# Belgian Energy Communities: Key Challenges and Opportunities

Chadi Mahfoud[1], Rebecca Guglielmino[2], Gabriele Sapienza[2], Mohammed Qasem[1], Jon Teres-Zubiaga[3] and Sesil Koutra[1]
[1]*Faculty of Architecture and Urban Planning, University of Mons, Havré St. 88, Mons, Belgium*
[2]*University of Catania, St. Tomaselli n 31, Italy*
[3]*University of the Basque Country, Department of Energy Engineering (ENEDI Research Group), Spain*

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Abstract: Being a 'zoon politikon', humankind develops its first 'communities' to harvest food, build shelter, and have socio-political interactions. Nowadays, the term has been configured as a challenging and promising concept for climate change mitigation and adaptation and advocates for the incorporation of various solutions within urban settings. In this contribution, a targeted and comprehensive understanding of the patterns of the 'energy community' (renewable/citizen) phenomenon is provided to provide clear observations unveiling the research gap. The work explores the spectrum of the 'energy community' according to the literature, as well as motivations and contextual factors in the Belgian context from different perspectives highlighting the necessity for sustainable development that harmonizes human activities with natural ecosystems. What is finally the energy community and what motivates its actions? What are the key factors that insight into the successful stories of energy communities in Belgium? What are the differences in the three areas of the Belgian territories? Building on this overview, this paper highlights the current research gap and provides insight into how the communities are emerging in three areas, the opportunities, and challenges they pose, and how their diffusion might be further facilitated despite their complexity and multi-dimensional nature.



## 1 INTRODUCTION

Energy transition encompasses multiple challenges to counter severe global issues englobing the pressing challenges of climate change and rapid urbanization. Unusual global energy demands due to the pandemic and the recent Ukrainian war aggravated the situation and influenced power generation, distribution, and consumption. As a counter to this multiple polarization, the European Union set up energy engagements for its members with collective actions involving active citizen participation to empower equitable energy production.

Over the past years, the concepts of "energy communities" have gained traction. (Gianaroli et al., 2024) and concretized in the EU "Clean Energy Package for all Europeans" (CEP) framework in 2016 (European Parliament, 2019). Two years later, the officialization of the concepts came up within two European Directives: 1) the EU Renewable Energy Directive 2018/2001 (RED II) (European Parliament, 2021) and the EU Internal Electricity Market Directive 2019/944 (European Parliament, 2019b). Since these moments, the need for a comprehensive understanding has gained rising interest. *What is finally the energy community and what motivates its actions?* Building on this overview, this work highlights the current research gap and provides insights into how the communities are emerging, the opportunities and challenges they pose, and how their diffusion might be further facilitated despite their complexity and multi-dimensional nature.

The work explores the spectrum of the 'energy community' according to the literature, and their main configurations, as well as motivations and contextual factors in the Belgian context from different perspectives highlighting the necessity for sustainable development that harmonizes human activities with natural ecosystems by recognizing the dynamic relationships between built environments and landscapes. Overall, this study investigates the diversity in Key Performance Indicators that enhance energy performance in Belgian building typologies. Drawing on data from the Tabula tool, this research



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offers a comprehensive assessment of the role of architectural design in promoting energy efficiency in buildings and renewable energy integration within Renewable Energy Communities.

# 2 'ENERGY' AND 'COMMUNITY'. STATING THE ART

## 2.1 Defining the Energy Community

The concepts are gaining public acceptance as a promise to contribute to energy justice being mushrooming all over the world counting down more than 9,000 sites worldwide. (European Commission, 2022), since their birth back in the 70s (Denmark) to promote community-owned wind energy projects and the incorporation of new technological achievements for the heating requirements connected to grids (Capellan-Pérez, et al., 2018). Onwards, from the 90s, Great Britain and the Netherlands promoted renewable installations through national funds for electricity RES production. (Mutani et al., 2020) with the multiplication of the initiatives in the United Kingdom (Seyfang et al., 2013), Spain (Kunze and Becker, 2015) and France (Nadai and Van der Horst, 2010).

The setup of energy community understanding is still somewhat vague with wide scope and contexts. (Hicks & Ison, 2018). Several studies have developed statements on energy communities and similar or different viewpoints. Being an appealing policy instrument for citizen-centered oriented actions to promote the energy mix (Pons-Seres de Brauwer and Cohen, 2020), the phenomena of the 'Renewable' and 'Citizen' Energy Community are explored. Bauwens et al. (Bauwens et al., 2022) analyzed more than 180 related terms (e.g. "renewable energy community", "energy sustainable communities", "energy cooperatives", "citizen energy community", "integrated energy system", or 'local energy communities, basically considered as an extensive approach to generation closer to local consumption (Manso-Burgos et al., 2022).

Unveiling the confusion of researchers due to overlapping and mismatches of the concepts, De São José et al. state a wide spectrum of understandings and ambiguities (De São José et al., 2021).

## 2.2 Unveiling Definitions' Ambiguities

In line with its formalized definitions in European legislation the **Renewable** Energy Community is defined as a legal entity in which (European Parliament, 2018): *' […] an open and voluntary participation is developed effectively controlled by the community members ('prosumers'), who are located in the proximity of renewable energy potential and are owned of the legal entity having as a principle goal to provide multiple benefits (social, economic, environmental) to its users'.*

Later on, the revised Electricity Market Directive (2019/944) (European Parliament, 2019b) proposes the definition of the **Citizen** Energy as a legal entity in which:

*' […] a voluntary, open, and effective participation of its members is generated aiming to provide multiple benefits (social, economic, environmental) (rather than financial) and to engage them in the generation from RES and all the subsequent steps to provide the required energy services to the users'.*

Other studies address operational particularities of the concepts, such as the renewable energy trends with the emergence of the 'Thermal ECs' (e.g. (Ceglia et al., 2022; Trivedi et al., 2022), while others focus on the governance systems and the people-oriented approaches (e.g. (Busch et al., 2021); (Leonhardt et al., 2022); (Sousa et al., 2019)) Or the business models of the related synergies developed (Busch et al., 2021).

In addition to technical design, decision-making processes, and social empowerment are determinants for the ECs' setup, as the socio-psychological factors (e.g. age, educational level, etc.) (e.g. (Koirala et al., 2018).

# 3 MULTIPLE CHALLENGES OF RENEWABLE ENERGY COMMUNITIES IN BELGIUM

Looking specifically at energy-community barriers, the analysis for the Belgian frame identifies a lack of experience and expertise in the community models at social, cultural, and organizational levels.

The challenges are multiple, starting with transparency and trust by the prosumers, the complicated legal and funding supporting schemes and the lack of previous knowledge.

In this work, the authors raise the question of circumventing these challenges in Belgian cases

through a benchmarking viewpoint and spark their interest to find the favorable settings and bottlenecks to develop decentralization of the energy systems.

The most important incentive for this roadmap is the average age of existing buildings and the share of old buildings in the age of total stock (Zangheri et al., 2020). Analyzing the situation in Belgium, based on data from the European Census we map more than 50% of Belgian's building stock from 1946 to 1990.

The energy performance of the buildings presents another hurdle in the advancement of ECs as much of the housing stock was built between 1946 and 1990 in a time when optimizing the energy efficiency of the building was not a strategic priority. So far, the renovation wave across Belgium is at 0.5%, which is less than the 1% current average EU building renovation rate yearly. (European Commission, 2019; Renovate Europe, 2023).

All the current constraints diverged the same concerns related to the geographical scope and the proximity to resources (physical boundaries) to minimize energy distribution losses, the activities performed (e.g. generation, distribution consumption, electromobility, etc.) or the membership rules and their business models (e.g. (Bolton & Hannon, 2016; Steinberger et al., 2009) and funding schemes that either focus solely on the participants or involve commercially relevant activities.

As key human-oriented players in the clean energy transition, RECs engage citizen participation and contribute to energy democratization (e.g. (Heldeweg & Saintier, 2020; Szulecki & Overland, 2020) However, in this light, diverse questions are emerging, such as the broader benefits of RECs to contribute to low-carbon societies. Considerations are usually revealed regarding the embodied carbon infrastructure, as well as the lifecycle impacts of renewable energy technologies, but also the spatial requirements for energy generation. (Van Zalk & Behrens, 2018).

On the other side, and apart from the technical barriers, concerning potential economic and social benefits, RECs should enhance local job opportunities and alleviate energy poverty for vulnerable social groups. A lack of initiative from local stakeholders and supporting mechanisms and associated institutional and legal constraints are associated with structural obstacles to energy community applications.

Nonetheless, probably the most important challenge in Belgium remains the regional government structure with a heterogeneous legal framework foreseeing diverse directives for the three federations: Wallonia, Flanders, and Brussels Capital Region. Indeed, Belgian Renewable Energy Communities (RECs) could face a series of challenges when it comes to their integration into the main grid; the first burden is adhering to the obligations of an energy supplier, for that, a distinction is made between electricity produced and consumed in EC as collective self-consumption or as supply, another consideration is whether the electricity is sold within the boundaries of an EC or sold outside (supply) (European Commission, 2021; ROLECS, 2021).

In particular, in the case of Wallonia, the adoption of the REDII (Renewable Energy Directive) (European Parliament, 2001) defines the RECs purpose in the production, consumption, and storage for the public benefits with further balances of consumption and production flows within a local perimeter of energy-sharing, in which every natural person, local authority, or company can participate in the process (Service Public Justice Fédéral, 2023)

From its side, the Flemish government draws the concept in the areas of production, distribution, consumption, supply, storage, and electromobility by introducing the idea of **active consumer**, while for the case of Brussels capital, the concept of self-consumption is primordial. (Frieden et al., 2020).

# 4 METHODOLOGICAL APPROACH

The methodological approach performs a systematic review among the major relevant research branches of energy communities with a particular focus on the

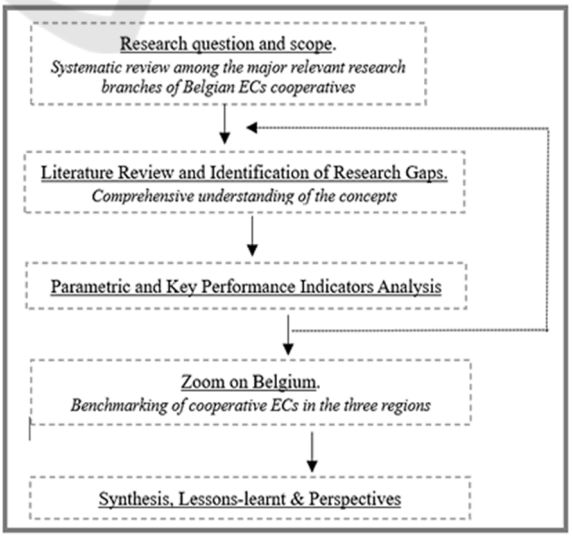


Figure 1: Roadmap of methodological approach.

Belgian context to develop a detailed overview of the studied factors in qualitative content analysis for the comprehension of their dynamics and interpret the content analysis for reporting the successful stories and their key strategies.

In the workflow, the crucial step of the study of the energy communities' projects is the definition of the successful factors of the (R)ECs projects. In this step, the work is in progress and the majority of the cases analyzed are ongoing. However, the authors unveiled as key indicators the following categories:

- *Architectural*, including passive standards, and geometrical criteria (e.g. orientation, roof inclination, glazing, etc.);
- *Technical/Technological*, concerning the maturity of technological systems setup;
- *Membership structure;*
- *Business model;*
- *Legal status* (e.g. cooperative, association, etc.);
- *Social* (e.g. energy poverty), etc.

# 5 BELGIUM CASE ANALYSIS

Belgium can showcase interesting pilot projects with the overarching goal of energy-community-driven initiatives. Energy Communities in Belgium are region-specific matters, in essence, every region (i.e. Flanders, Brussels Capital Region, and Wallonia) has established its regulatory framework and legislative bodies to manage these dynamics. This study focuses on the ECs that target the inclusion of citizen participation as cooperatives and investors in energy generation via renewable energy projects relying on unique investments from the prosumers based on renewable energy investments, keeping the energy prices fair and avoiding focusing on excessive profits, all shareholders are eligible to annual dividends.

In reality, energy communities organized within this model (cooperative) are by far the most in Europe. (Caramizaru and Uihlein, 2020) (more than 1000 cases) organized in citizen-based processes in the hands of shareholders and bottom-up approaches.

## 5.1 Flanders

While Flanders is the Belgian frontrunner in fostering the most advanced energy cooperatives (such as Ecopower (a cooperative founded in 1991 for renewable energy investments of 67.000 members with 20 wind turbines, one hydropower installation, one district heating network, and 250 decentralized PV panels) (Friends of the Earth Europe, 2020) there is still of lack of local legal frameworks and tariffing structures that facilitate the economic feasibility of ECs.

A study done by Felice et al. (Felice et al., 2021) suggests that the inclusion of various flexible energy sources is the primary solution for making RECs feasible economically in Flanders, the best case in his study highlighted a 17% cost reduction compared to the Business-As-Usual (BAU) case due to the capacity tariff that these technologies possess that can take advantage of the peak shaves.

ZuidtrAnt (local energy cooperative in Antwerp with multiple projects towards low-carbon incentives, e.g. Tandems, solar roofs, hydrogen storage, shared cargo bikes, etc.) is another example of a citizen-led energy cooperative dedicated to advancing the renewable energy transition through community involvement. (Proka et al., 2019).

Figure 2: Ecopower Cooperative (Friends of the Earth Europe, 2020).

The cooperative aims to provide affordable, sustainable energy by leveraging investments from shares purchased by citizens. These investments fund projects focused on renewable energy solutions, with a multidisciplinary team of experts contributing specialized knowledge to realize these initiatives. Operating in and around Antwerp, ZuidtrAnt emphasizes maximizing energy efficiency across various projects to accelerate the shift to renewable energy (Table 1).

Table 1: Projects of ZuidtrAnt Energy Community (ZuidtrAnt Energy Community, 2023).

| Projects | Year | Progress |
|---|---|---|
| Projects sun | 2023 | 9 new solar roofs, with a Capacity of 644 kWp |
| | | 28 solar roofs with a full capacity 1656 MWh to supply 382 household |
| | | Annual saving of 272 tons of $CO_2$ |
| SharedSun project | 2023 | Combined solar roofs with electric shared mobility |
| | | Seven solar roofs, nine charging stations and nine shared cars |
| TANDEMS | N/A | Synergies of ECs with local actors |
| RE-FLEX | 2023- | Scalable and modular charging plaza concept |
| | | Renewable energy production with energy storage in both stationery and EV batteries |
| KlimaatWerf | 2023 | 154 solar installations |
| | | 90 energy renovations |

In conjunction with the Cooperative Business model, RESCoop project emerge as Energy Cooperatives, that are formally acknowledged in the EU's Clean Energy Package as both 'citizen' and 'renewable' energy communities.

At the same project, a variety of services is presented (such as community coaching, tailored advocacy services for policymakers, financing projects, etc..) for those interested in engaging in energy community projects, be it individuals, enterprises, or local governing bodies, whether members of the cooperative or non-members.

In Belgium, REScoop.eu, the central coalition of all REScoops in Europe, was first established as a non-profit organization in 2013, with 11 members. Today, RESCoop.eu is operating at a scale of 2500 Energy Communities in Europe, and representing nearly 2 million citizens. (RESCoop.eu)

## 5.2 Wallonia

In Wallonia, the concept of "energy community" was initially brought to attention through business parks, in order to highlight their potential, the region isn't as advanced in establishing Renewable energy cooperatives as Flanders (European Commission, 2021).

Albeit Wallonia marked its very first pilot REC, under the name of "HospiGREEN" led by IDETA and tested in the Tournai-Ouest Economic Activity Zone. The project was conducted for a period of two years (2021-2023), and focused on organizing collective self-consumption among its participants to test a protocol for data exchange between the community and the distribution system operator for the optimization of consumption with production and monitoring processes. Beyond the diverse positive dynamics, the project deploys renewable energy production and strengthens the security of local production (IDETA, 2024).

The project associated two large energy-consuming hospitals, and producers of energy from wind and PV. This has resulted in 92% direct energy self-consumption by REC, with CHwapi being its biggest beneficiary bringing it together with the Regional Psychiatric Center Les Marronniers, the Nursing Home of the CPAS of Tournai Moulin à Cailloux and IDETA (headquarters and Negundo business center).

Figure 3: View of "HospiGREEN" Energy Community Project (IDETA, 2024).

## 5.3 Brussels

The Region of Brussels is on the roadmap to finalize the provisions of the energy community framework, with no specific legal forms yet. The current oversight in the area defines the self-consumption. Some examples are also found in the Brussels area, such as the pilot project at Tour & Taxis aimed at offering the production surplus of solar panels installed in neighboring buildings to consumers considering the principles of self-consumption. The project aims at large-scale electricity sharing on grid management (Nextensa, 2023)

Other studied projects included in the ongoing benchmarking study are provided in Figure 4 of the Appendix.

# 6 CONCLUSIONS

The study has reviewed the state-of-the-art analysis of energy communities unveiling the specific challenges in the complex context of Belgian territories in a multidimensional spectrum. The methodological roadmap proposed identified different steps in ongoing research of rising scientific interest.

In a benchmarking study of the three regions of Belgium, the authors gathered data to evaluate the progress of reported projects on renewable energy cooperatives concluding on the significant potential for integrating renewable energy technologies in local heat networks using large-scale or residential-scale heat pumps, as developed already in Flanders with positive outcomes.

Based on the reviewed cases combined with extensive literature, the study discussed in a wide context the different challenges for successful REC projects emphasizing technical, financial, societal, and other relevant factors. A delicate balance between the goals and impacts of the communities, the conflicting (or cooperative) interests of the stakeholders, and the funding schemes for sharing benefits is considered for the next steps with the consideration of complementary projects of the field.

In this line, it is recommended to verify and evaluate any regulatory frameworks and legislations for RECs in short to medium terms, with the objective of ensuring the former remains relevant and without any unforeseen consequences as the concept of RECs is in an ongoing advancement and the governing policies must synchronize with its trajectory. Comprehensive energy policies and legislative frameworks (e.g. the adoption of the Clean Energy for All Europeans Package) would encourage strong commitments and officialize the legal structures to foster the implementation of RECs.

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# APPENDIX

| | | WALLONIA | | | FLANDERS | | | |
|---|---|---|---|---|---|---|---|---|
| | **KPIs** | **COCITER** | **HesbEnergie** | **Courant d'Air** | **ECOPOWER** | **ZuidtrAnt** | **BeauVent** | **Wase Wind** |
| **Technical/Technological** | | Supply of renewable electricity produced by member cooperatives. | Wind and hydroelectric projects | Renewable energy production projects (30,000 MWh/year). | Production and supply of green electricity from wind, solar, and hydroelectric source | Investment in renewable energy projects | Invests in wind turbines, solar panels, and bioenergy projects. Installed electrical power | Production of renewable energy via wind turbines. |
| **Membership** | | 15 Cooperatives | 1.654 | 4.850 | 68.238 | 651 | 8.835 | 3.000 |
| **Scale of Projects** | | Aggregates production from various local projects. | Wind, hydroelectric, biomass | Wind farm (5 wind turbines), 2 wind turbines are owned by courant d'air, 4 PVs on schools | 248 projects, including wind turbines and solar installations. | 29 projects, including 28 solar roofs and 1 district heating network. | - 244 Installations Various renewable energy installations. | Four wind farms in the Waasland region. |

Figure 4: Other ECs cooperative projects studied in Wallonia and Flanders.