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White Paper on the successful creation and more sustainable functioning of renewable energy communities

Output 3.3

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DRP0200163 – NRGCOM - Creating appropriate operational conditions for renewable energy communities in the Danube Region

Summary

The White Paper addresses the critical energy challenges in the Danube region and outlines key recommendations for promoting Renewable Energy Communities (RECs). The Danube region covered by the NRGCOM project comprises 12 target countries—Hungary, Austria, Bulgaria, Germany, Croatia, Czech Republic, Moldova, Montenegro, Romania, Slovenia, Slovakia, and Serbia—with highly diverse levels of development and regulatory frameworks. While countries such as Austria and Germany have operated functioning energy communities for years, others, including Montenegro, Croatia, Serbia, and Moldova, remain at an exceedingly early stage of development and still lack fully functioning energy communities.

Incorporating also the results of the pilot tests (A.3.2 and A.3.4) of the project NRGCOM, this White Paper supports the more effective functioning of energy communities in the Danube Region by 1) listing the obstacles encountered and the solutions to overcome them, 2) defining the conditions for the successful creation of an energy community, 3) offering development opportunities for existing energy communities and 4) summarising all the previous findings and sharing the results of the research and pilot actions, which have been developed in the activities within special objective 1 to 3 of the project NRGCOM.

In line with the title of this White Paper, the document addresses two closely connected dimensions. First, it identifies the legal, financial, technical, and organisational conditions necessary for the successful establishment of new Renewable Energy Communities in the Danube region. Second, it examines the measures required to ensure the long-term sustainability, resilience, and efficient operation of already existing energy communities. Attention is given to governance models, citizen participation, access to financing, regulatory support, digitalisation, and cross-sector cooperation, all of which are essential both for the creation of new RECs and for strengthening the performance and durability of existing ones.

Accordingly, the chapters of this paper try to consistently reflect this dual perspective by highlighting not only how Renewable Energy Communities can be initiated, but also how they can remain economically viable, socially inclusive, and environmentally sustainable over the long term. In this regard PART A of the document applies to energy communities in general and PART B takes a deeper dive in the individual framework and circumstances of each partner region.

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Overview of renewable energy communities' development in the Danube region

Initial situation: The Energy Landscape of the Danube Region

Geopolitical and Energy Security Context

At the start of the NRGCOM project in 2024, the Danube region was characterised by highly diverse energy systems, still largely shaped by fossil fuels and centralised energy infrastructures. In many countries, coal, natural gas, and oil continued to form the backbone of energy supply, while nuclear energy also played a key role in specific national contexts, particularly in Slovakia. At the same time, the deployment of renewable energy sources and decentralised energy solutions varied significantly across the region. This structural heterogeneity resulted in differing levels of energy dependency. Several countries, including Croatia and Moldova, remained heavily reliant on imported fossil fuels, making them particularly vulnerable to energy price fluctuations and supply disruptions.

The energy crises of recent years further highlighted these vulnerabilities and strengthened the political and societal need to diversify energy sources and improve energy resilience. Another defining feature at the beginning of the project was the strong dominance of centralised energy systems. Large-scale fossil-fuel and nuclear power plants continued to determine electricity generation in most participating countries, while decentralised approaches — including Renewable Energy Communities (RECs) — were still at an early stage of development in many parts of the region. Existing grid structures, administrative procedures, and regulatory frameworks were often not yet adapted to support citizen-led and locally organised energy initiatives.

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The baseline analysis conducted within the NRGCOM project revealed major differences in the legal and practical development of RECs across the Danube region. Countries such as Austria, Germany, Slovakia, and Slovenia already had relatively well-established legal frameworks and functioning energy communities with several years of practical experience. In contrast, Montenegro, Serbia, Moldova, and partly Croatia and Romania had either no functioning energy communities or only limited pilot initiatives, while their regulatory frameworks were still under development or only partially implemented like in Hungary.

By the time of preparing this White Paper, important progress could be observed in several countries of the region. Regulatory discussions around RECs have intensified, awareness among municipalities and citizens has increased, and initial pilot projects and support mechanisms have started to emerge even in countries that had previously lacked functioning energy communities.

Nevertheless, significant disparities between countries remain. While some states are already focusing on improving the long-term sustainability, financing models, and governance structures of existing RECs, others are still addressing fundamental legal, institutional, and technical barriers necessary for the initial establishment of energy communities. This uneven development demonstrates both the dynamic progress achieved since the launch of the NRGCOM project and the continuing need for targeted policy support and regional cooperation across the Danube region.

The Socio-Economic Challenge: Energy Poverty and Affordability

In addition to geopolitical and structural energy challenges, energy affordability represents one of the most pressing socio-economic issues across the Danube region. Energy poverty continues to affect a significant share of the population, particularly low-income and vulnerable households, which are forced to spend a disproportionately large part of their income on electricity, heating, and other essential energy services. As a result, many households struggle to maintain adequate indoor comfort and energy security, especially during periods of rising energy prices and market instability.

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The causes of energy poverty are multifaceted and deeply interconnected. They include increasing energy costs, outdated and energy-inefficient building stock, limited financial capacity to invest in energy-efficient technologies, and unequal access to renewable energy solutions. In many countries of the Danube region, residential buildings were constructed decades ago and suffer from poor insulation, inefficient heating systems, and high energy losses. At the same time, many households lack access to financing mechanisms or support schemes that would enable investments in building renovation, rooftop photovoltaic systems, heat pumps, or other sustainable technologies. Energy should therefore not be viewed solely as a technical or economic commodity, but as a basic prerequisite for social participation, public health, and quality of life. Energy poverty has far-reaching consequences, affecting physical and mental health, educational opportunities, labour productivity, and overall social inclusion. It also reinforces existing social inequalities and regional disparities.

In this context, there is a growing risk of a “two-tier energy transition.” While wealthier households, companies, and municipalities are increasingly able to invest in photovoltaic systems, battery storage, electric mobility, and other renewable energy technologies, lower-income groups often remain excluded from these opportunities due to financial, technical, or administrative barriers.

Without targeted support measures, the benefits of the energy transition may therefore be distributed unevenly, potentially deepening socio-economic inequalities.

Renewable Energy Communities (RECs) can play a significant role in addressing these challenges by enabling citizens, local authorities, and small businesses to jointly produce, consume, and manage renewable energy at the local level. Practical experience from existing RECs demonstrates that one of the most immediate and tangible benefits for members is access to more affordable electricity prices and improved feed-in conditions for locally generated renewable energy. In addition, RECs can strengthen local energy resilience, increase citizen participation in the energy transition, and create new opportunities for social innovation and community-based investment models.

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For this reason, strengthening inclusive and accessible Renewable Energy Communities should be considered not only an energy policy objective, but also an important social policy instrument for reducing energy poverty and ensuring a fair and socially balanced energy transition across the Danube region.

RECs as a Transformative Mechanism

Renewable Energy Communities (RECs) represent an innovative and increasingly important approach to addressing both energy policy objectives and broader socio-economic challenges. They are based on the principle of local, community-driven generation, consumption, sharing, and management of energy, primarily from renewable sources. By enabling citizens, municipalities, small businesses, farmers, and other local actors to actively participate in the energy system, RECs contribute to a more decentralised, democratic, and resilient energy transition. Unlike traditional energy market structures, which are typically dominated by large, centralised utilities, RECs empower local communities to become active participants rather than passive consumers. This not only strengthens local energy autonomy and resilience but also increases public acceptance of renewable energy projects and promotes greater citizen engagement in climate and energy policies.

RECs are legally independent entities and can take various organisational forms, including cooperatives, associations, partnerships, municipalities, or private companies. Regardless of their legal structure, their primary purpose is not profiting maximisation, but the generation of environmental, economic, and social benefits for their members and the wider local community. This community-oriented approach distinguishes RECs from conventional commercial energy suppliers.

At the European Union level, the concept of Renewable Energy Communities was formally introduced through the *Clean Energy for All Europeans Package*, particularly through the Renewable Energy Directive (RED II) and the Electricity Market Directive. These legislative frameworks define energy communities as legal entities based on open and voluntary participation, democratic governance, and

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local control. Their core objective is to provide environmental, economic, or social benefits to members or local areas rather than maximising financial returns.

Where successfully implemented, RECs have demonstrated the potential to deliver multiple benefits simultaneously. In addition to providing affordable and locally produced renewable energy, they can contribute to reducing energy poverty, increasing energy security, stimulating local investment, creating regional economic value, and supporting social cohesion. Energy communities can also accelerate the deployment of renewable energy technologies by mobilising local participation and increasing public trust in the energy transition. Functionally, RECs can perform a wide range of activities across the energy value chain. These include renewable energy production through photovoltaic systems, wind energy, biomass, hydropower, or geothermal energy; local energy distribution and sharing; electricity storage through battery systems; collective self-consumption models; demand-side management; electric mobility services; and peer-to-peer energy trading within the community.

In more advanced models, RECs may also integrate smart grid technologies, digital energy management systems, and sector coupling solutions linking electricity, heating, and mobility. As a result, RECs are increasingly viewed not only as technical energy projects, but as integrated community development models that combine climate protection, economic resilience, social innovation, and citizen participation.

Regulatory and Market Heterogeneity

The regulatory and market landscape of the Danube region is characterised by pronounced heterogeneity, often described as a "patchwork ". This diversity results from differing national legal frameworks, varying levels of implementation of European directives, as well as differing market structures and infrastructural conditions. For the development of RECs, this situation represents both a challenge and a key starting point for deriving country-specific guidelines.

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The Clean Energy Package

With the EU "Clean Energy Package," a comprehensive regulatory framework has been established to strengthen the role of citizens and local actors in the energy system. Two directives are particularly relevant for energy communities: The Renewable Energy Directive (RED II) and the Electricity Market Directive.

The Directive on common rules for the internal electricity market ((EU) 2019/944) introduces new rules that enable active consumer participation—either individually or through citizen energy communities—in all markets, whether through generation, consumption, sharing or selling electricity, or by providing flexibility services through demand response. The revised Renewable Energy Directive (2018/2001/EU) aims to strengthen the role of renewable self-consumers and renewable energy communities.

Both definitions describe forms of collaboration centred around specific ownership structures, governance models, and non-commercial purposes (in contrast to traditional market actors). Due to some differences in scope and eligibility criteria, renewable energy communities can generally be considered a subset or type of citizen energy communities.

The EU framework has been further strengthened by Directive (EU) 2023/2413 (RED III), which amends the Renewable Energy Directive and introduces higher 2030 renewable energy targets, accelerated permitting procedures and stronger requirements for the deployment of renewable energy. For Hungary, this means that the further development of energy communities should be assessed not only in light of RED II and the Electricity Market Directive, but also in relation to RED III implementation and the need to remove administrative and permitting barriers for renewable energy projects.

Despite these clear European requirements, the level of implementation across the Danube region remains highly uneven. The comparative analysis of the NRGCOM project identifies three key evaluation criteria:

1. Readiness of the legal framework: All EU Member States have successfully transposed the requirements of the relevant EU directives into national law. However, in some countries, secondary regulations—clarifying aspects such

as grid access and energy sharing—are still lacking, which negatively affects practical implementation.

2. Availability of support: In general, all EU Member States have access to various funds supporting distributed renewable energy generation and energy communities. Other countries still need to establish support mechanisms alongside finalising their legal frameworks.
3. Implementation in practice: Germany and Austria are the two countries that have successfully implemented similar concepts in the past. However, countries such as Slovenia, Romania, and the Czech Republic have also demonstrated a high level of readiness.

The following table provides a detailed overview of the implementation status in the 12 countries according to Deliverable *D1.1.1 Comparative Analysis Report - International comparison of national legal systems*:

Country	Legal Framework	Support	Practical Implementation
Austria	Legal framework for REC and CEC established; Single Point of Contact defined; grid conditions and tariffs prescribed	Funding programmes available through national and regional EU-supported instruments	Community installations since 2017; continuation under the new legal framework
Bulgaria	RECs recognised by relevant laws; implementing regulations still under development	National programme for renewables in the household sector	Only for prosumers in the household sector
Croatia	Legal framework in place; categories and procedures defined	Funding available through national EU-supported instruments	Limited implementation: improvement of the quality and consistency of the legal framework required

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Czech Republic	New legal framework since January 2024; registration, capacity categories, and tariff models defined	Diverse financing mechanisms and technical assistance at national and regional level	Limited implementation; new legal framework must prove effective in practice
Germany	Legal framework established; REC definition implemented, CEC not yet enshrined in law	Support schemes through various mechanisms such as feed-in tariffs and financial incentives	Energy communities successfully implemented since 2025
Hungary	Primary legal framework is in place under the Electricity Act. Energy communities may operate as associations, cooperatives or non-profit companies. New rules on energy cooperatives applied from 2026, and condominium energy communities have been introduced as a specific form of cooperation. However, secondary rules on metering, allocation, billing, data exchange and practical implementation still require further clarification.	Dedicated financial support for energy communities remains limited and should be strengthened, especially for feasibility studies, legal and technical advisory services, metering infrastructure, smart meters, IT systems, storage and community organisation.	Practical implementation remains limited. According to the national policy analysis, 18 energy communities have been registered, while condominium energy community models and energy cooperatives represent emerging implementation pathways.
Moldova	Legal basis established; comprehensive assessment and implementing regulations to be developed	Financial support for RECs still to be established	Implementation after completion of the legal framework

Montenegro	Renewable energy law still under development	Programmes to support prosumers available	After adoption of the law and implementing regulations
Romania	Legal framework established - secondary is under way; registration, grid connection rules, and tariffs defined	Funding available but limited, through national and regional EU-supported transition programmes and instruments	Energy communities implemented to some extent
Serbia	RECs recognised in law; further regulation required through implementing acts	Support programmes provided for by law – still to be developed	Implementation after completion of the legal framework
Slovakia	Legal framework established; Single Point of Contact and procedures defined	Support mechanisms to be further developed	Limited implementation; Deterioration of the quality and consistency of the application of the legal framework; energy communities in the number of 18 entities have been gradually successfully implemented and registered since 2024.
Slovenia	Legal framework for REC and CEC established; registration, grid conditions, and tariff models defined	Support mechanisms via national EU-supported instruments	Implementation ongoing; local and regional energy agencies should play a greater role

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Challenges within the Energy Community Framework

In addition to EU Member States, the Danube region also includes several countries that are part of the Energy Community (EnC). These countries have committed to gradually aligning their national energy legislation with the EU acquis, including key provisions related to renewable energy, electricity markets, and citizen participation in the energy transition. However, despite this formal commitment, many EnC contracting parties continue to face significant structural, administrative, financial, and institutional challenges in implementing these frameworks effectively. In many non-EU countries of the Danube region, the legal and regulatory framework for Renewable Energy Communities (RECs) remains at an early stage of development.

In some cases, relevant legislation has only recently been adopted, while in others important secondary legislation, licensing procedures, or operational rules are still missing. As a result, the practical establishment and functioning of energy communities is often hindered by legal uncertainty, unclear responsibilities among institutions, and insufficient administrative capacities.

Beyond legislative gaps, additional barriers frequently include limited access to financing, low public awareness, insufficient technical expertise, weak local institutional support, and underdeveloped energy infrastructure. Grid access procedures can be complex and lengthy, while existing electricity market structures are often still designed primarily for centralised energy systems rather than decentralised and community-based models. At the same time, socio-economic conditions within many Energy Community countries can further complicate the development of RECs. Higher levels of energy poverty, lower purchasing power, and limited access to private capital often reduce the ability of households and local communities to invest in renewable energy technologies. Without targeted policy measures and inclusive financing instruments, there is a risk that the benefits of the energy transition remain concentrated among a relatively small number of actors.

Given these implementation gaps and uneven levels of development, knowledge transfer, and capacity building from EU Member States with more advanced REC

frameworks could play a crucial role in accelerating progress across the wider Danube region. Countries such as Austria, Germany, and Slovenia can provide valuable experience regarding legal transposition, governance models, financing mechanisms, citizen engagement, digital solutions, and practical operation of Renewable Energy Communities. Strengthening regional cooperation, and cross-border pilot initiatives could therefore significantly support both the creation of new RECs and the long-term sustainability of existing ones in Energy Community countries.

Market Structure and Grid Regulation Barriers

A decisive factor for the development of energy communities is the structure of energy markets, as well as access to and integration into existing grid infrastructures. In the Danube region, these structures are still largely designed for centralised energy generation, which makes the integration of decentralised actors more difficult.

Key barriers include:

1. **Grid access and regulatory hurdles:** Although energy communities formally have the right to access energy markets, administrative and regulatory barriers often persist in practice. These include complex permitting procedures, unclear responsibilities, and in some cases discriminatory grid fees or market rules. In some countries, energy communities must meet extensive requirements to participate in electricity markets or trade energy among themselves. Integration into balancing and settlement systems also presents an additional hurdle.
2. **Technical and infrastructural limitations**: A major issue is the often-outdated grid infrastructure. Many electricity grids are not designed to accommodate a high number of decentralised generators, leading to capacity constraints and technical challenges. This particularly affects rural areas, where the potential for renewable energy is often high, but grid infrastructure is insufficiently developed. The stable integration of energy communities into existing grid systems remains a key challenge, especially in countries with highly centralised energy structures.

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3. **Market integration and business models**: Existing market mechanisms are often not tailored to the needs of energy communities. Traditional market models are based on large-scale energy producers and standardised trading processes, whereas RECs are characterised by flexible, local, and often small-scale structures. This leads to challenges in marketing surplus energy, setting prices within the community, and adapting to dynamic consumption and production patterns. Although platforms and mechanisms to support energy communities (e.g., for data exchange or energy trading) already exist in some countries, they are not yet widely established and are often technically and organisationally complex.

Comprehensive Analysis of Barriers and Bottlenecks

Legal and Regulatory Uncertainty (The Foundation)

One of the fundamental challenges for the development of RECs in the Danube region lies in legal and regulatory uncertainty. Although European directives define a general framework, their national implementation is often inconsistent, incomplete, or subject to interpretation. This creates significant uncertainty for the planning and implementation of energy communities. A key issue is the lack of clarity in defining energy communities. While most countries are guided by European directives, differences remain in legal classification, permitted activities, and requirements regarding membership structure and governance. These differences hinder not only the comparability of models but also the transferability of successful approaches between countries.

In addition, restrictive regulatory provisions can have a limiting effect. In many cases, energy communities are primarily understood as non-profit organisations aimed at generating social, environmental, or local economic benefits. However, this orientation often limits profit distribution and reduces attractiveness for private investment. As a result, the development of viable business models becomes more difficult, particularly in the early stages when high investments are required. Another source of uncertainty is the dynamic nature of legislation. In many countries, the regulatory framework is still

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evolving or continuously being adjusted. This instability complicates long-term planning and significantly increases risks for project developers and investors.

Administrative and Capacity Gaps (The Operational Hurdles)

Beyond legal frameworks, administrative and organisational challenges represent a major barrier to the effective implementation of Renewable Energy Communities (RECs) across the Danube region. In practice, the establishment and operation of RECs are often associated with complex, time-consuming, and resource-intensive administrative procedures, which can be particularly difficult for smaller initiatives, municipalities, or citizen groups to manage.

Key challenges include lengthy permitting and approval processes, the formal registration of legal entities, tax, and accounting obligations, as well as requirements related to grid connection, metering, and participation in electricity markets. These procedures are frequently not harmonised and can vary considerably between countries, regions, or even individual administrative bodies. As a result, project developers are often confronted with a fragmented regulatory environment, leading to uncertainty, delays in project implementation, and increased administrative costs.

A further critical constraint is the limited organisational and technical capacity within many emerging energy communities. RECs are typically initiated and driven by citizens, local authorities, or small associations that rely heavily on voluntary engagement. While this bottom-up approach is a core strength of the model, it often comes with a lack of professional expertise in key areas such as project development, legal structuring, financial planning, energy system design, and long-term operational management. Given the technical and regulatory complexity of modern energy systems, this capacity gaps can significantly slow down or even prevent successful project implementation.

This situation is further reinforced by the absence or limited availability of centralised support structures. In many countries, there are no dedicated one-stop shops, coordination platforms, or specialised agencies that provide structured guidance for energy communities throughout the project lifecycle. The

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lack of such institutional support leads to information asymmetries, duplicated efforts, and inefficiencies, increasing transaction costs for all stakeholders involved. In addition, the absence of clearly defined advisory services makes it more difficult for new initiatives to navigate administrative requirements and access available funding or support schemes.

Overall, these administrative, organisational, and capacity-related barriers highlight that the successful deployment of RECs depends not only on favourable legal frameworks, but also on strong institutional ecosystems that can actively support implementation on the ground.

Financial Barriers and Investment Mobilisation (The Economic Model)

The financial dimension represents another key challenge for the development and scaling of Renewable Energy Communities (RECs) across the Danube region. The establishment of RECs typically requires significant upfront investment, particularly for renewable energy generation assets such as photovoltaic systems, wind turbines, biomass installations, as well as energy storage technologies and, where applicable, supporting infrastructure such as metering systems or local distribution components. For many citizen groups, municipalities, and small organisations, mobilising this initial capital remains a major barrier. Although a range of financing instruments theoretically exists—including national and regional public funding schemes, European Union programmes, private sector investment, cooperative financing models, and community-based crowdfunding approaches—access to these mechanisms is often complex and uneven. Application procedures can be administratively demanding, require significant technical documentation, and involve long approval timelines. In addition, many initiatives face difficulties in identifying suitable funding opportunities due to fragmented information landscapes and limited advisory support. In several countries of the region, dedicated financial support structures for energy communities are still underdeveloped or entirely absent, further limiting access to capital.

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A further structural challenge lies in the uncertainty and variability of RECs' business models. In most cases, energy communities generate revenues through a combination of self-consumption savings, internal cost-sharing mechanisms, and the sale of surplus electricity to the grid. However, these revenue streams are strongly influenced by national regulatory frameworks, grid tariffs, market design, and fluctuating energy prices. As a result, income projections are often only partially predictable, making long-term financial planning more difficult and increasing perceived investment risk.

This uncertainty is compounded by the relatively high investment risk profile of many REC projects. High upfront capital expenditures coincide with uncertain and sometimes volatile revenue streams, while potential changes in regulatory frameworks, subsidy schemes, or electricity market rules add an additional layer of risk. In many cases, this combination of financial uncertainty and regulatory instability results in delayed investment decisions, scaled-down project designs, or the complete abandonment of otherwise viable initiatives. These financial barriers significantly limit the pace of REC development in many parts of the Danube region and underline the need for more stable support schemes, simplified access to funding, and innovative financing mechanisms tailored specifically to community-based energy projects.

Technical and Infrastructural Constraints

Technical and infrastructural conditions represent another significant barrier to the development and scaling of Renewable Energy Communities (RECs) across the Danube region. Many existing energy systems were historically designed around centralised generation models and large-scale infrastructure, and are therefore only partially suited to integrating decentralised, flexible, and community-based energy structures. A key challenge is limited grid connection capacity and insufficient grid readiness in many areas. In numerous regions, distribution grids are not yet adequately reinforced or digitally equipped to accommodate increasing shares of decentralised renewable generation.

This can lead to network congestion, curtailment of renewable energy production, long waiting times for connection approvals, and in some cases additional

technical requirements imposed on project developers. These constraints are often particularly pronounced in rural or economically less developed regions, where grid infrastructure investment has historically been limited.

In addition, the deployment of enabling technologies such as smart metering systems, advanced monitoring tools, and digital energy management platforms is essential for the effective operation of RECs. These technologies allow for real-time tracking of energy production and consumption, facilitate transparent and fair internal billing, and enable more sophisticated operational models such as collective self-consumption or dynamic load management. However, in many parts of the region, the rollout of such infrastructure remains incomplete or uneven, which restricts the full functionality and efficiency of energy communities.

Another important aspect is the technical complexity of integration with existing grid operators and market systems. RECs must comply with a wide range of technical standards and regulatory requirements to be connected to and operate within national electricity systems.

These include grid stability and safety requirements, metering and settlement procedures, participation in balancing and ancillary service mechanisms, and integration into existing market and billing frameworks. For many community-led initiatives, these requirements are highly complex and require specialised technical and regulatory expertise that is often not readily available at local level. In addition, coordination with distribution system operators can be challenging due to differing interpretations of technical requirements, administrative procedures, and limited experience with community-based energy models. This can result in delays, increased project complexity, and higher transaction costs for REC developers.

Overall, these technical and infrastructural deficits significantly constrain the effective integration of Renewable Energy Communities into existing energy systems. Addressing these barriers is therefore essential not only for enabling new projects, but also for ensuring the scalable and long-term successful operation of RECs across the Danube region.

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The Value Proposition: Benefits of Community-Led Energy Transition

Socioeconomic Advantages and Local Resilience

Renewable Energy Communities (RECs) make a significant contribution to regional value creation and the strengthening of local resilience. A key characteristic of RECs is the active involvement of citizens, municipalities, and local businesses in renewable energy production and consumption. This local participation helps ensure that financial resources remain within the region rather than flowing to external energy suppliers. Cooperation with local enterprises strengthens regional economic activity and fosters new forms of collaboration and partnership. Furthermore, energy communities introduce inclusive participation models that enable citizens to engage even without substantial upfront investments. This broadens access to participation and allows the financial benefits generated through renewable energy production to be distributed more equitably within the community. At the same time, municipalities can reduce administrative burdens and improve efficiency through shared organisational structures, joint resource use, and knowledge exchange.

Another important benefit is the potential reduction in energy costs. Through local energy production and self-consumption, community members can partially satisfy their energy demand independently of external market fluctuations. In addition, community-based structures create opportunities to influence electricity pricing at the local level, contributing to greater price stability and possible long-term savings. Collectively, these factors can also help alleviate energy poverty by improving access to affordable and locally produced energy.

Based on the findings of *O1.1 Strategy to create the proper legal, technical and social conditions for energy communities* and *D2.1.1 Engagement Strategy*, the documents examine the role of RECs as drivers of a community-led energy transition in the Danube Region, with particular emphasis on the legal, technical, social, and motivational conditions necessary for their successful development. The analysis demonstrates that RECs provide substantial socioeconomic and environmental benefits by strengthening local resilience, increasing regional value creation,

enhancing energy security, and promoting citizen participation in renewable energy generation and consumption. At the same time, the study identifies significant barriers that continue to hinder REC development, including fragmented legal frameworks, administrative complexity, insufficient financial incentives, limited grid access, and low levels of public awareness. These challenges are especially pronounced in countries where REC legislation remains underdeveloped or only partially aligned with the European Union acquis.

Drawing on comparative pilot experiences presented in Deliverable *D3.2.1 Report on the success of the mentoring method* from countries such as Hungary, Croatia, Serbia, Moldova, Slovakia and Germany, the paper highlights the importance of tailored governance models, stakeholder engagement, mentoring schemes, and trust-based awareness-raising approaches. The findings confirm that interactive and locally adapted methods — including peer-to-peer exchange, professional training, study visits, and REC ambassador networks — are more effective in encouraging participation than purely digital communication strategies.

The project findings further emphasise that REC development requires differentiated policy approaches depending on the national context. While countries with more advanced REC frameworks benefit primarily from improving administrative efficiency and scaling existing models, emerging contexts require foundational legal frameworks, capacity building, and targeted financial support mechanisms. Based on these findings, the paper proposes strategic recommendations for establishing supportive legal environments, strengthening social inclusion, improving operational conditions, and enhancing the long-term sustainability of RECs throughout the Danube Region. Overall, the research demonstrates that community-led energy initiatives can play a central role in accelerating the renewable energy transition while simultaneously fostering democratic participation, regional cooperation, and social cohesion.

Environmental Impact and Climate Mitigation

Renewable Energy Communities play a key role in accelerating the expansion of renewable energy across the energy system. By enabling the active participation of local actors in energy generation, they support the deployment and diffusion of technologies such as photovoltaics, wind power, biomass, and, in some cases, small-scale hydro or hybrid systems. In many regions, RECs act as important drivers of decentralised investment, helping to mobilise local capital and social acceptance for renewable energy projects. Projections and early implementation experiences indicate a continued and significant increase in installed renewable capacity—particularly in the photovoltaic sector—where community-based models are expected to contribute substantially to future growth.

Through the increased deployment of renewable energy sources, energy communities make a direct contribution to greenhouse gas emission reductions. By replacing fossil fuel-based electricity and heat generation with locally produced renewable energy, RECs support a sustained decrease in CO_2 emissions and contribute to the achievement of national and European climate targets. Beyond direct emission reductions, they also foster a broader structural transformation of the energy system toward a more decentralised, low-carbon, and renewable-based configuration.

In addition, RECs can influence energy consumption behaviour in a positive and lasting way. As members are directly involved in both the production and consumption of energy, they tend to develop greater awareness of energy use and efficiency. This increased engagement often leads to more conscious consumption patterns and improved energy management at household and community level. Operational mechanisms such as aligning local consumption with renewable generation profiles, implementing demand-side management, and utilising flexibility solutions further enhance system efficiency and contribute to the optimisation of overall energy use within the community. In general, renewable energy communities not only accelerate renewable energy deployment and emissions reduction but also act as catalysts for behavioural change and improved energy efficiency, thereby strengthening both the environmental and systemic performance of the energy transition.

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System Benefits and Grid Stability

In addition to their environmental and economic benefits, Renewable Energy Communities (RECs) also generate important systemic advantages for the energy system. By enabling decentralised generation and local consumption of renewable energy, RECs help reduce the load on supra-regional transmission and distribution infrastructure. Local production combined with self-consumption shortens energy flows, decreases transmission losses, and contributes to relieving congestion in existing grid networks, particularly during peak generation periods.

Furthermore, RECs can actively support grid stability by improving the spatial and temporal balance of energy flows. The integration of decentralised storage solutions—such as battery systems, thermal storage, or electric vehicle batteries—enables surplus renewable energy to be stored locally and used when demand increases or generation declines. Practical experience from existing projects demonstrates that the combination of local generation and storage not only enhance self-consumption rates but also contributes to overall system stability. In some cases, these integrated approaches also open additional applications, for example in the provision of sustainable heating solutions or sector coupling between electricity and heat. Innovative operational models, such as the aggregation and coordinated management of flexibility, further strengthen the system-relevant role of energy communities.

By bundling distributed energy resources, managing demand response, and optimising local consumption patterns, RECs can help to mitigate peak loads and reduce stress on the electricity system. This increases overall system efficiency and supports a more balanced utilisation of generation and network capacities. Renewable Energy Communities contribute to the transformation of the energy system toward a more resilient, flexible, and decentralised structure. By combining local generation, storage, consumption, and flexibility management, they act as important enablers of system integration for renewable energy sources and support the long-term stability of the evolving energy landscape.

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Social Cohesion

A key and often underestimated benefit of Renewable Energy Communities (RECs) lie in their social impact. By actively involving citizens, municipalities, and local stakeholders in energy-related decision-making and project development, RECs foster civic engagement and strengthen social cohesion at the local level. The joint planning, implementation, and operation of energy projects create new forms of cooperation, shared responsibility, and identification with regional development goals.

A particularly important effect is the increased acceptance of renewable energy infrastructure and the broader energy transition. Because decisions within energy communities are made in a democratic and participatory manner and because members directly benefit from the outcomes, willingness to support renewable energy expansion tends to increase significantly. This participatory approach helps to reduce societal resistance to renewable energy projects and facilitates the implementation of transformation measures at the local and regional level. Furthermore, energy communities promote transparency, empowerment, and inclusive participation within the energy system. Members are typically given the opportunity to engage in decision-making processes, influence investment priorities, and actively shape the strategic direction of the community. This democratic governance structure strengthens trust in energy policies and contributes to a more resilient and socially embedded energy transition over the long term.

In this context, it is also important to highlight the role of energy efficiency as a complementary benefit and strategic pillar of RECs. Beyond its relevance for addressing energy poverty, energy efficiency measures contribute more broadly to reducing overall energy demand and lowering energy costs for households, municipalities, and other local actors involved in or supporting energy communities. Investments in building insulation, efficient heating and cooling systems, smart energy management, and behavioural changes can significantly enhance the economic performance of RECs while simultaneously reducing pressure on local energy systems. This integrated perspective—combining

renewable energy generation with efficiency improvements—strengthens both the financial viability and the social impact of energy communities.

RECs can not only contribute to decarbonisation and energy system transformation, but also act as important drivers of social innovation, democratic participation, and local economic resilience, while energy efficiency further amplifies these benefits across all participating actors.

Models, Solutions, and Practical Guidance for REC Establishment

Operational and Governance Models (Best Practices, e.g. Association)

Selecting an appropriate organisational and governance structure is a critical success factor for Renewable Energy Communities (RECs). In practice, certain legal forms—particularly associations and cooperatives—have proven to be especially suitable across different national contexts. Associations typically offer a relatively simple and low-threshold entry model, making them well suited for initiating community engagement and enabling broad participation at an early stage. Cooperatives, on the other hand, tend to provide stronger economic structures, clearer investment frameworks, and greater scalability, which can be advantageous for long-term development and the expansion of energy projects.

However, regardless of the chosen legal form, the effectiveness of a REC largely depends on the quality of its internal governance arrangements. Successful energy communities are typically characterised by transparent and well-defined decision-making processes, clearly assigned roles and responsibilities, and strong mechanisms for member participation and accountability. Democratic governance principles are particularly important in maintaining trust and ensuring long-term engagement of members and stakeholders. In addition, cooperation with local stakeholders—such as municipalities, local businesses, energy agencies, and technical experts—can significantly strengthen the institutional capacity of RECs. Such partnerships contribute to professionalisation, improve access to technical and administrative expertise, and facilitate smoother project

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implementation. They also help bridge the gap between grassroots initiatives and formal energy system requirements, thereby increasing the overall effectiveness and sustainability of energy communities.

A well-designed combination of an appropriate legal structure, robust governance mechanisms, and strong local partnerships is essential for ensuring the successful establishment, operation, and long-term resilience of Renewable Energy Communities.

Innovative Financing Mechanisms for Sustainability (Crowdfunding, Loans)

Alternative financing models are playing an increasingly important role in enabling the development and scaling of Renewable Energy Communities (RECs) across the Danube region. Citizen participation mechanisms—such as community shares, cooperative investments, and crowdfunding schemes—can significantly strengthen the local capital base. At the same time, these approaches enhance social acceptance and ownership, as local stakeholders become directly involved in the financing and benefits of renewable energy projects. In addition to citizen-based financing, debt instruments such as bank loans and cooperative credit lines are essential, especially for larger or more capital-intensive investments. In practice, many successful REC projects rely on a combination of different funding sources, including public subsidies, private capital, and citizen contributions. This diversified financing structure helps to distribute financial risks more effectively, improve bankability, and close potential funding gaps.

In the longer term, the economic sustainability of energy communities depends on the stability and predictability of their revenue models. Core income streams typically include savings from collective self-consumption, revenues from the sale of surplus electricity to the grid, and, in some cases, additional services such as flexibility provision or local energy services. The viability of RECs is therefore closely linked to regulatory frameworks, market design, and electricity price structures, which together determine the overall attractiveness and resilience of their business models. The combination of diversified financing instruments and stable, well-designed revenue mechanisms can be seen as crucial for ensuring the

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long-term financial sustainability and scalability of Renewable Energy Communities.

Policy Recommendations based on NRGCOM experience findings

Based on the analytical work, pilot implementation experience, and transnational exchange developed within the NRGCOM project (Mainly O1.1. Strategy, 3.4.1. Efficiency Report, O2.2. Pilot activities and 1.3.1. Collection of best internal operational governance practices), the further advancement of Renewable Energy Communities (RECs) in the Danube Region depends above all on the creation of clear, stable, and enabling framework conditions. Across the region, progress is strongly influenced by the maturity of national legal frameworks, while remaining inconsistencies in definitions, fragmented provisions, missing secondary legislation, and regulatory uncertainty continue to hinder both the establishment of new RECs and the effective operation of existing ones. A key policy priority is therefore to establish transparent and harmonised legislation that clearly defines the role, rights, obligations, and permitted activities of RECs, while ensuring fair, non-discriminatory access to energy markets, grid infrastructure, and energy-sharing mechanisms for citizens, municipalities, SMEs, and other eligible actors. Such frameworks should ensure non-discriminatory and fair access to energy markets, while also providing legal certainty for all involved actors, including citizens, municipalities, and small enterprises.

At the same time, the simplification and standardisation of administrative procedures is essential. Complex and heterogeneous approval processes should be streamlined through harmonised requirements, clear guidelines, and, where possible, digitalised procedures. The establishment of centralised “one-stop shop” structures or dedicated contact points can significantly reduce bureaucratic barriers, shorten implementation timelines, and support project developers throughout the entire lifecycle of a REC. A further strategic priority is capacity building and knowledge transfer. The project NRGCOM demonstrated that many emerging RECs require tailored support in legal structuring, technical planning, business model development, governance, and financial preparation as can be seen in Output 2.2 “*Dissemination and professional awareness raising pilot activities*.” Practical, data-driven mentoring and targeted trainings proved more effective

than generic theoretical guidance, while advisory services, templates, and accessible guidance materials were repeatedly identified as necessary tools for founders and operators. These accessible guidance materials can help bridge existing knowledge gaps. In addition, the systematic exchange of best practices between countries and regions can enhance institutional learning and contribute to the professionalisation and scalability of energy communities across the Danube region.

In the financial domain, improving access to funding and developing innovative financing mechanisms is crucial. A balanced combination of public funding schemes, European support instruments, private sector participation, cooperative financing models, and citizen-based investment approaches can help reduce upfront investment barriers and improve the economic viability of projects. Furthermore, tailored financial instruments that reflect the specific characteristics of RECs can play an important role in mobilising local investment and strengthening long-term sustainability. In parallel, continued investment in grid infrastructure and the integration of RECs into electricity markets is essential to overcome existing technical constraints. Modernised and digitalised distribution grids, increased flexibility, and improved interoperability between community-based systems and existing market structures are key prerequisites for enabling the large-scale deployment of RECs. Ensuring that RECs are properly integrated into balancing mechanisms, metering systems, and market participation schemes will further enhance their functionality and contribution to the energy system.

In parallel, continued investment in technical infrastructure and market integration is indispensable. The project's pilot actions confirmed that the large-scale development of RECs requires modernised and digitalised distribution grids, reliable smart metering, energy management systems, and effective integration into balancing, settlement, and market participation schemes. Quarter-hourly metering, data quality, and digital tools were identified as critical enablers of efficient operation, while outdated infrastructure, limited grid capacity, and complex DSO procedures remain major bottlenecks in many countries. Ensuring interoperability between community-based systems and existing energy market structures is therefore a precondition for the broader deployment and long-term

efficiency of RECs, see which can be seen in the *D3.4.1 Efficiency report of the targeted energy communities*.

Finally, the successful promotion and scaling of Renewable Energy Communities require a coordinated and multi-level approach that addresses legal, administrative, financial, technical, governance, and social dimensions simultaneously. NRGCOM also showed that RECs are not merely technical energy projects, but socio-technical systems whose success depends on citizen trust, stakeholder participation, inclusive governance, and long-term community engagement. Only through such integrated action can RECs fully realise their potential as drivers of a decentralised, democratic, socially inclusive, and sustainable energy transition in the Danube Region.

Dissemination, Capitalisation, and Transnational Strategy

Dissemination and capitalisation constitute a central pillar of the NRGCOM project's strategy for ensuring the long-term uptake, transferability, and replication of Renewable Energy Communities (RECs) across the Danube Region. The White Paper itself serves as the project's key capitalisation output, integrating the strategic foundations developed under Output 1.1 "*Strategy to create the proper legal, technical and social conditions for energy communities*" with the evidence generated through awareness-raising actions, ambassador activities and pilot implementations, and translating them into a coherent framework for future policy and practice. In this context, the REC Ambassador Network (A.2.1) has played an essential role as a transnational mechanism for knowledge transfer, stakeholder mobilisation and public communication, bringing together experts from public administration, academia, civil society, municipalities, energy agencies and the private sector, and enabling both national and cross-border exchange through events, workshops, media activities and dedicated online platforms. At the same time, pilot actions have provided the empirical basis for dissemination by demonstrating how REC models can be tested and adapted under diverse legal, technical, and socio-economic conditions. The White Paper itself represents a key capitalisation output, consolidating the project's strategic analyses, pilot experiences, research findings, and policy recommendations into a practical and transferable framework for both the creation of new RECs and the more

sustainable functioning of existing ones. It builds directly on the project's earlier strategy work and on the results of pilot actions implemented under Activities 3.2 and 3.4, thereby translating tested approaches and evidence into guidance of lasting relevance for policymakers, municipalities, energy agencies, civil society actors, and potential REC founders.

The mentoring pilots in Hungary, Croatia, Serbia, Moldova and Germany confirmed that the maturity of the legal framework is the decisive factor for implementation progress, while also showing that structured mentoring, stakeholder engagement and feasibility-based planning are transferable methods across contexts (D3.2.1) In parallel, the technological pilots in Austria, the Czech Republic, Slovakia and Slovenia validated the ETMEC software and readiness methodology, generating practical evidence on how digital tools and harmonised assessment approaches can support more efficient and scalable REC development (D.3.4.1).

Together, these elements form a transnational dissemination and capitalisation strategy that not only communicates project results but also embeds them in durable cooperation structures, ensuring that the White Paper functions as a practical reference for policymakers, practitioners, and future REC founders throughout the region.

A central capitalisation mechanism of the project was the Renewable Energy Community Ambassador Network, established to strengthen awareness, knowledge transfer, and stakeholder engagement across participating countries (A.2.1). This network brought together a broad range of experts from public administration, academia, municipalities, civil society, energy agencies, and the private sector, who acted as multipliers, mentors, and advocates of the REC concept. Through national and transnational cooperation, ambassadors contributed to public events, trainings, workshops, conferences, podcasts, media appearances, study visits, and policy dialogue, while also supporting the exchange of expertise through dedicated online channels, including the LinkedIn expert group and the NRGCOM project website. The ambassador model proved particularly valuable in bridging the gap between technical and legal complexity

on the one hand and the practical concerns of citizens, municipalities, and SMEs on the other, thus enhancing both the visibility and credibility of REC initiatives.

Pilot actions constituted the second major pillar of the project's transnational strategy. The mentoring pilots implemented in Hungary, Croatia, Serbia, Moldova, and Germany tested the practical applicability of the jointly developed REC mentoring method in highly diverse legal, institutional, and market settings (Deliverable D3.2.1) These pilots demonstrated that the maturity of the legal framework remains the most decisive factor in determining implementation progress, while also confirming the transferability of structured mentoring approaches based on stakeholder engagement, feasibility analysis, governance preparation, and practical roadmaps.

The dissemination strategy of NRGCOM further relied on broad and diversified outreach activities under Specific Objective 2, aimed at increasing public understanding of RECs and motivating participation in community-led energy initiatives. More than 40 awareness-raising events, 31 professional trainings, and 9 fairs were organised, complemented by handbooks, videos, podcasts, brochures, social media communication, webinars, and study visits. These activities reached thousands of participants and demonstrated that face-to-face formats, peer learning, and trust-based communication consistently outperform stand-alone digital information in generating both awareness and concrete follow-up interest. The project also confirmed that approaches must be tailored to national and regional contexts, as countries across the Danube Region differ significantly in legal readiness, social familiarity with the REC concept, and institutional capacity.

From a transnational perspective, NRGCOM highlights that no single dissemination or support model can be applied uniformly across the region. Instead, effective capitalisation requires differentiated pathways: in emerging contexts, priority must be given to awareness raising, confidence building, and legal clarification; in more advanced contexts, the focus shifts toward improving governance quality, operational efficiency, market integration, and scaling. Transnational knowledge exchange, study visits, pilot cooperation, and ambassador-led networking therefore played a decisive role in enabling less

experienced countries to benefit from the practical experience of frontrunners such as Austria, Germany, Slovenia, and Slovakia. In this way, dissemination, and capitalisation under NRGCOM have not only supported the visibility of project results, but also laid the foundation for their continued use, adaptation, and replication beyond the project lifetime.

Key executive messages

1. RECs are not just technical projects; they are socio-technical systems requiring coordinated governance, finance, infrastructure, and citizen engagement.
2. Legal and regulatory maturity is the most decisive factor in implementation success.
3. Data-driven feasibility analysis and early DSO engagement are critical for reducing delays and improving viability.
4. Associations and cooperatives are often the most accessible starting points, but legal form must match context.
5. Smart metering, digital energy management and clear internal rules and framework are essential for efficient operation.
6. Trust-based communication, ambassadors, and peer examples are among the most effective ways to mobilise participation.
7. Inclusive design is necessary to ensure RECs contribute to affordability, energy poverty reduction, and a just transition.

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