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Social sciences introduction. Local energy communities : State of the art and chapters' cross-sectional analysis

Gilles Debizet, Marta Pappalardo

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Local Energy Communities

Emergence, Places, Organizations,
Decision Tools

Edited by
Gilles Debizet,
Marta Pappalardo,
and Frédéric Wurtz

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Preface

Renewable and waste energies are being increasingly scaled up at building, village and city levels. Energy sharing communities are emerging at the initiative of citizens, with the support of non-profit organizations, companies or local authorities. Energy projects and communities are introducing new forms of mediation between production and consumption, which question democratic principles like social justice and citizen participation, as well as the governance and design of energy systems. Considered as a grouping of individuals or legal entities actively involved in a project for the production and/or consumption of renewable energy, energy communities are emerging and spreading in Europe and elsewhere. They form an elastic object, where the representations of the actors bear as much weight as the material characteristics of the devices and the energy system itself.

This movement for local energy production and sharing is part of the general backdrop of the fight against climate change, which calls for an environmental and energy transition. Our societies are becoming aware of their impact on the production, distribution, storage and consumption of energy. The transition from an energy system based on mass imported carbon-based stock energies (oil, coal, gas, etc.) to endogenous flow energies (solar, wind, etc.) is underway, with significant variations from country to country in terms of the role of nuclear power. This decarbonization of production by resources that are less controllable than fossil fuels calls for attention to the flexibility of the system, especially the power grid, which must constantly balance inflows and outflows. The economic and environmental costs of this decarbonization also call for the promotion of sobriety.

In this context, local actors are getting to grips with the energy issue. They are investing in and using local renewable energy production and means of waste energy recovery; they are sharing energy via common and/or public networks. These communities are thus developing and deploying low-carbon renewable energy production activities and services. The involvement of citizens and communities is driven by social values of ecological commitment and participation that go beyond the sole objective of renewable energy production. It could induce individual and collective practices that limit the import of exogenous energies by aiming not only at sobriety but

also at the temporal adaptation of energy uses to the moments of production, along with the development of storage means physically close to these uses. In other words, this involvement could have the effect of adapting local consumption to local production to minimize the demand for non-local energy production.

Obviously, the emergence of such energy communities does not always have the same motives or effects, depending on whether the territory concerned is served by the electricity grid. Where there is no electricity grid, local renewable electricity production and distribution projects provide an essential service boosting both the quality of life of the inhabitants and economic activities. Where the grid fails and provides electricity intermittently, parallel systems are often implemented at the household or facility level, and sometimes on a larger scale. This book covers geographic areas where a highly reliable electric grid delivers electricity, sometimes complemented by a gas or heat network. In these areas, production facilities, group purchasing of renewable energy, collective self-consumption and any other community initiative related to energy are not motivated by access to reliable energy, except from a distant perspective of local post-collapse resilience. Other motivations are at play. Dealing with empirical cases in several European countries and Canada, the chapters in this book reveal practices and dynamics of change in countries and territories served by a reliable electricity grid.

This book draws on social science analyses, and to a lesser degree, engineering science relative to energy communities, especially their emergence and organization, the regulatory framework and the design of technical solutions. These help to elucidate the ongoing dynamics within and surrounding *Local Energy Communities* in fully electrified countries such as Canada, France, Germany, the Netherlands, Spain, Switzerland and the United Kingdom. This work also focuses attention on new paradigms driving innovative tools for designing community energy systems. It reveals the controversies at – and between – different scales, while outlining a diversity of drivers and levers for scaling up energy communities or local energy sharing.

Origin of the book

The 14 chapters that follow result from a selection of papers presented during the webinar series: “Energy communities for collective self-consumption: frameworks, practices and tools”. This was held by the Université Grenoble Alpes, France, in partnership with Plan Urbanisme Construction Architecture (PUCA, State agency for innovation in these fields), from June to October 2020.

The initiative of holding the conference and publishing the book was taken by the *Eco-SESA Programme* (<https://ecosesa.univ-grenoble-alpes.fr/>)

eco-sesa-program/). Eco-SESA is one of the first seven Cross-Disciplinary Projects of the Grenoble Alpes University IDEX awarded under the “Initiative of Excellence” national label, a label reserved for the top-ten universities in France. The Eco-SESA programme spans 16 laboratories (Physical Sciences and Engineering/Social Sciences and Humanities). It addresses five key objectives for integrating on-the-spot renewable energy generation in urban areas: understanding the effects of the mass deployment of variable renewable energies; assessing the effects of self-consumption; understanding and predicting the behaviour of consumers and district stakeholders; governing and coordinating energy at the district/urban scale; and designing appropriate energy components and associated design tools. The current book is a direct contribution to two of the five research fronts of the Eco-SESA program: “Interactions modelling between buildings and with grids in a district” and “Architectures for integration of renewable on-the-spot generation”.

Framework of the book

Based on the selected papers from the webinar series, the book is organised in 5 sections. The central sections take a social science look at the three main forms of energy communities: collective self-consumption, citizen cooperatives and peer-to-peer digital service. The first section analyses the social construction of energy communities. The last section presents approaches to the design of community energy systems that take social dimensions into account.

The first section presents people’s motivations for community energy and goes on to examine several initiatives led by collectives of inhabitants and urban production actors. The authors describe the emergence of *Local Energy Communities* in Europe and Canada. They highlight the internal and local dynamics and the weight of the incumbent actors.

- A1. Inhabitants’ activities and needs relative to renewable energy pooling and sharing: a prospective scenario approach
Antoine Martin, Marie-France Agnoletti and Eric Brangier
- A2. Shared geothermal energy projects in Montreal: the importance of pre-existing collective action spaces
Myriam Proulx and Sophie Van Neste
- A3. Energy communities and commons: rethinking collective action through inhabited spaces
Marta Pappalardo
- A4. Anticipating energy communities in urban projects: challenges and limits
Inès Ramirez-Cobo, Gilles Debizet and Silvère Tribout

The following three sections each focus on a type of energy community. A variety of perspectives – sociological, economic, political and legal – explore the three main forms as they emerge in Europe and begin to be

recognized in the national regulatory frameworks of Western countries. There follows a brief description of each section dedicated to a type of energy community.

- Collective self-consumption has been authorized for some years by national electricity regulations in Germany, Spain and France. Producers, or prosumers, and consumers located in the same place or nearby can thus exchange electricity and subtract these flows from the consumption billed by their regular supplier. Two chapters highlight the emergence of the scheme and the controversies sparked. In particular, they show how operational actors, such as grid operators, municipalities, social housing and companies designing and installing renewable energy facilities, have weighed in on adjustments to the scheme.

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| <p>B1. Regulatory framework of collective self-consumption operations: comparative study France, Spain, Germany
<i>Blanche Lormeteau</i></p> <p>B2. The controversial emergence of collective self-consumption in France
<i>Thibaut Fonteneau</i></p> |
|---|

- Citizen cooperatives appear with the aim of locally producing energy or supplying electricity. They gather, on local, regional and national scales, to carry out renewable energy projects and promote the ideal of *Local Energy Communities*. These three chapters highlight internal decision processes, territorial partnerships, collective learning and network structuration, questioning the outlook of territorial spreading and national scaling up.

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|--|
| <p>C1. Trajectories of renewable energy communities: between democratic processes and economic constraints
<i>Armelle Gomez, Benjamin Tyl, Aude Pottier</i></p> <p>C2. Emergence and transformation of <i>Enercoop</i>: the French network of electricity supply cooperatives as a new social economy initiative
<i>Rémi Maître</i></p> <p>C3. Cooperation within and the institutionalization of participatory renewable energy projects in France: a focus on co-developed citizen, public and private partnership projects
<i>Amélie Artis, Justine Ballon, Dorian Litvine, Émilie Dias and Sylvie Blangy</i></p> |
|--|

- Peer-to-peer digital services link producers and consumers within virtual energy communities. Market-based approaches and digital paradigms, such as smart-grids, an energy internet and blockchain, are shaping new business models. Notions such as “prosumer”, “peer-to-peer” and “guarantees of origin” introduce new ways of renewable energy sharing, and even local energy marketplaces. The different

chapters outline not only the intrinsic differences between market and cooperative approaches but also their potential complementarity.

- D1. Emerging digital business models for energy communities: enablers for citizen participation in the energy transition? – Perspectives from Germany
Christine Dede and Monika Heyder
- D2. Digital technologies for consumer-centred energy markets: opportunities and risks of an energy internet
Hugo Schönbeck, Anna Gorbacheva and Alexandra Schneiders
- D3. Digital energy trading platforms: an economic analysis
Thomas Cortade and Jean-Christophe Poudou

The last section presents tools for modelling and optimizing energy systems, taking into account the functioning of way energy communities work and their relations with public energy networks. Projects sharing “in-situ” renewable energy are carried out in various configurations and for different stakeholders. It is no longer just a question of defining an optimal technical solution from an economic stance, but rather one of reconciling the expectations, constraints and objectives of several stakeholders and environmental concerns. These two chapters rely on methodologies and tools, ranging from the design of the community system to everyday active management.

- E1. Proposal to take into account stakeholders’ motivations in models of optimization decision support tools
Lou Morriet, Frédéric Wurtz and Gilles Debizet
- E2. Decision support for technical design of on-the-spot renewable energy projects involving several stakeholders
Jaume Fito, Sacha Hodencq, Lou Morriet, Julien Ramousse, Frédéric Wurtz and Gilles Debizet

Each section of the book begins with a transition that summarizes the results of the previous section, introduces the common highlights of the chapters and presents each chapter individually.

Reflecting a social science perspective, the first introduction by Gilles Debizet and Marta Pappalardo presents a state of the art on the community and local dimensions and a cross-sectional analysis of the chapters. In the second introduction, Frédéric Wurtz offers a transversal reading of the chapters from an engineering science perspective.

Social sciences introduction.

Local energy communities

State of the art and chapters'
cross-sectional analysis

Gilles Debizet and Marta Pappalardo

1 Introduction

Since the beginning of the 2010s, the energy community model has attracted the interest of many actors, particularly because of the possibility of citizen participation in the decision-making process. This societal and political objective is intertwined with the environmental values of reducing greenhouse gas emissions and energy sobriety, while meeting the aim of moving away from traditional market logics. Many actors associate energy communities with the idea of spatial proximity or even interpersonal relations between their members. This enthusiasm has been translated into legislation, particularly on the European continent by the European RED II and IEMD directives, which legally define energy community and thus enable national and local policies favouring them.

The definition of energy community in this book is not based on official criteria. It recognizes a diversity of objectives and actors: an energy community is a grouping of individuals or legal entities actively involved in a project of production and/or consumption of renewable energy. Thus, the community is an elastic object, where the representations of the actors have as much weight as the objective and technical characteristics of the devices. The feeling of being part of a community, the implementation of horizontal forms of governance, the interweaving of technical installations and spaces, or the local anchoring all contribute to shape such communities.

This broad, polysemous definition is based on a scientific review of social science research, described below. It precedes the cross-sectional analysis of the chapters, which allows for a generalization of results and draws several lessons from this book.

2 English- and French-speaking state of the art on the concepts of *community* and *local*

The literature on energy communities reveals major differences. The term *energy community* can define collectives ranging from a few participants up to several thousand members. It can be limited to the perimeter of a building

or extend over vast territories, and be carried by very informal collectives, public authorities or digital social networks. The term has been widely used in social science literature, but with a marked difference according to linguistic areas. Its translation *communauté énergétique* has only recently appeared in the French-language literature (Debizet and Pappalardo, 2021; Pappalardo, 2021) whereas, for some years now, citizen-initiated renewable energy projects have been the subject of French-language journal articles.

The concept of energy communities differs according to the disciplinary entries. To avoid taking stock of each of them, two broad structuring dimensions, beyond the object (abstract and physical) of energy, can be grouped together. The first is organizational and is mainly expressed in English-speaking sociological works by the term *community*, i.e. the modes of involvement of actors, the dynamics of collective decision-making, and even questions of democracy. The second dimension is spatiality. This is linked to the location of organizations, resources and material devices, as well as the inclusion of energy communities in territorial dynamics. These aspects are studied by geographers and urban planners as well as social scientists in the field of science and technology, especially related to the material and technological aspects.

This short review provides also English-speaking readers with an overview of the ways in which French-language literature explores what Anglophones usually refer to as an energy community.

2.1 Community: an organizational dimension intertwined with the energy sector, internal democracy and local networks

Depending on the cases studied, research cultures and the countries where the scientific work is carried out, the concept of energy communities varies. While the German-speaking world is interested in citizen energy (Radtke and Henning, 2013), local energy initiatives (Blanchet, 2015; Hoppe et al., 2015) and energy ownership (Lowitzsch, 2018), the English-speaking world centres more on the community and how it works. Thus, the literature on energy communities focuses on so-called citizen or grassroots energy communities (Hargreaves et al., 2013; van der Waal, van der Windt and van Oost, 2018) and their forms of internal organization. The emphasis on the organizational and even institutionalization dynamics of energy communities (Seyfang and Haxeltine, 2012; Wirth, 2014) is confirmed in several works on energy communities in the UK, much of which focuses on the processes and effects of citizen involvement in projects (Walker and Devine-Wright, 2008).

These authors emphasize the empowerment of citizens and solidarity rather than a group of people living in the same space or under the same local authority, all of which is referred to by the notion of *community* in English (Hicks and Ison, 2018), which has positive connotations. Conversely, the literal French translation *communauté* may refer to the negative representation

of communitarianism. In this regard, Yalçın-Riollet, Garabuau-Moussaoui and Szuba (2014) point out how French linguistic culture leads to thinking of communities rather as spaces of withdrawal and *entre-soi*, keeping oneself to oneself, in contrast to the values of the Republic. Aubert and Souami (2021) note an overemphasis on the expression ‘energy community’ to describe the set of actors involved in local renewable energy production and sharing projects.

In France, publications on energy communities are rather recent, but there is robust literature on the territorialization of energy and the organization of actors in the energy sector. This contributes to the emergence of three major scientific debates: the mutation of economic models and the organization of the energy sector, the democratic forms of communities and the relationship with the network.

French studies analyse the socio-economic forms of energy-producing communities, whether they are cooperatives, mixed economy companies or associations. The local level, considered as a space for the deployment of renewable energies, requires an adaptation of the energy project (Dobigny, 2012; Fontaine and Labussière, 2019; Nadaï et al., 2015). This research highlights the transcending processes of trial and error and risk-taking that give these initiatives a political dimension that is opposed to national energy policy (Cointe, 2016). This research explores the transformative power of energy communities and even the establishment of an energy democracy. Through the control of energy infrastructures, citizen participation and the local distribution of benefits, energy communities are asserting themselves as alternative spaces to socio-economic and market models (Wokuri, 2021). These experiences are, however, strongly conditioned by the political and economic systems of the country where they emerge (Wokuri, 2019).

Research on internal deliberation systems in communities (Pappalardo, 2021; Maître, 2021), reports a number of experiments in the governance of collectives, moving away from the model of representative democracy towards more horizontal forms, such as sociocracy or holacracy. According to these approaches, the distinctive character of the energy community does not lie so much in the type of renewable energy implemented, but rather in the experimentation of modes of governance. Thus, while energy communities in the form of production or supply cooperatives were the first to be established in territories (Fontaine, 2019), *in situ* production and consumption communities are currently asserting themselves as spaces for political experimentation through the reorganization of collectives (Rumpala, 2013). This organization is deeply intertwined with the spaces where energy consumption practices take place (Pappalardo and Debizet, 2020).

The relationship between the network and alternative organizational models, called ‘energy communities’ in the English-language literature, has given rise to several notions. One is the *post-network* (Coutard and Rutherford, 2011) of an ongoing transition from the traditional model of the large centralized network to logics built around the local dimension,

while another is the notion of *energy territories* implemented on the scale of the city, the neighbourhood or the building (Souami, 2009). The notion of *socio-energy assemblage* has been used to analyse energy and urban governance in search of renewable or fatal energy (Aubert, 2020; Debizet et al., 2016; Hampikian, 2017), emphasizing the role of energy intermediaries (Tabourdeau and Debizet, 2017) in the wake of the French school of proximity (Bahers and Durand, 2017). The notion of *energy autonomy* points to spaces for the construction of new relationships to resources and new forms of organization (Lopez, Pellegrino and Coutard, 2019).

2.2 Local: the spatial dimensions of energy communities, outlined by places and proximities

These debates between social scientists in the French-speaking world raise questions about the attention given to urban and territorial dynamics as a structuring variable for the action of energy communities. Some research identifies space as an indicator for classifying energy communities within taxonomic exercises. For example, Heiskanen et al. (2010) distinguish between geographically local communities, sectoral communities, communities of interest and virtual communities. Moroni et al. (2019) put forward a taxonomy of energy communities that introduces the territorial variable in their characterization, constructing a four-cell matrix. The first distinction is made between place-based communities, i.e. communities built on a local dimension that is displayed and operative, and non-place-based communities. The second distinction concerns the ambitions of the community, which can be single-objective (particularly around the energy function) or multi-objective (single-purpose or multi-purpose). This taxonomic work leads to the establishment of typologies of energy communities, in which the spatial dimension is not understood as a bedrock of non-local policies and economic interests, but as an element that operates in the structuring of local communities and their capacity for action.

In this context, energy communities are now emerging as models of a renewed spatiality based on energy (Dubois and Kebir, 2021), which takes on different meanings and is part of a tradition of questioning the dominant centralized model. It ranges from the desire for autonomy, which gives rise to citizen projects that claim locality as an instrument of sustainability (Brusadelli, Lemay and Martell, 2016), to the use of the energy community as a tool in the discussion around urban production (Aubert, 2020; Ramirez-Cobo, Tribout and Debizet, 2021). This pooling of actors around energy consumption and production reinterprets not only space as a place to locate energy devices but also locality as a set of values (Herault-Fournier, Merle and Prigent-Simonin, 2012; Martin and Upham, 2016; Perlaviciute et al., 2018), such as the traceability of energy, the exit from large distribution infrastructures or the geographical proximity between producers and consumers (Debizet and Tabourdeau, 2017; Tabourdeau and Debizet, 2017).

In this sense, energy communities are objects deeply embodied in a local space, or rather in a reflection on space that transcends traditional conceptions of energy and its management.

3 Cross-sectional analysis of the chapters

The cross-sectional reading of the 14 chapters gives a glimpse of a set of lessons whose scope goes far beyond the case studies and fields described by the various authors. It highlights recurring results in several chapters, the first stage in their rise to generality. The division into five sections does not overlap with the two dimensions mentioned in the description of the state of the art, but explores new segmentations without any hierarchy or search for progression in the structuring. The works of the authors encompass a diversity of disciplines in the humanities, social sciences and engineering sciences; they cannot be treated from the angle of a unified subject matter without undervaluing the salient, recurrent results of one each. Subheadings in the form of questions help the readers to focus their reading according to their interests.

3.1 Why and how do members commit to community energy projects?

Reflections on actors' motivations are transversal to many chapters of this book. Project participants sometime create an organization in the form of association or cooperative (Proulx and Van Neste; Pappalardo). This confirms the importance of decision-making autonomy, on the scale of a collective dwelling or an urban block, for participants in energy communities. In this sense, while the will to engage in energy sobriety is one of the main motivations for the emergence of the projects presented, the possibility of 'deciding for oneself' and even the desire to escape from the monopoly of the large distributors are likewise at the centre of the energy communities studied.

According to Maître, the participants in the French *Enercoop* network see themselves as activists in the energy sector in several ways. As consumers, they commit to paying more for their energy to embark on a path of sobriety; as employees, they accept salaries that are different from those of the market, even sometimes revised downwards, to participate in a network that claims actions and values that are contrary to classic market exploitation. Finally, as bearers, they are part of an entire network built on a participatory system that guarantees the transparency of its governance, from the origin of its resources to its holacratic modes of operation. Proulx and Van Neste analyse how pre-existing collective spaces are the driving force behind the motivation of actors to set up citizen and innovative projects, anchored in the territories of their daily lives. Pappalardo takes a close look at negotiations among the individuals and community, balancing consumption

practices with community survival. While horizontal governance systems, such as holacracy or sociocracy, can overcome obstacles and reach compromises within official bodies, this book also reveals numerous informal dynamics that act on the directions taken by communities in ways that have different degrees of visibility but are equally decisive.

The importance of ‘precursor’ actors, as described by Rogers (Rogers, 2003), is emphasized by Martin, Agnoletti and Brangier, who recognize that it is easier for designers to access the visions and expectations of these actors. While actors who initiate or lead energy communities (and in general the integration of innovations) are often the pivotal players (Debizet et al., 2016; Mitchell, Agle and Wood, 1997) in project implementation, they also have to deal with a variety of stakeholders who are not solely interested in the energy dimension. A duality develops between ‘precursor’ and ‘expert’ users, who are easily integrated into the designers’ preparatory studies, and ‘ordinary’ or ‘lay’ actors, who organize their participation in the community around a multitude of factors, of which energy is only one component. This difference not only refers to Moroni et al.’s (Moroni et al., 2019) taxonomy between single-purpose and multi-purpose communities; it also reminds us that, when moving from the individual to the collective, actors come up against a wide range of interests and values, and that compromise does not always lead to the success of the energy project (Ramirez-Cobo, Debizet and Tribout).

The tensions that arise in and around communities are reported in several chapters of this book. While some authors focus on tensions within communities that arise at the micro-local level (Pappalardo; Proulx and Van Neste), others examine these tensions at the territorial level and in the institutionalization of projects (Gomez, Tyl and Pottier; Artis, Ballon, Litvine, Dias and Blangy). A place-based approach reveals tensions between actors with divergent interests in the territory encompassing the incipient energy community. The innovative character of energy communities prompts actors to make compromises, creating transformative ripples beyond the space of the energy community or project (Proulx and Van Neste; Artis et al.). However, when the actors’ interests clash with well-established traditions of action in the territory, negotiations may founder and lead to the failure of the envisaged community energy project (Ramirez-Cobo et al.). In such contexts, some decision-support and design tools can enable compromises in multi-actor decision-making processes (Morriet, Wurtz and Debizet).

The renewed relationship with energy resources also involves the motivations and actions of consumers, who organize their energy use individually and collectively. Maître, for example, analyses how the *Enercoop* network voluntarily sets a higher price than the market price to encourage energy sobriety among consumers. Meanwhile, other chapters highlight the system and architectural materiality, along with skills, as key resources. In the energy communities studied by Pappalardo, consumption practices are not influenced solely by participating in an autonomous production system common to the other members of the community but are constructed in a

differentiated manner in spaces that are shared to varying degrees. Thus, individual practices in the domestic sphere remain largely impervious to collective social control, and even to the ambitions of sobriety that are nevertheless embraced by the community. In their research, Martin, Agnoletti and Brangier emphasize how these practices, with different levels of sobriety, are constructed on the basis of users' knowledge and capacities to interact with the energy devices themselves.

3.2 *How are energy communities local?*

The energy production and distribution facilities of the energy communities presented in this book are, with a few exceptions, centred around a place or located in a space; in general, the members of the community reside or carry out activities in the vicinity. In other words, in most of the cases discussed, the physical facilities and members of the same energy community are located in the same area. This being said, the question arises as to the spatial proximity and its concomitant effects on the community members. The cross-cutting analysis of the chapters highlights three influential dynamics: the local as opposed to the dominant regime, the distinct role of the 'local' depending on whether the main actor of the energy project is local or not, and local anchoring as a driving force for scaling up.

3.2.1 The local as a counter-model to the dominant electricity regime

Most of the authors of this book see local energy communities as part of a movement of emancipation from the state and the large energy suppliers (Martin et al.). Electricity is particularly associated with images of a centralized network that leaves little room for citizens and of energy producers, including renewable energy producers, led by multinational companies with purely profit-making motives (Artis et al.). In contrast, the local is adorned with virtues: renewing links with the natural environment that surrounds the habitat (Martin et al.), interdependence with neighbours based on the sharing of equipment (Proulx et al.), giving back 'power to the people' (Schönbeck, Gorbatcheva and Schneiders). While globalization in general and the liberalization of energy in Europe have extended the distances between the consumer and the production chain while reinforcing the free choice of supplier, energy community actors tend to enthusiastically cultivate a dependence on the local: its physical resources, its human resources, its scenes of deliberation, to name but a few.

For example, the citizen production cooperatives federated by the French national network *Energie Partagée* are explicitly committed to involving 'local stakeholders and resources' and to management and governance by local residents (Artis et al.). This enthusiasm for local energy communities can also be found at the other extreme of the scale; the European Union's commission and parliament positively perceive energy communities as a

way to increase the acceptability of renewable energies (Lormeteau). The emerging scientific focus on *energy justice* (Sovacool et al., 2017) perceives the local as a space where resilience can be organized to reduce the vulnerability created by the global system's removal from populations and territories of the control of energy sources necessary for their development.

Some authors temper this enthusiastic vision of the local. Pappalardo highlights the tensions between privacy and the setting of rules for sharing, in this case access to renewable electricity, in a participatory habitat. Fonteneau points to the controversy over the financing of the electricity grid as an instrument of national solidarity. Ramirez-Cobo et al. show the tensions between local scales, such as building, neighbourhood and city, that have arisen in the context of urban projects. In other words, while, according to some economists, sociologists, psychologists and jurists, the local level is a paragon of virtue, geographers, urban planners and other sociologists are more circumspect, calling for a deeper exploration of what *local* actually means.

3.2.2 *Community energy as an outcome of the local level*

In the introduction to a recent special issue of the francophone journal *Flux*, devoted to local energy communities, Debizet and Pappalardo (2021) highlighted two lines of Francophone research on energy. Focusing on the electricity sector, one line presents the local level as a test to which renewable energy projects are subjected, and calls for an adaptation of the energy project (Dobigny, 2012; Nadaï et al., 2015). The other, taking the angle of urban production or territorial development, considers energy as a new field of action for citizens and local authorities. Local actors thus carry out projects and go through the ordeals imposed by the socio-technical energy regime (Debizet et al., 2016), as outlined in the Geels' chapter of the book *Cities and Low Carbon Transitions* (Bulkeley et al., 2010).

While they have seized upon the liberalization of the electricity market and the economic incentives for renewable energy in most countries, production cooperatives systematically involve local authorities well upstream of the implementation of production facilities. Partnership with these is part and parcel of the principles of action for these cooperatives (Gomez et al.). It is always preferable to involve local authorities upstream as sooner or later they will have to grant some approval or authorize the installation. However, it is also a question of (re-)politicizing energy production choices, while accelerating the reappropriation of the energy issue and the development of local energy resources (Artis et al.).

Citizens' cooperatives clearly contribute to the acceptability of renewable energy hoped for by the European Union, as do collective self-consumption operations (Lormeteau). Generally initiated and carried out by established, legitimate local actors, these operations extend their scope beyond their usual socio-economic fields. Such local actors extend their scope to energy: local authorities share the surplus with local consumers, social housing

bodies give their residents access to affordable green electricity and urban real estate companies empower occupants with a micro-grid perspective (Fonteneau). The motivations of these actors are not limited to citizen appropriation of energy; they include the energy object in the essential mission or service of their organization.

3.2.3 Territorial anchorage and combinations of spatial and organizational proximities as levers for scaling-up energy communities

From the national level, the local level is seen as a challenge to overcome. At this overarching level, the effectiveness of support for renewable energy is a highly controversial issue (Fonteneau). Citizen projects and collective self-consumption initiatives do not benefit from economies of scale compared to large wind and solar farms. Subsidies or tax cuts would be required for projects to approach the economic viability necessary for their emergence. The local dynamics contributing to the establishment of community energy are little perceived by the actors in the energy sector.

The combination of spatial proximity (in projects and operations) and organizational proximity (in transcalar networks) contributes to accelerating the capitalization and dissemination of knowledge and know-how. The participatory or even holacratic decision-making process (Maître), along with the principle of co-construction with partners (Gomez et al.), multiplies the learning of know-how for setting up and implementing installations within citizen cooperatives and among their partners (craftsmen, service providers, local authorities, etc.) (Artis et al.). The grouping of local production cooperatives within a national federation allows for access to specialized expertise, also enabling know-how to be leveraged and disseminated between local cooperatives (Artis et al.) and, ultimately, from one territory to others. The reinvestment of the revenue from the sale of electricity by citizen cooperatives in new local renewable facilities reduces the capital profitability but finances the establishment of more facilities.

Collective self-consumption could also benefit from the effects of learning and dissemination within the structures that support them, such as groups of municipalities, social housing organizations and their umbrella regional and national networks (Fonteneau). Thus, economies of scale are not intrinsic only to the scale of the project or its carrying organization but could be linked to the ability of a network of organizations to leverage and share knowledge and to pool purchases.

3.2.4 The diversity of scales of sharing and the ensuing tensions

In the chapter by Martin, Agnoletti and Brangier, the domestic space is the place where innovative forms of energy consumption are tested on an individual scale and possibly with the collaboration of several households.

These ‘precursor’ households experiment with different consumption solutions (or even individual production solutions) in their daily lives, enabling them to achieve efficiency and sobriety objectives. The transition to the collective dimension complicates these dynamics. Individuals can no longer take into account only their own expectations and practices but must deal with the other members of the energy community, as in the case studies presented by Pappalardo. Thus, the nature of the inhabited spaces becomes significant in the exercise of certain social control and hence in the establishment of energy sharing rules. This transition requires adjustments, even compromises, necessary for the survival of the community. The results of Pappalardo’s research show how these rules, adjusted and interwoven in the inhabited space, are based on spaces, whether physical or of expertise, that pre-date the very decision to set up an energy community project. Indeed, participatory housing and spaces governed by the commons model as a whole are confirmed as spaces that are conducive to the emergence of policies in practice.

In Proulx and Van Neste’s chapter, these spaces are those of the neighbourhood, of inter-personal relationships on the neighbourhood scale, in this case the back alley. The physical spatial dimension (existing or projected) is more central to the research of Ramirez-Cobo, Tribout and Debizet, where it serves as a basis for all the exchanges related to the emergence of the energy project. In the end, the usual governance scales, such as the building and the city, were chosen as the space for pooling renewable energy production facilities, to the detriment of the urban project scale, the neighbourhood. The local level thus covers a wide variety of scales, from private dwelling to the whole urban area, and institutional configurations. These scales compete with each other, not only when it comes to pooling facilities but also when capitalizing on knowledge and know-how to make it available to other energy communities.

3.3 *Why so many different types of energy communities?*

In total, five types of energy communities are addressed in this book:

- residents’ cooperatives sharing production facilities (Proulx, Van Neste; Pappalardo)
- collective self-consumption operations (Lormeteau; Fonteneau; Morriet et al.)
- citizens’ production cooperatives (Gomez et al.; Artis et al.)
- consumer cooperatives (Maître)
- digital peer-to-peer services (Cortade and Poudou; Dede and Heyder et al.; Schönbeck et al.)

We have not added to this list the aborted projects of local production systems for the recovery of waste heat (Fito, Hodencq, Morriet, Ramousse, Wurtz and Debizet) or those initiated in the framework of urban projects (Ramirez-Cobo et al.).

These types result from a dialectic between citizen/local mobilizations and national energy frameworks. The majority of authors have highlighted the dynamics of community mobilization, in particular, individual motivations (Martin et al.; Gomez et al.; Morriet et al.); the spatialized construction of communities (Proulx et al.); and decision rules (Maître; Pappalardo), which are also spatially entangled. Others have emphasized the construction of generally national frameworks associated with the electricity distribution system (Lormeteau; Fonteneau; Dede et al.) and the related market mechanism (Cortade et al.). These frameworks outline three modes of relationship to the market. First, there is the direct action on the market and, second, the withdrawal of flows from the market, as observed by Debizet and Pappalardo (2021) for energy communities in France. The third mode is that of the local marketplaces in Columbia, Germany, India and the Netherlands (Dede et al. and Schönbeck et al.).

- 1 Direct action in the electricity market has been adopted by citizen cooperatives of producers and consumers. Acting on the national or even European electricity market, citizens' cooperatives are subject to competition from capital-intensive producers and suppliers, including of renewable energy. More than prices, the competitive advantage of these cooperatives lies in the values they embody: mainly green and local energy, along with co-construction with local partners.
- 2 Implemented in Germany, Spain and France (Lormeteau), the collective self-consumption scheme removes flows from the national electricity market. The collective self-consumption operation allocates local production to the members of the community and thus reduces their supply from a national supplier. Collective self-consumption brings additional economic and symbolic benefits to community members, tenants of social landlords or occupants of owner-occupied buildings (Fonteneau), who are not reduced to the sole role of consumers from electricity suppliers.
- 3 Digital peer-to-peer solutions in Germany (Dede et al.), the Netherlands and the UK (Schönbeck et al.) establish digital marketplaces and, often on a local scale, reproduce the fundamentals of the market: multiplicity of suppliers and demanders, freedom of matching and adjustment by price. The company that programs the algorithm organizes the transactions between the subscribers of the service and probably leaves little room for debate within the community.

These three relationships to the market are considered as alternatives to the national and European electricity market, the very dominant convention of the electricity system. Beyond the common energy and low-carbon objective, each mode guides the construction of the energy community. (1) The major aim of citizens' cooperatives is to increase the number of members and projects. (2) Those who run collective self-consumption operations aspire to provide an additional service or benefit to nearby households or

small companies. (3) For companies running digital platforms, the goal is to create economic value.

We also note various forms of energy sharing outside the energy market in cooperative housing (Proulx et al.; Pappalardo).

3.4 What questions do energy communities pose to energy democracy?

Many trade-offs and open questions need to be addressed by energy system designers. Most of these relate to the governance of energy communities, which is itself shaped by existing infrastructure and regulations on the relationship of customers to the public grid and their electricity supplier. As these regulations can quickly change and the infrastructure can gradually be altered, it is important to identify the issues raised by the growth of energy communities in terms of energy democracy.

The way in which citizens are reclaiming control over the energy resource is a common thread throughout the chapters in this book. Many of the authors highlight how the civic nature of the initiatives reshapes roles traditionally assigned to producers and consumers. The democratic investment of members in energy communities takes place with less latitude: from being a simple consumer taking part, or not, in a local marketplace (Schönbeck et al.; Dede et al.) to actively participating in a cooperative using facilities in one's living area (Gomez et al.). This democratic involvement happens in scenes of varying levels of formality: from the decision by consent of citizen cooperatives (Maître) to the implicit and informal adjustments observed in collective housing (Pappalardo).

The different research projects nevertheless have several points in common: (1) A political reshaping is observed, in which the citizen becomes a protagonist and carries values detached from economic interests. (2) The citizen acts in their living space, even if on different scales. (3) A democratic ambition is evident and leads to rethinking the energy transition, and even the ecological transition, on new bases. (4) New forms of governance spawn new perceptions of access to energy resources, not as a public service but as a common good.

Horizontal governance structures how communities sharing common resources contribute to the dynamics of mutual acculturation by making available a range of expertise (Proulx et al.; Pappalardo). They do this within spaces where community action already exists (e.g., participatory housing) or is organized, according to the citizens' cooperative, following a binary distribution of roles: member/community. This is only apparent because other roles (e.g., roof rental, contribution of expertise) are played by members of the cooperative (Proulx et al.; Gomez et al.) or may be wholly or partly provided by partners, as in the case of citizen-public-private projects (Artis et al.), heat recovery (Fito et al.) and collective

self-consumption (Morriet et al.). The diversity of roles is essential to the implementation of actions but complicates the governance of the commons and the exercise of democracy.

4 Outlook

The implementation of institutional and political forms leading to a renewed ‘energy democracy’ (Szulecki and Overland, 2020) appears in various forms in the different case studies in this book. However, while a certain desire for autonomy, or even for reappropriation of control over the resource, is common to several initiatives, the declared desire to act politically is not necessarily made explicit by the actors in these projects. While for some the establishment of an energy democracy is one of the main objectives, for others it is rather the process of institutionalization that makes these experiments democratic laboratories through energy.

The desire for autonomy, although most often achieved through participation in a collective experiment, is primarily individual. However, motivations and governance are entangled in deliberative and everyday practices, in the values held by actors and designers. This leads to a conflictive differentiation between individual and collective dimensions, and the recognition that, in energy communities, it is not only the juxtaposition of individual interests that is at stake but a transformative interplay of the practices and values of each of the members.

The cross-sectional analysis has highlighted the trajectories of different types of energy communities: through a dialectic between bottom-up and top-down dynamics, between community, local and national scales. Relationships with the market are both complementary and competing and give rise to specific governance systems (see section 2.3). Conversely, each type of pre-existing organization and subsequent energy community adopts a specific relationship to the energy market, based on its *raison d’être* and sometimes its governance and values. In sum, each type of energy community can be seen as a different and often competing type of niche, in the sense of Geels (2002), for the implementation of renewable energy. Hence, there is a competition, on the one hand, among different types of communities in settled areas and, on the other, with large companies involved in large-scale renewable energy facilities. Thus, the encouragement of energy communities by EU directives opens up dynamics in rather different and uncertain directions. Is it a matter of making large renewable energy parks acceptable through individual and community acceptance of these technologies? Or are such communities’ alternatives to the dominant electricity market, including the future one, which will be powered mainly by renewable energies?

Relative connected energy autonomies, as described by Lopez, Pelegrino and Coutard (2019), are emerging and could take on an increasing but variable role, depending on the country and territory. It is likely that the major

networks, in particular the one that best serves the areas – namely the electricity network – will persist and play an essential role in the energy transition. Societal and scientific challenges concern both the margins of this network and the distribution of its internal governance; the organization of transactions between production and consumption is a question that must remain open and publicly debated.

Finally, this book on local energy communities forces us to think of a differentiation of societal challenges according to countries and territories, including in Europe. In this period of abundant initiatives characteristic of societal transitions, it also calls for the production and circulation of new knowledge on the socio-technical dynamics linking communities, energy systems and society and their wider environment.

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