational dimension of the transnational networks has a strong virtual counterpart, which, in most cases is pervasive in all possible channels. This aspect is analysed in the next section.

4.1.5 Virtual level

Understanding actors' behaviour requires understanding the influence of various dimensions at different levels. Even though several authors observe that engagement and participation are mostly situated and limited within geographical, cultural and material constraints (Ryghaug et al. 2018), there is broad understanding of the necessity especially for citizen-led, innovative actions, to transcend the local boundaries in order to acquire legitimacy and voice citizens' needs. While the local scale may sometimes be empirically the most determinative, globally active actors can also develop dependencies on the local places with which they have key relationships to achieve their goals. Similarly, local community initiatives, can achieve substantial power when clustered into a global dimension. Thus, we can say that proximity interaction need not be exclusively local or physical but can also occur in many places simultaneously with actors active at multiple levels. This scalar shift (Coenen et al. 2012) could shed light on qualitative transformations in the functioning of processes in a specific context, from being personal, negotiated, and contingent, to transactional and generalized.

Under these assumptions, the virtual level acquires key importance in the energy citizenship emergence discourse. The level of virtual proximity refers to the relational closeness between individuals, developed using information and communication technologies (Coughlan 2014). It provides the space for the development of collective entities owning the typical characteristics of the community resulting from simultaneous local and global relationships, more like a series of singularities owning responsibilities, autonomy and desiring to actively be engaged in society.

The virtual level is evident in some case studies that make use of digital infrastructures to aggregate knowledge, to support with information and to enhance the participation of a broader number of citizens in specific initiatives.

One of these is the case of Som Mobilitat (Spain) that works by using an online digital platform for providing sustainable mobility services and by operating at local groups level as well as at supranational level to share good practices and resources.

Another example is the MobileCityGame virtual community developed by Fraunhofer and applied in the City of Karlsruhe (Germany). It is an online digital game used for the real-life simulation of cities for demonstrating the complexity of the sustainable urban mobility sector and supporting citizens' engagement in the energy transition.

Virtual proximity works on the identification of issues to share knowledge from and to build relational ties that often can even lead to a design dimension. The platform dimension is often the main space where virtual interactions emerge around specific topics. The platform allows participants to perform their citizens' rights in an open environment, a digital public space that provides them knowledge, tools for action and connects them to other users with the same needs or desire to be engaged in a certain matter. The knowledge is often diffused using the virtual level for training and learning, defining also mentoring mechanisms and exchanges among the different experiences of energy citizenship. A virtual level of engagement is the space where energy citizens of different types are given support with policy and technical advice, methodological tools, mutual learning and interlevel cooperation.

Finally, we must recognize that the Covid-19 pandemic induced diffused reactions to a global emergency that set the ground for new experimentations interconnecting people involved in different countries through transmedia formats. It has shown that the virtual is not opposed to the real but blended and just as "real" for the users as the in-presence contacts and behaviours.

Drivers and barriers

The virtual level of engagement for energy citizenship emergence is considered as transversal to the above-mentioned levels. In fact, it is inherent in the virtual dimension; the possibility to incorporate different geographical dimensions as well as to facilitate energy citizenship on multiple domains. This is the main driver of this level, the capacity to bridge levels and engagement stages, and providing a distributed, non-hierarchical supporting network. This is the element that allows energy citizenship to receive support, access to financing, to upscale, to be replicated and eventually to bridge individual gaps, through knowledge sharing.

Considering this, the *Smart Specialisation Platform on Energy (S3PEnergy)* is an example of an enabling platform supporting the implementation of the Cohesion Policy funds for energy, and for the promotion of activities for achieving a shared vision on knowledge-based energy policy. The S3PEnergy works with EU territories to better align energy innovation activities in the implementation of their S3 in energy.

The digital dimension though is commonly thought as a barrier for the participation of specific categories, losing the pervasive power that stands in its premises. The digital divide, in fact, shows an increasing inequality in access to and use of technologies, especially for specific categories: the elderly (the so-called "intergenerational digital divide"), women not employed or in particular conditions (the so-called "gender digital divide"), immigrants (the so-called "linguistic-cultural digital divide"), people with disabilities, people in prison and in general those who, having low levels of schooling and education, are unable to use IT tools. The inability to access information, and participate in online initiatives by these subjects, prevents the individual the regular exercise of their rights, qualifying as a loss of opportunity for inclusion.

4.1.6 Proximity Domains and Geographical Level Matrix

This section contains an abridged version of a Proximity Domains and Geographical Level Matrix (Table 6). In this Matrix, proximity domains and geographical levels are set into relation and completed with a description, the identification of indicators (to be completed with T5.2) and a reference to case studies. The complete matrix is available in Annex B. The Matrix is intended as a first attempt to detect and systematize specific dimensions linked with the proximity domains and to locate them in their more usual geographical level emergence. This analysis has been supported by the analysis and observation of case studies.

Table 6. Proximity Domains and Geographical Level Matrix

(L: local; R: regional; N: national; S: supranational; V: virtual)

Proximity domains	Dimensions	Geographical Levels					Descriptors
SPATIAL DOMAIN		L	R	N	S	V	
SPATIAL	Urban structure	x					Types of structure (neighbourhood, block, building, others)
	Climatic area / region	x	x	x	x	x	Homogeneous climatic area (similar climatic conditions / necessities)
	Resource availability	x	x	x	x	x	Availability of natural resources to be exploited (eolic, solar, others)
	Energy infrastructure closeness	x	x	x			Presence of energy plants in an area; presence of existing energy infrastructures
	Cluster and activities closeness	x	x	x			Physical presence of associations, groups of firms, institutions, clusters, etc
POLICY DOMAIN		L	R	N	S	V	
POLICY	Political agendas	x	x	x	x		Presence of strategies, goals, actions and an agenda on transition goals; presence of green procurements mechanisms
	Administrative structure (across levels)	x	x	x	x	x	Hampering or enabling aggregating mechanisms and agency
	Regulatory framework	x	x	x	x	x	Structure and presence of norms habilitating or not people/tech aggregations

SOCIAL DOMAIN		L	R	N	S	V	
SOCIAL	Community dimension	X				X	Presence of community bonds or ties; presence of leaders or spokespersons
	Collaboration mechanisms	X	X	X	X	X	Presence of active associations, third sector, social enterprises, community projects, practices, civic actions
	Knowledge and learning	X	X	X	X	X	Presence of specific training programs on energy; presence of network with other cities/regions in order to learn from peers; training on technical aspects, other
	Energy Awareness	X	X			X	Presence of specific awareness goals under the energy citizenship configuration.
TECHNICAL DOMAIN		L	R	N	S	V	
TECHNICAL	Energy system	X	X	X			Energy system structure, management and characteristics (e.g. hierarchical or distribute structure)
	Technological readiness	X	X	X		X	Readiness of the context in relation with technology, e.g. electric vehicle distribution, presence of the recharging stations, energy grid, etc
	Technological appliances	X				X	Presence and distribution of devices (e.g. small-scale home devices; urban devices; etc)
	Enabling structures	X	X	X	X	X	e.g. supporting online platforms; digital twins, control rooms, sharing platforms, ICT coverage (e.g. wifi free connection hotspots; 3/4/5g networks)
ECONOMIC DOMAIN		L	R	N	S	V	
ECONOMIC	Energy system economic structure	X	X	X	X	X	e.g. energy price; subsidies for renewable energy transition; etc
	Energy system enabling economics		X	X			Presence of incentives (national, regional or others); innovative business models; etc
	Value redistribution / inclusion mechanisms	X	X	X		X	Presence of mechanisms related with energy poverty
	Cluster economy	X	X	X			Concentration of entities representing non-governmental organizations, traditional and socially-oriented enterprises and other institutions

5 Discussion

The taxonomy on emergence of energy citizenship in geographical levels started from the observation of citizenship and its energy mobilization with the lenses of proximity. Proximity is meant as a re-connecting practice, to bridge the disconnection gaps (production and distribution process, organization process, governing structure) that characterizes citizens and the energy system. Proximity seems to change in its domains at different levels, with patterns that help to understand whether energy citizenship has a chance of emerging and thriving. Proximity concerns an exchange of knowledge that can occur at multiple levels. In fact, if codified knowledge travels on a global scale thanks to increasingly fast and pervasive means of communication, tacit and rooted knowledge still responds to the network logic of territorial systems and to the specificities that characterize the local level and the interactions and community ties that are operational to respond to decarbonization goals.

This led traditional geographical correspondences to break down and be redefined within areas that have much to do with new territorial units based on proximity purposes, with variable and temporally unstable boundaries, linked to specific projects, oriented by economic processes, contingent, local, or global. Through the GRETA case studies' analysis, we see the definition of new and dynamic territorial geographies, constituted by unprecedented aggregative constellations characterized by dynamics of cooperation between actors of various kinds (institutional and non-institutional) and territorial areas often not included within institutional boundaries.

5.1 Multiple geographical levels of energy citizenship emergence

This deliverable highlights the importance of considering several geographical levels, when looking at "where" energy citizenship emerges and acts. The taxonomy describes different geographical levels and their main characteristics:

The local level is where proximity relationships are encouraged thanks to spatial closeness and clustering, daily and frequent social interactions, possibility to have domestic technological experimentations, policy territorialization and promotion of an economy close to peoples' living environment. The local level is commonly recognized to have better chances to lead people to participate in energy issues (van der Schoor and Bert 2015), even though this is not automatically granted only by the proximity of the people close to the energy source (Walker et al 2021). The local policy dimension is, in fact, fundamental in allowing to clarify action framework towards energy, but also to create relationship and networking opportunities (Rhodes 1996), as well as facilitate economic incentives. The local, is the level where energy citizenship initiatives might easily be born and have broader success, due to the high amount of trust, common aims, language and values developed through daily close interaction.

The regional level is administratively identified as an intermediate level between State and cities, sub-statal entities or federal autonomies. This level usually provides a larger strategic planning framework which allows to easily embed private-led or bottom-up experiences around energy, such as energy communities. It is a level that entails multilevel forms of governance, linking multi-interests' actors towards a common goal (Blasch et al. 2021). These characteristics put regional levels forward as a bridge between levels, voicing needs from the local, translating them towards the national and diffusing them in the supranational. The regional level has been also including large trans-metropolitan spaces (Soja 2014; Harrison and Hoyler 2015) merging some metropolitan areas into "more flexible, networked, and smart forms of planning and governance" (Zimmermann et al. 2020), new expressions of territorial cooperation and conflict around issues and agendas of collective provision, such as energy.

The national level of energy citizenship emergence is the level in charge of the definition of each country's priorities to achieve energy balance and efficiency between use and supply, to comply with supranational targets set. Some national legislations are starting to recognize citizens associations (like energy communities) for improvement of energy consumption, as keys for the national strategy for resilience. The distribution of energy technologies and the natural resources on which they are deployed across space often depend on their inclusion in a system of national policies and goals that are also tied to spatial legacies (including contested ones, see Bridge et al. 2013). The deployment and geographic spread of new and more efficient technologies play a central role in energy citizenship emergence and deployment, and they find in the national level its privileged dimension of investigation.

The supranational level is the dimension where proximity mechanisms are mainly achieved through a policy action that is distributed throughout different countries and levels. The supranational level seeks to bypass impasses in the intergovernmental climate process with a global alliance of initiatives (Bridge et al. 2013). EU funding programmes, global initiatives and networks are increasingly involved in supporting individual and collective action helping energy users to engage in the generation and management of sustainable energy. Transnational networks as well as global climate movements, are considered under this level, as part of an enabling context providing knowledge proximity in a widespread manner, provoking a spillover effect towards lobbying energy issues, mostly directed at the political level.

Finally, the level of virtual proximity refers to the relational closeness between individuals, developed using information and communication technologies (Coughlan 2014). This level allows energy citizenship to be supported through a digital infrastructure that connects transversally the local to the supranational level. The virtual level of engagement provides the space for energy citizens of different types to be given support with policy and technical advice, methodological tools, mutual learning and interlevel cooperation.

5.2 From vertical distinction to cross-level interaction

This taxonomy demonstrates that the process of citizens-led energy transition is geographically dependent, and triggers change on multiple domains. Considering the geographic context as a multi-level place of interactions, transition mainly relies on the "interaction of natural, technical and cultural phenomena in a geographical setting" (Bridge et al. 2013). Transition is conceptualized as a socio-technical one, since it includes a high interrelationship between networks of actors, institutions, knowledge, and material artifacts.

From a governance perspective, energy citizenship and energy communities are embedded into a complex configuration of a multi-level and polycentric system. The establishment of the Covenant of Mayors for Climate & Energy (CoM) in 2008 aims to create a common umbrella for local climate action. The membership structure is highly diverse and covers small rural towns as well as metropolitan regions. This diverse structure also pertains to the geospatial nature of the CoM, with many signatories in Italy, Spain and Belgium and relatively low participation, for example, from German and French municipalities. The standardized reporting and monitoring scheme establishes top-down dynamics but at the same time, Kern (2019) describes the CoM as a form of "embedded upscaling" of local experiments due to the close cooperation between municipalities, regions, the EU COM, and the JRC. The inclusion of national and regional authorities as "Covenant Coordinators" and other NGOs, climate networks, associations and energy agencies as "Covenant supporters" adds to the complexity of this governance arrangement. Citizen energy communities can profit from top-down knowledge transfer and funding opportunities but at the same time can also use this structure to advocate for their interests. The region Emilia-Romagna, for example, acts as a coordinator for the various municipalities represented in the CoM and REScoop.eu, joined the CoM in July 2021 as "Covenant Supporter", following their strategy to expand cooperation between cooperatives and municipalities as "natural allies" of their citizens.[2] Research on the links between energy community projects and municipalities is developing, and first insights highlight the strong interconnection between community actors and local governmental actors, the role of (direct-) democratic institutions and federal structures (Schmid et al. 2020).

Despite variations across levels, energy citizenship development still seems to require local knowledge and know-how to make the best possible use of energy resources for the benefit of the citizens. However, according to the analysis, it seems clear that different geographical levels play important roles in triggering the birth of different forms of energy citizenship but mostly in supporting citizens' engagement to grow and proceed in this pathway. The different meanings and determinants that the concept of

[2] https://www.rescoop.eu/toolbox/the-rescoop-municipality-approach

proximity entail through levels, show that energy citizenship emergence and operational capacity present a multi-layered structure of relations and interdependencies that need to be considered while approaching the topic.

The case studies highlight the need for policy measures that allow energy citizenship to be enabled in the interaction with a multitude of distributed systems, tailoring the design to local communities, but at the same time considering the needs of a larger system. In fact, according to Bouzarovski and Simcock (2017), what makes an energy project local may also have a profound effect on broader issues, including energy justice.

This suggests looking at energy citizenship not only as a contingent process in defined boundaries and in a specific timespan. For this reason, a local-global networking perspective might be useful to connect leveraging mechanisms, provide solutions to barriers and bottlenecks and finally facilitate the generation of an enabling environment for energy citizenship to occur. A local-global network perspective can help to think through the level boundaries that might be drawn when considering energy behaviours. At the policy level, recognition of this networked pattern contributes to better transferability of findings from practical relevance and policy recommendations. It also provides a useful methodology for delineating the emergence of energy citizenship by following energy citizenships' relational network wherever it leads, rather than setting boundaries in an arbitrary and closed manner. In other words, this posture allows energy citizenship to define its geographic dimensions based on how actors themselves develop relationships in space and time.

6 Conclusion

Energy citizenship necessarily appears to be linked at multiple geographical levels. These are analytic dimensions (not only administrative ones) describing the context where energy citizenship might occur. It answers to the "where" of energy citizenship, how activities are distributed across the space (physical and virtual). The contextual dimension of energy citizenship allows to understand the choices of the actors engaged, what influences them, and the leverage that triggers them to operate towards energy efficient behaviours or activate to champion energy transition. The geographical dimension allows to better understand the dynamics of the energy citizenship emergence, in relation with contextual factors. The context of energy citizenship emergence contains several scales of interaction, socio-economic variables and levels of governance climate, policy and economy determinants which vary from supranational to local contexts.

The taxonomy followed a mix of methodologies: the preliminary acquisition of the knowledge developed in WP1 was confronted with a theoretical analysis on literature on geographical aspects of energy citizenship and on policy documents at EU and global level; this was followed by a broad case study analysis on the most significant documents collecting empirical evidence on energy citizenship, case studies of energy communities or collective energy initiatives from EU projects and an in-depth investigation on some selected GRETA case studies. The preliminary knowledge was shared through brainstorming sessions and bilateral meetings with the consortium partners and task participants and eventually shaped into the taxonomy.

This taxonomy highlighted five broad levels where energy citizenship might emerge, be recognized and act. The local level allows for spatial and social proximity based on daily contact and closeness of interests (including economic). The local level is the level that allows to see closely and make visible the energy and therefore permits a better literacy on the topic. One risk, however, relates to the lack of diversity in an overly narrow local community, diversity that allows for openness to alternative directions, new ideas, a window into larger trends and urgencies: an advantage that seems to be enabled by the regional level, capable of intermediating between levels, and an ability facilitated also by the implementation of policy frameworks that are more strategic, broad, and prescriptive, allowing for incursions of experience from below. Consequently, the regional level seems to facilitate the cooperation of multiple actors around a theme and better control even in the distribution of resources at the territorial level. The regional level dialogues closely with the national level, a dimension in which the various domains of proximity converge in a framework predominantly related to policies. Here the commitment of policy makers appears fundamental in the creation of an enabling context for energy citizenship. However, the political commitment of the national level necessarily incorporates the orientations and agendas of the supranational level. The supranational level also contributes to building an environment conducive to the emergence of energy citizenship through networking,

mentoring and advocacy with various actors. An action that is effective only if it includes all categories of actors and energy citizens, even the most vulnerable, geographically distant or politically difficult to reach and recruit. Finally, the geographical layers are transversally supported by the virtual environment, the layer that is most capable of voicing needs and trends. The virtual level provides a (public) space for education and training where citizenship can be upscaled, have access to funding mechanisms, foster replication, and bridge individual gaps.

This reflection urges to move toward a local-global networking perspective, one that allows to read energy citizenship through its multiplicity of geographical patterns, tracing its path dependencies, learning from its contextual barriers and obstacles and supporting its elements of success.

In conclusion, rather than considering what kind of level is optimal in energy citizenship emergence, we claim that the goal should be to best combine different levels in a dynamic and variable scheme.

References

Andersson, U. (2001). *Network embeddedness and transfer of information and innovation in MNCS-the dual role of the subsidiary*. Företagsekonomiska institutionen.

Armstrong, J. H. (2021). People and power: Expanding the role and scale of public engagement in energy transitions. *Energy Research & Social Science*, *78*, 102136.

Balest, J., Pisani, E., Vettorato, D., & Secco, L. (2018). Local reflections on low-carbon energy systems: A systematic review of actors, processes, and networks of local societies. *Energy Research & Social Science*, *42*, 170–181. https://doi.org/10.1016/j.erss.2018.03.006

Boeri, A., Longo, D., Massari, M., Sabatini, F., & Trimarchi, M. (2021). From Hierarchical Convergence to Reticular Expansion: Urban Dynamics Through Alice's Mirror. *Diid—Disegno Industriale Industrial Design*, *73*, 12–12.

Boschma, R. (2005). Proximity and innovation: a critical assessment. *Regional studies*, *39*(1), 61-74.

Boulanger, S., & Massari, M. (forthcoming). Designing Sustainable Cities: A qualitative review of institutional and grassroot initiatives in shaping climate aware cities. *Sustainability*.

Boulanger, S. O. M., Massari, M., Longo, D., Turillazzi, B., & Nucci, C. A. (2021). Designing Collaborative Energy Communities: A European Overview. *Energies*, *14*(24). https://doi.org/10.3390/en14248226

Bouzarovski, S., & Simcock, N. (2017). Spatializing energy justice. *Energy Policy*, *107*, 640–648.

Breukers, S., & Wolsink, M. (2007). Wind power implementation in changing institutional landscapes: An international comparison. *Energy Policy, 35,* 2737-2750.

Bridge, G., Bouzarovski, S., Bradshaw, M., & Eyre, N. (2013). Geographies of energy transition: Space, place and the low-carbon economy. *Energy Policy*, *53*, 331–340. https://doi.org/10.1016/j.enpol.2012.10.066

Brink, E., & Wamsler, C. (2018). Collaborative governance for climate change adaptation: Mapping citizen–municipality interactions. *Environmental Policy and Governance*, *28*(2), 82–97.

Brink, E., & Wamsler, C. (2019). Citizen engagement in climate adaptation surveyed: The role of values, worldviews, gender and place. *Journal of Cleaner Production*, *209*, 1342–1353.

Burt, R. S. (2004). From structural holes: The social structure of competition. *The New Economic Sociology: A Reader*, 325–348.

Catney, P., MacGregor, S., Dobson, A., Hall, S. M., Royston, S., Robinson, Z., Ormerod, M., & Ross, S. (2014). Big society, little justice? Community renewable energy and the politics of localism. *Local Environment*, *19*(7), 715–730. https://doi.org/10.1080/13549839.2013.792044

Chang, M., & Lee, J.-H. (2021). Augmented proximity: Integration of physical and virtual proximity to enhance network connectivity. *PLOS ONE*, *16*(11), e0260349. https://doi.org/10.1371/journal.pone.0260349

Coenen, L., Benneworth, P., & Truffer, B. (2012). Toward a spatial perspective on sustainability transitions. *Research Policy*, *41*(6), 968–979. https://doi.org/10.1016/j.respol.2012.02.014

Coopérnico – Energia verde, sustentabilidade e cidadania. (n.d.). Retrieved January 10, 2022, from https://www.coopernico.org/pt

Coopérnico renewable energy cooperative, Portugal. (2020, September 12). *Communities for Future*. https://communitiesforfuture.org/get-inspired/coopernico-renewable-energy-cooperative-portugal/

Coughlan, T. (2014). Enhancing Innovation through Virtual Proximity. *Technology Innovation Management Review*, *4*, 17–22. https://doi.org/10.22215/timreview/765

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

Devine-Wright, P. (2012). *Renewable energy and the public*. Routledge.

Durose, C. (2009). Front-line workers and 'local knowledge': Neighbourhood stories in contemporary UK local governance. *Public Administration*, *87*(1), 35–49.

European Commission. Directorate General for Energy. (2019). *Clean energy for all Europeans.* Publications Office. https://data.europa.eu/doi/10.2833/21366

Faller, F. (2016). A practice approach to study the spatial dimensions of the energy transition. *Environmental Innovation and Societal Transitions*, *19*, 85–95. https://doi.org/10.1016/j.eist.2015.09.004

Fisher, D. R., & Nasrin, S. (2021). Climate activism and its effects. *WIREs Climate Change*, *12*(1). https://doi.org/10.1002/wcc.683

Gailing, L., & Röhring, A. (2016). Is it all about collaborative governance? Alternative ways of understanding the success of energy regions. *Utilities Policy*, *41*, 237–245. https://doi.org/10.1016/j.jup.2016.02.009

Hansen, T., & Coenen, L. (2015). The geography of sustainability transitions: Review, synthesis and reflections on an emergent research field. *Environmental Innovation and Societal Transitions*, *17*, 92–109. https://doi.org/10.1016/j.eist.2014.11.001

Harrison, J., & Hoyler, M. (2015). Megaregions: Foundations, frailties, futures. In *Megaregions*. Edward Elgar Publishing.

Heidrich, O., Reckien, D., Olazabal, M., Foley, A., Salvia, M., de Gregorio Hurtado, S., Orru, H., Flacke, J., Geneletti, D., Pietrapertosa, F., Hamann, J. J.-P., Tiwary, A., Feliu, E., & Dawson, R. J. (2016). National climate policies across Europe and their impacts on cities strategies. *Journal of Environmental Management*, *168*, 36–45. https://doi.org/10.1016/j.jenvman.2015.11.043

Heikkinen, M., Karimo, A., Klein, J., Juhola, S., & Ylä-Anttila, T. (2020). Transnational municipal networks and climate change adaptation: A study of 377 cities. *Journal of Cleaner Production*, *257*, 120474. https://doi.org/10.1016/j.jclepro.2020.120474

Heiskanen, E., & Matschoss, K. (2017). Understanding the uneven diffusion of building-scale renewable energy systems: A review of household, local and country level factors in diverse European countries. *Renewable and Sustainable Energy Reviews*, *75*, 580–591. https://doi.org/10.1016/j.rser.2016.11.027

Hicks, J., & Ison, N. (2018). An exploration of the boundaries of 'community' in community renewable energy projects: Navigating between motivations and context. *Energy Policy*, *113*, 523–534. https://doi.org/10.1016/j.enpol.2017.10.031

Hoff, J., & Gausset, Q. (2015). *Community governance and citizen-driven initiatives in climate change mitigation*. Routledge.

Huybrechts, B., Creupelandt, D., & Vansintjan, D. (2018). Networking renewable energy cooperatives–the experience of the European federation REScoop. EU. In *Handbuch Energiewende und Partizipation* (pp. 847–858). Springer.

Jans, L., Bouman, T., & Fielding, K. (2018). A Part of the Energy "in Crowd": Changing People's Energy Behavior via Group-Based Approaches. *IEEE Power and Energy Magazine*, *16*(1), 35–41. https://doi.org/10.1109/MPE.2017.2759883

Kern, K. (2019). Cities as Leaders in EU Multilevel Climate Governance: Embedded Upscaling of Local Experiments in Europe. *Environmental Politics, 28*(1), 125–145.

Kern, K., & Bulkeley, H. (2009). Cities, Europeanization and Multi-level Governance: Governing Climate Change through Transnational Municipal Networks. *JCMS: Journal of Common Market Studies*, *47*(2), 309–332. https://doi.org/10.1111/j.1468-5965.2009.00806.x

Koltunov, M., & Bisello, A. (2020). Comunità energetiche rinnovabili: proposta per una classificazione dei benefici multipli ed esempi di approcci valutativi. *LaborEst*, *21*, 77–84. https://doi.org/10.19254/LaborEst.21.11

Koltunov, M., & Bisello, A. (2021). Multiple Impacts of Energy Communities: Conceptualization Taxonomy and Assessment Examples. In C. Bevilacqua, F. Calabrò, & L. Della Spina (Eds.), *New Metropolitan Perspectives* (Vol. 178, pp. 1081–1096). Springer International Publishing. https://doi.org/10.1007/978-3-030-48279-4_101

Laes, E., Gorissen, L., & Nevens, F. (2014). A Comparison of Energy Transition Governance in Germany, The Netherlands and the United Kingdom. *Sustainability, 6,* 1129-1152.

Largue, P. (2021, September 25). Portuguese communities go green with novel energy cooperative model. *Smart Energy International*. https://www.smart-energy.com/start-up-zone/portuguese-communities-go-green-with-novel-energy-cooperative-model/

Latour, B. (2007). *Reassembling the social: An introduction to actor-network-theory*. Oup Oxford.

Lennon, B., Dunphy, N., Gaffney, C., Revez, A., Mullally, G., & O'Connor, P. (2020). Citizen or consumer? Reconsidering energy citizenship. *Journal of Environmental Policy & Planning*, *22*(2), 184–197.

Lowitzsch, J., & Hanke, F. (2019). Renewable Energy Cooperatives. In J. Lowitzsch (Ed.), *Energy Transition* (pp. 139–162). Springer International Publishing. https://doi.org/10.1007/978-3-319-93518-8_7

Melkas, H., Uotila, T., & Tura, T. (2016). Policies of related variety in practice: The case Innovation Session Method. *European Planning Studies*, *24*(3), 489–510. https://doi.org/10.1080/09654313.2015.1088515

Mirzania, P., Ford, A., Andrews, D., Ofori, G., & Maidment, G. (2019). The impact of policy changes: The opportunities of Community Renewable Energy projects in the UK and the barriers they face. *Energy Policy, 129,* 1282–1296.

Moore, M.-L., Riddell, D., & Vocisano, D. (2015). Scaling out, scaling up, scaling deep: Strategies of non-profits in advancing systemic social innovation. *Journal of Corporate Citizenship*, *58*, 67–84.

Moroni, Antoniucci, & Bisello. (2019). Local Energy Communities and Distributed Generation: Contrasting Perspectives, and Inevitable Policy Trade-Offs, beyond the Apparent Global Consensus. *Sustainability*, *11*(12), 3493. https://doi.org/10.3390/su11123493

Moroni, S., Alberti, V., Antoniucci, V., & Bisello, A. (2018). Energy Communities in a Distributed-Energy Scenario: Four Different Kinds of Community Arrangements. In A. Bisello, D. Vettorato, P. Laconte, & S. Costa (Eds.), *Smart and Sustainable Planning for Cities and Regions* (pp. 429–437). Springer International Publishing. https://doi.org/10.1007/978-3-319-75774-2_29

Moroni, S., Alberti, V., Antoniucci, V., & Bisello, A. (2019). Energy communities in the transition to a low-carbon future: A taxonomical approach and some policy dilemmas. *Journal of Environmental Management*, *236*, 45–53. https://doi.org/10.1016/j.jenvman.2019.01.095

Nielsen, A. B., & Papin, M. (2021). The hybrid governance of environmental transnational municipal networks: Lessons from 100 Resilient Cities. *Environment and Planning C: Politics and Space*, *39*(4), 667–685. https://doi.org/10.1177/2399654420945332

Ortiz Cebolla, R., & Navas, C. (2019). Supporting hydrogen technologies deployment in EU regions and Member States: The Smart Specialisation Platform on Energy (S3PEnergy). *International Journal of Hydrogen Energy*, *44*(35), 19067–19079. https://doi.org/10.1016/j.ijhydene.2018.05.041

Ostrom, E. (2010a). Beyond Markets and States: Polycentric Governance of Complex Economic Systems. *American Economic Review*, *100*(3), 641–672. https://doi.org/10.1257/aer.100.3.641

Ostrom, E. (2010b). Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change*, *20*(4), 550–557. https://doi.org/10.1016/j.gloenvcha.2010.07.004

Palm, J., & Kojonsaari, A.-R. (2020). *Distributed Energy Systems and Energy Communities Under Negotiation* [Preprint]. In Review. https://doi.org/10.21203/rs.3.rs-99657/v1

Pellerin-Carlin, T., & Serkine, P. (2016). Europe needs crowd-based innovation for a competitive energy transition. *Institute Jacques Delors*.

Rangoni, B. (2019). Architecture and policy-making: Comparing experimentalist and hierarchical governance in EU energy regulation. *Journal of European Public Policy*, *26*(1), 63–82. https://doi.org/10.1080/13501763.2017.1385644

Raven, R., Schot, J., & Berkhout, F. (2012). Space and scale in socio-technical transitions. *Environmental Innovation and Societal Transitions*, *4*, 63–78. https://doi.org/10.1016/j.eist.2012.08.001

Roberts, J., & Gauthier, C. (2019). Energy communities in the draft National Energy and Climate Plans: Encouraging but room for improvements. *REScoop: Berchem, Belgium*.

Rogers, E.M. (1962). *Diffusion of innovations*. Free Press of Glencoe.

Rossetti, G., & Cazabet, R. (2018). Community discovery in dynamic networks: A survey. *ACM Computing Surveys (CSUR)*, *51*(2), 1–37.

Ryghaug, M., Skjølsvold, T. M., & Heidenreich, S. (2018). Creating energy citizenship through material participation. *Social Studies of Science*, *48*(2), 283–303.

Sabel, C. F., & Zeitlin, J. (2012). *Experimentalist Governance*. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199560530.013.0012

Šćepanović, S., Warnier, M., & Nurminen, J. K. (2017). The role of context in residential energy interventions: A meta review. *Renewable and Sustainable Energy Reviews*, *77*, 1146–1168.

Schmid, B., Meister, T., Klagge, B., & Seidl, I. (2020). Energy Cooperatives and Municipalities in Local Energy Governance Arrangements in Switzerland and Germany. *The Journal of Environment & Development, 29*(1), 123–146. https://doi.org/10.1177/1070496519886013

Soja, E. W. (2014). 7. Regional Urbanization and the End of the Metropolis Era. In *My Los Angeles* (pp. 194–218). University of California Press.

Späth, P., & Rohracher, H. (2010). 'Energy regions': The transformative power of regional discourses on socio-technical futures. *Research Policy*, *39*(4), 449–458. https://doi.org/10.1016/j.respol.2010.01.017

Terren, L., & Soler-i-Martí, R. (2021). "Glocal" and Transversal Engagement in Youth Social Movements: A Twitter-Based Case Study of Fridays For Future-Barcelona. *Frontiers in Political Science*, *3*, 1-15. https://doi.org/10.3389/fpos.2021.635822

Toke, D. (2011). Ecological modernisation, social movements and renewable energy. *Environmental Politics, 20(1),* 60-77.

Toke, D., Breukers, S., & Wolsink, M. (2008). Wind power deployment outcomes: How can we account for the differences? *Renewable and Sustainable Energy Reviews, 12,* 1129-1147.

Tricarico, L. (2018). Community Energy Enterprises in the Distributed Energy Geography. *International Journal of Sustainable Energy Planning and Management*, 81-94 Pages. https://doi.org/10.5278/IJSEPM.2018.18.6

Vainio, A., Pulkka, A., Paloniemi, R., Varho, V., & Tapio, P. (2020). Citizens' sustainable, future-oriented energy behaviours in energy transition. *Journal of Cleaner Production*, *245*, 118801.

van der Schoor, T., & Scholtens, B. (2015). Power to the people: Local community initiatives and the transition to sustainable energy. *Renewable and Sustainable Energy Reviews*, *43*, 666–675. https://doi.org/10.1016/j.rser.2014.10.089

Walker, C., Devine-Wright, P., Rohse, M., Gooding, L., Devine-Wright, H., & Gupta, R. (2021). What is 'local'about Smart Local Energy Systems? Emerging stakeholder geographies of decentralised energy in the United Kingdom. *Energy Research & Social Science*, *80*, 102182.

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

Walker, G., Devine-Wright, P., Hunter, S., High, H., & Evans, B. (2010). Trust and community: Exploring the meanings, contexts and dynamics of community renewable energy. *Energy Policy*, *38*(6), 2655–2663.

Wierling, A., Schwanitz, V. J., Zeiß, J. P., Bout, C., Candelise, C., Gilcrease, W., & Gregg, J. S. (2018). Statistical Evidence on the Role of Energy Cooperatives for the Energy Transition in European Countries. *Sustainability*, *10*(9). https://doi.org/10.3390/su10093339

Yanow, D. (2004). Translating local knowledge at organizational peripheries. *British Journal of Management*, *15*(S1), 9–25.

Yildiz, Ö., Rommel, J., Debor, S., Holstenkamp, L., Mey, F., Müller, J.R., Radtke, J., & Rognli, J. (2015): Renewable energy cooperatives as gatekeepers or facilitators? Recent developments in Germany and a multidisciplinary research agenda. *Energy Research & Social Science, 6,* 59-73.

Yildiz, Ö. (2014). Financing renewable energy infrastructures via financial citizen participation – The case of Germany. *Renewable Energy, 68,* 677-685.

Zimmermann, K., Galland, D., & Harrison, J. (2020). *Metropolitan regions, planning and governance*. Springer.

Annex A. EU-wide case study analysis

Som Mobilitat, Spain	
Level of the case study	National level; virtual level
Type of case study	Cooperative (non-profit)
Types of available data	Website and publication
Short description	Som Mobilitat is a non-profit consumer cooperative that offers mobility products and services to accelerate the transition towards a more sustainable mobility, providing 100% electric and cooperative car sharing. The cooperative is based on a mobility model that is committed to promoting walking, cycling, public transport and shared electric vehicles. Som Mobilitat was created as a mechanism for changing the model of mobility and provides a platform to foster collaborative projects and strengthen others already operating. The objective of the initiative is to go from a mobility based on the private use of vehicles towards a mobility where both the vehicle and the journey can be shared, intertwining individuals and groups, in order to build efficient and sustainable transport models. Nowadays, new technologies and advances in alternative mobility approaches make it possible to design a decreasing mobility model, both in the number of vehicles and in CO_2 emissions. The challenges posed by current mobility take place at the local level but have global responses. For this reason, Som Mobilitat is organized in the territory in local groups to ensure that it is the people of each municipality who promote and adapt the mobility services in each neighbourhood, town or city. At the same time, they operate on a network at European level to share good practices and resources with other sustainable mobility cooperatives through the creation of the first network of mobility cooperatives in Europe called REScoop Mobility, under the umbrella of the REScoop.eu cooperative federation.
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☐ Presence/Development of an enabling regulatory framework (at national or local level) ☐ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☒ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Web app and platform for providing services of sharing mobility; High collaboration among the local units and the national

	network with the international REScoop mobility; Crowdfunding and association quote
Critical aspects	The most critical aspect can be the adaptation of the platform to different types of urban context and the business model application to large territory.
Enabling aspects	One of the most positive aspects is the social model that represents an alternative to profit-oriented, private and vertical mobility products. It aims to accelerate local sustainable mobility and reduce expenses in individual mobility
Milestones	The web platform and the business model at the base of the provided services.
Elements of interest	The most interesting elements are the adaptation to different size urban context and the connection to a European network to share experience and improve the services.
References	• JRC (2020), "Energy Communities: an overview of energy and social innovation" • Som Mobilitat website: https://www.sommobilitat.coop/en/

Oborniki slaskie, Poland	
Level of the case study	Local level
Type of case study	on-going creation of a bioenergy community
Types of available data	outputs from the Horizon 2020 project BEcoop
Short description	The case study Oborniki slaskie (OBS) is an urban-rural area near the city of Wrocław characterized by nature protected sceneries and numerous grasslands and forests. It provides biomass in the form of briquettes, wood chips, straw, wood. This area is not supplied by local heating network and centralized system for heat supply, buildings currently use fossil fuels boilers. The predominant type of heating is coal, covering over 70% of buildings (private and public). OBS has the potential to increase the use of biomass resources for heating purposes, sourced from local agricultural producers. Within the BEcoop project, the study of an effective use of biomass for energy purposes is implemented, with the involvement of local population and authorities in surveys and activities, that will support to get funding.
Case study key aspects/elements	☐ Presence/Development of a particular participatory approach ☐ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools

	☒ Presence/Development of innovative cooperation streams ☐ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Urban-rural area; Large availability of biomass; New bioenergy RESCoop
Critical aspects	The area is still strongly linked to fossil fuels and there is not existing local energy cooperative yet.
Enabling aspects	The most positive aspects are the availability of biomass and the will to implement an energy transition process, as well as the pollution reduction, the increase of local potential and conservation measures to grow biomass use.
Milestones	Presence of biomass and support to create a new and innovative bioenergy RESCoop.
Elements of interest	The most interesting aspect regards the process to create a bioenergy community to provide heating from renewable sources, from a technological and framework regulation points of view.
References	• H2020 BEcoop project website: https://www.becoop-project.eu/pilot-areas/poland/ • REScoop.eu website: https://www.rescoop.eu/

Marstal Fjernvarme, Denmark	
Level of the case study	Local level
Type of case study	Consumer owned co-operative
Types of available data	informative data from website and papers
Short description	Marstal Fjernvarme A.m.b.A. includes around 1600 members and has been created in 1962. Marstal Fjernvarme is a solar district heating plant on the island of Ærø, Denmark. The pipe system is up to 30 years old but is continuously renewed. The collectively owned district heating network provides hot water to around 2200 inhabitants of the island town of Marstal. The company provides heat to Marstal from 100% renewables. In particular, the district heating network is based on renewables, using the technologies: solar heat collectors (50-55%), wood chips (40%), heat pump (2-3%), bio-oil, CHP; thermal energy storage, with an annual production of about 32000 MWh. This large heat storage combined with CHP using renewables to produce district heating represents a large scale innovative, cost-effective and technically 100 % sustainable renewable energy system, of which solar thermal covers more than 50%. The co-operative is organized so that daily decisions are taken by a board elected at the yearly general assemblance. All major investments are discussed and decided by the general assemblance, where all

	consumers are invited. During the project preparation the community was informed from articles in the local newspaper (and by meeting members of the board or employees from the district heating company in the daily life).
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☐ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Assemblies and board to take decisions; Large heat storage combined with CHP; 100 % sustainable renewable energy system
Critical aspects	The citizenship community aspects could be more clear
Enabling aspects	The most positive aspect is the technologies used that provide a large scale innovative, cost-effective and technically 100 % sustainable renewable energy system.
Milestones	The presence of a district heating network allows the development of technological systems to supply renewable energy.
Elements of interest	The most interesting aspects are related to the technologies used to provide energy, including thermal energy storage systems.
References	• JRC (2020), "Energy Communities: an overview of energy and social innovation" • Solar Marstal website: https://www.solarmarstal.dk/

Svalin co-housing complex, Denmark	
Level of the case study	Local level
Type of case study	energy community, co-housing community
Types of available data	informative data from website and papers
Short description	Svalin is a sustainable co-housing community with 20 households in Trekroner, Roskilde (Denmark). Houses and shared infrastructure were designed to accommodate solar panels, geothermic heat pump and electric vehicles. The community is energy positive, producing more renewable energy than it

	consumes. Each household consumes its electricity generation while transferring the electricity surplus to the electric grid under current Danish regulatory framework. The scope of the new developed project is to collectively consume 100% renewable and local energy by sharing the renewable energy generation among the community, thus avoiding the traditional intermediary parties. This project is serving as a living laboratory for the Technical University of Denmark's (DTU) research project Energy Collective. The community is geared towards not just own energy generation, but also raising awareness over energy usage in general. For example, the outdoor lighting system in the community changes colour depending on the CO_2 emission level of the electric energy consumed in Denmark. Svalin households can use that information to decide when the best time to consume electricity is, i.e. times when the CO_2 emissions are low. In parallel real-time data measurements on energy import/export for the various houses, common house and the community as a whole are collected and on a mobile application (with different features for a Svalin resident and non-resident).
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☒ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	High sense of community; High social dimension and values; Electricity sharing to accommodate solar panels, geothermic heat pump and electric vehicles; Real time data measuring and mobile application at different scales; sharing economy principles; Innovative approach based on consumer-centric electricity markets
Critical aspects	-
Enabling aspects	The concept of energy sharing at the base of the community and the social dimension and value.
Milestones	The social dimension and value at the base of the community institution allow the technological aspects to support the energy sharing among participants at the community and the maximum effort of the energy resource with zero environmental impact.
Elements of interest	The most interesting aspects are related to the high sense of community and to the technological aspects that demonstrate the flexibility of a community sharing electric energy for solar panels, geothermic heat pump and electric vehicles.
References	• JRC (2020), “Energy Communities: an overview of energy and social innovation” • Energy Communities Hub website: https://www.housingevolutions.eu/project/svalin-co-housing-p2p-energy-community/

	• H2020 Excite project: http://www.excite-project.eu/uploads/9/8/8/4/9884716/d4.1_guidelines_for_local_authorities_on_stakeholder_engagement.pdfs

Enercoop, France	
Level of the case study	National level
Type of case study	Social enterprise cooperative – Energy supplier - Société Coopérative d'Intérêt Collectif (SCIC)
Types of available data	informative data from website and papers
Short description	The cooperative supplies renewable electricity (supplier of 100% renewable electricity, purchases electricity directly from renewable energy producers). Enercoop is the only supplier of energy in the form of social enterprise cooperative. It is one of the few green electricity suppliers that buys energy directly from producers. Made up of 11 separate regional renewable energy cooperatives, Enercoop operates 100 hydro schemes, 25 windfarms, 104 solar projects and 3 biomass generator - 249 GWh of electricity in 2017. In 2021 Enercoop counts 100,000 customers and has the objective to create many regional cooperatives around France where the local members can be in charge of all parts of the energy process from production to consumption.
Case study key aspects/elements	☐ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☐ Presence/Development of an enabling regulatory framework (at national or local level) ☐ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☐ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Social enterprise cooperative; 100% renewable electricity; Ethical approach
Critical aspects	The citizens sensibilization process to buy green energy
Enabling aspects	It represents a cooperative focused on energy supply with the base ethical principles.
Milestones	The citizens sensibilization process can enlarge the cooperative over time and on the other hand the availability of renewable energy producers.
Elements of interest	The most interesting element is the ethical economy as principles of the cooperative.
References	• Enercoop webite: https://www.enercoop.fr/

	• JRC (2020), "Energy Communities: an overview of energy and social innovation" • Wikipedia page: https://en.wikipedia.org/wiki/Enercoop

SAS Ségala Agriculture et Energie Solaire Cooperative, France	
Level of the case study	Regional level
Type of case study	Cooperative (collective interest)
Types of available data	informative data from website and papers
Short description	SAS Ségala Agriculture et Energie Solaire is a company created by the local agricultural cooperative Fermes de Figeac in order to specifically carry out the installation of solar PV on agricultural buildings, based on the local cooperative as crucial aspect. The SAS - Fermes de Figeac agricultural cooperative is located in the North of the Lot, on a living area of 80,000 ha where cattle breeding dominates. The 650 farmers who are members of the cooperative represent 9% of the territory's active population. The installed photovoltaic power plants on roofs are the largest collective photovoltaic roofing project in France: 6 hectares of agricultural buildings bringing together 120 farmers. This agricultural and territorial cooperation project responds to several challenges including the preservation of ecosystems, the maintenance of a vibrant agriculture and the development of quality food in the territory. The scope is to promote responsible development based on the development of local resources, the creation of value and the search for new cooperation. Corporate Social Responsibility brings together all the practices put in place by the company with the aim of respecting the principles of sustainable development, i.e. being economically viable, having a positive impact on society but also better respect the environment and take into account the expectations of its stakeholders.
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☐ Presence/Development of an enabling regulatory framework (at national or local level) ☐ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☐ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Cooperative focused on agriculture; Cooperation; Farmers' involvement for incomes' sharing
Critical aspects	A critical aspect can the renewable energy sharing, produced by photovoltaic plants among the farmers of the cooperative.

Enabling aspects	The creation of additional value to the community: profits to reinvest, networks and expertise in the field of renewable energy, new competencies in negotiating large-scale projects. The positive aspect is the mutualization of a common resource as an additional income for the territory and cooperative, that guarantees regular income for farmers. The focus on agriculture is also interesting for the revitalization process of rural area.
Milestones	The presence of an existing cooperative and the creation of a dedicated company for the installation of PV plants on the agricultural building roofs.
Elements of interest	The most interesting aspect is linked to the agriculture sector revitalization through the creation of a community for resources' sharing and energy production.
References	• JRC (2020), "Energy Communities: an overview of energy and social innovation" • SAS website: https://energie-partagee.org/projets/segala-agriculture-energie-solaire/ • Fermes de Figeac website: https://www.fermesdefigeac.coop/

Som Energia, Spain	
Level of the case study	National level
Type of case study	Cooperative (non-profit)
Types of available data	from website and publication
Short description	Som Energia is one of the first energy cooperative created in Spain in order to promote sustainable development project and involve citizens. The main activities of the cooperative are energy generation, renewable energy supply in form of electricity and energy efficiency projects' implementation. The electricity is produced in generation facilities from renewable sources (solar, wind, biogas, biomass, etc.), financed with voluntary financial contributions from partners.
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☐ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☐ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Social innovative initiatives; Collaboration among local and national units; Renewable energy production

Critical aspects	-
Enabling aspects	The most positive aspect is that the implemented projects are financed by the members' investors applying a sustainable model of generation and consumption of renewable energy.
Milestones	A strong campaign and many initiatives to involved citizens are the main milestones
Elements of interest	The most interesting elements are the business model based on a citizens' involvement
References	• JRC (2020), "Energy Communities: an overview of energy and social innovation" • Som Energia website: https://www.somenergia.coop/

Solbyn Association, Sweden	
Level of the case study	Local level
Type of case study	cooperative housing association
Types of available data	from website and publication
Short description	Solbyn in Dalby is born as cooperative housing association initiated in 1979 with the aim to promote sustainable living and represents an example of energy community in Sweden. The community implemented several sustainable energy projects, including 30 wind shares, onsite thermal solar collectors and solar PV generation. It constitutes an eco-village that citizens built together through a tenant-owner association with a building company. The association is largely self-managing with support from the building company. The decisions were to form a tenant owned housing association as a legal representative. Solbyn shows us that a neighbourhood can be a source of beauty and scientific discovery where learning how to interact with nature and building relationships with a shared ethical commitment.
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☒ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Ecological village; High sense of community; High level of participation and engagement

Critical aspects	The most critical aspect can be to keep over time the community's engagement and to establish criteria for a common contract.
Enabling aspects	This case study represents an example of application of social, ecological and economic sustainability principles. It is based on self-sufficiency: created and administered as far as possible by residents themselves, using social contacts. The citizens are inspired by the vision of communal living and resource sharing and efficiency.
Milestones	The project started by the creation of an ecological village of fifty apartments where the community is moved by the same vision of environmental sustainability and energy efficiency.
Elements of interest	The sense of belonging of the citizens to the community and the self-managing.
References	• NEWCOMERS project website: https://www.newcomersh2020.eu/about-us#case-studies-energy-communities • Our Energy website: https://our-energy.eu/library/hear-from-solbyn-in-dalby • Solbyn community website: http://www.solbyn.org/ • JRC (2020), "Energy Communities: an overview of energy and social innovation"

Magliano Alpi, Italy	
Level of the case study	Local level
Type of case study	renewable energy community "CER Energy City Hall
Types of available data	from website
Short description	The renewable energy community called "CER Energy City Hall" was established in Magliano Alpi in December 2020. Before its constitution, a call of interest was open in order to collect adhesions from stakeholders. As coordinator and prosumer of the CER, the Municipality of Magliano Alpi has made available a 20 kWp photovoltaic system. Installed on the roof of the Town Hall, the system is connected to the POD of the Town Hall and can share the energy produced and not self-consumed with the CER, currently made up of the users of the library, gymnasium and schools, in addition to the four residents who were the first to join the starting nucleus. Two EV charging columns are also connected to the same system, which can be used free of charge by residents. The Municipality of Magliano Alpi (2,230 inhabitants) aims to have an active role in the development of innovative models for the revitalization of the territory. The mission of the Public Administration is to instill trust in citizens to make them aware of the energy transition and participate in the environmental and economic benefits that CERs can bring.

	The members of the CER are citizens, professionals, artisans, and the Municipality of Magliano Alpi as public body. The Municipality purchased the smart meters, which were connected to all the PODs adhering to the CER. The Municipality is also aggregating a "GOC" (Community Operating Group), that is a cooperative aimed at creating a short chain of technicians, designers, installers and maintenance technicians: the CERs therefore represent the catalyst for this process of aggregation of local skills, essential for creating development and jobs in the post-pandemic phase.
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☒ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	New development model for production and use of energy; central role of prosumer/citizen
Critical aspects	The most critical aspect can be linked to the citizenship engagement, based on an environment of trust that can make citizens involved and available to become prosumers.
Enabling aspects	The size of the city is an enabling aspect and the input coming from the Public Administration to create an energy community.
Milestones	The main milestones are: the adhesion of the Municipality to the "Manifesto of the Energy Communities for an active centrality of the Citizen in the new energy market" promoted by the Energy Center of the Polytechnic of Turin and the published expression of interest to involve prosumers, before creating the energy community.
Elements of interest	The most interesting aspect is the accord that rules the energy sharing inside the community.
References	• Magliano Alpi Renewable Energy Community website: https://cermaglianoalpi.it/

Melpignano Community Cooperative - MCC	
Level of the case study	Local level
Type of case study	cooperative
Types of available data	from website and publication

Short description	The cooperative was born in 2011 from the collaboration between Legacoop and the Melpignano Municipality (2.500 inhabitants), with the aim of producing energy using photovoltaic panels placed on the roofs of public and private buildings: it is composed by 33 PV systems for a total of 179.67 kW. The cooperative has the responsibility to install photovoltaic systems and to provide for their maintenance and management, producing energy and taking into account the demand of users who resell the surplus. The "Community Cooperatives" are structures, legally established, open to the participation of all citizens and economic operators, that has the role of "shared community tool for the development of the quality of life of the communities". The peculiarity of the Melpignano Community Cooperative is that of being made up of members-citizens-users, with the initial aim of creating a widespread network of photovoltaic systems on the roofs of houses, companies and public buildings. The initial investment was provided by a Bank Institution and allowed an important economic savings for families as well as the development of a virtuous local economy thanks to the use of the community's human and professional resources (engineers, electricians, locksmiths). This investment was preceded by a feasibility study drawn up by the Municipality of Melpignano, in collaboration with the University of Salento and with the Social Cooperative Officine Creative of Lecce.
Case study key aspects/elements	☐ Presence/Development of a particular participatory approach ☐ Presence/Development of innovative financing or business models ☐ Presence/Development of an enabling regulatory framework (at national or local level) ☐ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☒ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Cooperative approach; Agreement with PA, industrial partner and citizenship; Accessibility to the incentives
Critical aspects	The most critical aspect is the prosumers creation and citizenship engagement process.
Enabling aspects	The most enabling aspect is the creation of the cooperative for the installation and management of the PV systems and the business model that allows initial investments.
Milestones	The initial investment, the business model at the base and the cooperative approach are the milestones that brought to the creation of the MCC.
Elements of interest	The business model and the feasibility study as initial activities for the community cooperative creation.

References	• GECO – Green Energy COmmunity (2021), "Le comunità energetiche in italia – Una guida per orientare i cittadini nel nuovo mercato dell'energia" • Legambiente website: https://www.comunirinnovabili.it/cooperativa-di-comunita-di-melpignano/

Banister House Solar (BHS)	
Level of the case study	Local level
Type of case study	Community Energy Enterprise
Types of available data	from website and publication
Short description	Banister House Solar (BHS) is a Community Energy Enterprise located in the Borough of Hackney, north-east of London. Repowering London and Hackney Council are the partners engaged to develop this project together with the residents of the Banister House Estate and the local energy advocacy group. Hackney Council has provided funding and support for the project development. The BHS's main activity is the production of energy through a rooftop solar panel plant installed on 14 buildings at the Banister House Estate for 102 kWp solar array will generate up to 82,000 kWh of clean energy annually. To assure the availability of the buildings' rooftop, the enterprise has signed a 20-year life leasing agreement from the Hackney Council, the same period of the UK Government's Feed-in Tariff (FIT), that is an incentive representing the principal source of income for BHS together with the selling of the energy surplus. A part of the energy is also sold under a discounted 'power purchase agreement' with Hackney Council to be used on-site to power the Banister House communal areas. The key achievement of this project is environmental and social. Indeed, it allows empowering communities and promoting local leadership, citizens' engagement, addressing fuel poverty and increasing awareness of energy efficiency. 91 meetings held in the Banister House Community Hall, providing guidance on establishing a Community energy Society.
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☒ Presence/Development of innovative types of contracts/agreements

Keywords that better describe the case study	Community-owned renewable energy; Rooftop solar panel plant; Power purchase agreement
Critical aspects	The involvement of a bigger community.
Enabling aspects	The social impact on the inhabitants of the involved urban area.
Milestones	The main milestones are the business model at the base and the presence of stakeholders that worked with the territory for allowing the citizenship engagement and the community energy establishment.
Elements of interest	The social impact and engaging process
References	• Tricarico, L (2018), "Community energy enterprises in the distributed energy geography: A review of issues and potential approaches" published on "International Journal of Sustainable Energy Planning and Management Vol. 18 2018 81–94" • Repowering London website: https://www.repowering.org.uk/

Tirano, Italy	
Level of the case study	Regional level
Type of case study	Energy cooperative converted in renewable energy community
Types of available data	outputs from the Horizon 2020 project BEcoop
Short description	The urban-rural area is sited in the Po Valley, the worst area in Europe for air quality. The creation of a bioenergy community in Tirano can support local development and attract new investments and innovation, according to a model of environmental sustainability and progressive independence from fossil fuels. The renewable energy community is a solution for the long-term energy sustainability goals of the region, with the scope to replace obsolete biomass plants by biomass district heating. The network is currently connected to 3 biomass boilers for a total power of 20 MW. With the creation of the energy community, additional 192 energy prosumers will be able to sell energy into the grid or self-consume it with their private photovoltaic systems. The community will thus be able to meet an annual consumption of 34,443 MWh of thermal energy and 30,200 MWh of electricity, the latter distributed to users through 6,800 electrical connection points (PODs).
Case study key aspects/elements	☐ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools

	☒ Presence/Development of innovative cooperation streams ☐ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	District scale; Renewable energy community; New biomass district heating plants
Critical aspects	Implementation of the new biomass district heating and awareness-raising activities for engaging other Municipalities that are not supplied by methane gas network.
Enabling aspects	The most positive aspects are the feasibility to install district heating systems feed by biomass and to cover the heating demand thanks to the creation of a bioenergy community. Another enabling aspect is that the case study is already member of the FIPER national association, that represents most renewable energy producers for electricity and heat in Italy
Milestones	FIPER national association supports for the creation of the bioenergy community and availability of biomass and enables stakeholders that are interested to replace obsolete biomass plants by biomass DH.
Elements of interest	The framework to create a bioenergy community and the technological aspects to replace obsolete biomass plants by biomass DH, covering the heating demand of the community. Interesting for the involvement of an association of companies.
References	• H2020 BEcoop project website: https://www.becoop-project.eu/pilot-areas/italy/ • Legambiente website: https://www.comunirinnovabili.it/comunita-energetica-alpina-di-tirano/

ESEK – ENERGEIAKH KOINOTHTA KARDITSAS SYNPE, Thessaly, Greece	
Level of the case study	Regional level
Type of case study	Citizen energy cooperative converted in energy community
Types of available data	outputs from the Horizon 2020 project BEcoop
Short description	The ESEK profit citizen energy cooperative is located in the region of Thessaly (Regional Unit of Karditsa) in 2010, characterized by a strong agricultural production, with the aim to foster renewable energy in the region. In 2019, the energy cooperative was converted into an energy community, with over 400 members, including municipalities, SMEs and local associations. ESEK includes 6 local municipalities (members of the RESCoop) and local technological education institutions in the field of solid biofuels production and quality control to match European standards. The Regional Unit of Karditsa has a great potential of Renewable Energy Sources (RES), mainly

	biomass used for energy production. Moreover, thanks to partnerships with local authorities the Energy Community expands the supply chain with plant biomass coming from Municipal waste. According to the national law, the main activity of the energy community is the management of a biomass plant for the production of solid biofuels to generate energy for heating and cooling purposes.
Case study key aspects/elements	☐ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☐ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Energy cooperative converted into energy community; Potential of RES and biomass; Creation of a bioenergy heating and cooling community
Critical aspects	The regional area included within the energy community is quite large and many stakeholders are involved. Therefore, the most critical aspect can be the complexity of the regulation and management of the bioenergy community for heating and cooling supply.
Enabling aspects	The most positive aspect is the presence of an energy cooperative and of the national law framework.
Milestones	Expand the biomass supply chain and extend the activities to bioenergy production.
Elements of interest	Within BEcoop project, the most interesting aspect is report how the existing pelleting plant can be used to expand the RESCoop activities and combine them with the uptake of a local bioenergy heating community.
References	• H2020 BEcoop project website: https://www.becoop-project.eu/pilot-areas/italy/ • REScoop.eu website: https://www.rescoop.eu/

GOIENER, Basque Country & Navarra, Spain	
Level of the case study	Regional level
Type of case study	non-profit citizen energy cooperative
Types of available data	outputs from website
Short description	The GOIENER non-profit citizen energy cooperative aims at fostering renewable energy through a people-centered

	approach. GOIENER is member of the Spanish REScoop - UNION DE RENOVABLES. The main activities in which the cooperative is involved are energy billing, energy trading and investment in renewable energy projects (e.g. hydro, solar). The regional area of Basque Country and Navarra are characterized by a dense network of fossil fueled energy. There is availability of forest biomass mostly used for the industry. Within GOIENER new plans for clean energy production with the use of bioenergy are expected to be implemented, with the support of new business line offering assistance and possible biofuel to different types of consumers (households, housing community, municipalities, small businesses, etc.).
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☐ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	People-centered approach; Forest biomass available mostly used for the industry; New business line for different types of consumers
Critical aspects	The development of business line that can satisfy different types of consumers.
Enabling aspects	The presence of an already created non-profit citizen energy cooperative and the availability of biomass for the bioenergy production.
Milestones	Development of a new business line offering assistance and possible biofuel to different types of consumers; financing and engineering for domestic heating solutions as well as industrial; increasing acceptance level and knowledge on renewable energy solutions.
Elements of interest	The most interesting element is the development of business line that satisfy the needs of more consumers.
References	• H2020 BEcoop project website: https://www.becoop-project.eu/pilot-areas/italy/ • REScoop.eu website: https://www.rescoop.eu/ • GOIENER website: https://www.goiener.com/

Courant d'Air, Belgium	
Level of the case study	National level

Type of case study	Cooperative Limited Liability Company
Types of available data	descriptive data from websites and publications
Short description	Courant d'Air is a renewable energy citizen cooperative founded in 2009, recognized as a social economy enterprise active in eastern Belgium, operating in the field of renewable energy and energy efficiency measures. Courant d'Air counts around 2800 members in 2021. Courant d'Air has adopted a juridical and fiscal statute of an enterprise with social objective, opening renewable energy access to as many citizens as possible. Beyond the distribution of a moderate dividend, Courant d'Air seeks to support social, environmental and sustainable projects for the benefit of citizens and the common good. As part of this mission, Courant d'Air considers the raising of awareness on climate change, fossil fuels and nuclear energy as social goals, and seeks to sensitize people to the use of renewables and to the economical consumption of energy. Thanks to the skills acquired, the cooperative informs and educates citizens and municipalities on energy issues, including wind power, but also the rational use of energy. In schools, she is involved in the Generation Zero Watt project. In accordance with the REScoop Charter, Courant d´Air applies the universal cooperative principles, is committed to a democratic energy transition in the hands of local actors and pursues missions in the common interest.
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☐ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☒ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	High social values; Juridical and fiscal statute; Educational programme
Critical aspects	Matching the energy sharing economic aspects with the respect of social values and accessibility
Enabling aspects	The most positive aspects are the presence of a juridical and fiscal statute of an enterprise with social objective that rules the members' participation.
Milestones	The education programme for citizens and municipalities on energy issues, including wind power in particular, but also the rational use of energy. This allows people becoming members.
Elements of interest	The application of social value within the framework of the renewable energy citizen cooperative.

References	• MACISE REScoop website: https://www.rescoop-mecise.eu/aboutmecise/courant-dair • Courant d'Air website: https://www.courantdair.be/wp/ • JRC (2020), "Energy Communities: an overview of energy and social innovation"

Edinburgh community solar limited	
Level of the case study	Local level
Type of case study	Cooperative
Types of available data	descriptive data from websites and publications
Short description	Edinburgh Community Solar Co-operative (ECSC), legally known as Edinburgh Community Solar Limited is a registered society under the Co-operative and Community Benefit Societies Act 2014, and was born in 2013. It recently reached the quote of 30 host buildings across Edinburgh, which can generate 1.5 GWh/ year (weather dependent) of energy through solar power (PVs). This society aims to: - Support and be involved in the development, installation, management, operation, generation, transmission and provision of renewable energy and low carbon sources; - Reduce climate change emissions - Alleviate fuel poverty - Improve energy security - Help foster sustainable development in and around Edinburgh Edinburgh Community Solar Co-operative (ECSC) was formed in December 2013 as an Industrial & Provident Society, which is governed by its rules and run by a board of directors. ECSC, supported by Energy4All, raised the required funds (£1.4 million) to install 25 solar PV arrays. This was achieved with a public share offer, giving priority to Edinburgh residents to become members of the co-operative by purchasing shares for a minimum of £250. As part of its commitment to the people of Edinburgh, each year the Edinburgh Community Solar Co-operative assigns a portion of its proceeds to the Community Benefit Fund. Between 2018-2021, each of the 30 ECSC host buildings has the opportunity to apply for a grant from this fund for a project that matches the ECSC's objectives. During operation, some or all the electricity generated is used by the building, depending on internal demand. This electricity is sold to the Council through a Licence Agreement, which is now in place. ECSC also receives income through the Feed in Tariff. Any surplus electricity is exported to the grid for which ECSC also receives an income. The actual level of income depends on the level of daylight, how much electricity is used internally and the operational efficiency of the plant. Each year, after operation and

	administration costs have been covered, share interest is paid to members. The return on share capital is capped at 5%, which will rise with RPI each year. The surplus funds generated after payment of share interest is allocated to the community benefit fund.
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☒ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools ☒ Presence/Development of innovative cooperation streams ☒ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Solar power; Energy community; Active citizenship; CO_2 reduction
Critical aspects	-
Enabling aspects	This case study sets a new paradigm for the production and utilization of energy, making the citizen both producer and consumer.
Milestones	Citizen's engagement
Elements of interest	The business kickoff, listing organization as a society.
References	• https://www.edinburghsolar.coop/projects/how-the-co-op-works/ • ECs report p. 53 • https://www.changeworks.org.uk/projects/edinburgh-community-solar-co-op • https://www.solarpowerportal.co.uk/news/edinburgh_community_solar_co_operative_working_on_30th_installation

Energy4All - UK	
Level of the case study	National level
Type of case study	Cooperative
Types of available data	descriptive data from websites and publications
Short description	Energy4All is based in Barrow-In-Furness in North West England and was created by Baywind Co-operative (the UK's first renewable energy co-operative) to develop other community owned renewable energy projects across the UK. They have two-fold mission: to support the UK's transition to a low carbon energy systems; and to do this in a way that offers

	an opportunity for ordinary people to make a tangible contribution to tackling climate change.
Case study key aspects/elements	☒ Presence/Development of a particular participatory approach ☒ Presence/Development of innovative financing or business models ☐ Presence/Development of an enabling regulatory framework (at national or local level) ☒ Presence/Development of innovative technologies or tools ☐ Presence/Development of innovative cooperation streams ☒ Presence/Development of innovative types of contracts/agreements
Keywords that better describe the case study	Shared-Energy; Co-operative; Business development
Critical aspects	The most critical issues may arise principally from internal conflicts that can be created within the investors of the co-operative project.
Enabling aspects	Energy 4 all is now an established company that gives support to projects for co-operative, the key aspect of success is the fact of giving a consulting support to its investors. Providing all the knowledge necessary for the creation and development of their business model
Milestones	The most critical milestones were the implementation of the first projects. Since it is not a known society, the main hurdle will be to be known and develop the first projects.
Elements of interest	The idea itself has nothing innovative at a technological level, but the approach of supporting co-operative with the knowhow of experts was definitely the key to the success of this company. Energy4all develops technological innovation projects for communities, associations, local authorities and therefore promotes the energy development of towns, schools, etc.
References	• https://energy4all.co.uk/

Annex B. Complete Proximity Domains and Geographical Levels Matrix

Proximity domains	Dimensions	Geographical Levels					Descriptors	Indicators To be completed with T5.2	Examples
SPATIAL DOMAIN		L	R	N	S	V			
SPATIAL	Urban structure	X					Types of structure (neighbourhood, block, building, others)		An example is the Marstal Fjernvarme (Denmark) case, where the urban structure allowed the community to group around a solar and heating district.
	Climatic area / region	X	X	X	X	X	Homogeneous climatic area (similar climatic conditions / necessities)		An example is the Tirano (Italy) case (regional level), where the location inside the Po valley, put participants in similar climatic conditions (especially related with air quality).
	Resource availability	X	X	X	X	X	Availability of natural resources to be exploited (eolic, solar, others)		An example of this, at the local level, is the Oborniki slaskie (Poland) case, where the locally available biomass triggered the creation of a community around its use.
	Energy infrastructure closeness	X	X	X			Presence of energy plants in a area; presence of existing energy infrastructures		*(under completion)*
	Cluster and activities closeness	X	X	X			Physical presence of associations, groups of firms, institutions, clusters, etc		An example is the ENERGEIAKH KOINOTHTA KARDITSAS SYNPE (Greece) case, where the presence of an already existing energy cooperative with infrastructures, triggered the enlargement of the cooperative toward the creation of a proper energy community.
POLICY DOMAIN		L	R	N	S	V			
POLICY	Political agendas	X	X	X	X		Presence of strategies, goals, actions and an agenda on transition goals; presence of green procurements mechanisms		An example is the Region Emilia-Romagna (Italy) that produced the Labour and Climate Pact together with the local authorities, universities, enterprises, trade unions and non-profit sector, to agree to full employment and green transition.
	Administrative structure (across levels)	X	X	X	X	X	Hampering or enabling aggregating mechanisms and agency		France for example, has introduced a territorial development strategy for renewable energies, jointly designed with all the stakeholders to facilitate the development of agreed, cooperative projects. Under the proposed method, the scheme would operate through energy transition committees, bringing in elected representatives, socio-economic actors and citizens.
	Regulatory framework	X	X	X	X	X	Structure and presence of norms habilitating or not people/tech aggregations		The Netherlands with the National Regional Energy Strategy (RES) Program helps regions to achieve the transition to natural gas-free. The RES establishes how the sustainable generation of energy can fit into the spatial planning and the electricity network, and how support for the measures can be created in society. The national RES Program supports the regions in creating these RESs by supporting and sharing knowledge. It further connects parts, highlights risks and threads and identifies linkage opportunities.
SOCIAL DOMAIN		L	R	N	S	V			
SOCIAL	Community dimension	X				X	Presence of community bonds or ties; presence of leaders or spokespersons		An example of it (at the local level) is the Solbyn Association (Sweden), where one of the first trigger was the presence of a housing cooperative with the aim to promote sustainable living.

	Collaboration mechanisms	X	X	X	X	X	Presence of active associations, third sector, social enterprises, community projects, practices, civic actions		-
	Knowledge and learning	X	X	X	X	X	Presence of specific training programs on energy; presence of network with other cities/regions in order to learn from peers; training on technical aspects, other		An example of it (at the national-virtual level) is the SOM Mobilitat case, that operate on a network at European level to share good practices and resources with other sustainable mobility cooperatives through the creation of the first network of mobility cooperatives in Europe called REScoop Mobility, under the umbrella of the REScoop.eu cooperative federation.
	Energy Awareness	X	X			X	Presence of specific awareness goals under the energy citizenship configuration.		An example of it (at the national level) is the Enercoop (Frances) case, where a specific attention is given to the increase of awareness of citizens around the topic of energy and renewables.
TECHNICAL DOMAIN		L	R	N	S	V			
TECHNICAL	Energy system	X	X	X			Energy system structure, management and characteristics (e.g. hierarchical or distribute structure)		-
	Technological readiness	X	X	X		X	Readiness of the context in relation with technology, e.g. electric vehicle distribution, presence of the recharging stations, energy grid, etc		-
	Technological appliances	X				X	Presence and distribution of devices (e.g. small-scale home devices; urban devices; etc)		An example of it (at the local level) is the Svalin co-housing complex (Denmark), where forms of innovation and energy awareness are triggered by the presence of innovative small appliances (e.g. colour lighting in relation with energy consumption)
	Enabling structures	X	X	X	X	X	e.g. supporting online platforms; digital twins, control rooms, sharing platforms, ICT coverage (e.g. wifi free connection hotspots; 3/4/5g networks)		An example of it (at the virtual level) is the SOM Mobilitat case, that has a platform for multiple actions, from the functioning of the project itself, to crowdfunding, to management.
ECONOMIC DOMAIN		L	R	N	S	V			
ECONOMIC	Energy system economic structure	X	X	X	X	X	e.g. energy price; subsidies for renewable energy transition; etc		-
	Energy system enabling economics		X	X			Presence of incentives (national, regional or others); innovative business models; etc		An example of this is the Banister House Solar case (UK), where an innovative business model including leasing and the involvement of several financial actors have been put in place.
	Value redistribution / inclusion mechanisms	X	X	X		X	Presence of mechanisms related with energy poverty		A light example of this (at the local level) is the Magliano d'Alpi (Italy) case, where the EV charging colums are free of charge for residents. This has been done for increasing citizens trust and awareness on the energy topic.
	Cluster economy	X	X	X			Concentration of entities representing non-governmental organizations, traditional and socially-oriented enterprises and other institutions		An example of it (at the local level) is the SAS Ségala Agriculture et Energie Solaire Cooperative (France) where one of the first motivations around the creation of the energy community was the presence of the same economic cluster or participants, in this case agriculture and breeding.