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ENERGISING FUTURES

ADVANCING AN INCLUSIVE AND ACCESSIBLE ENERGY TRANSITION THROUGH URBAN REGENERATION

WeGenerate
PEOPLE-CENTRIC SUSTAINABLE NEIGHBOURHOODS

Policy Paper | 2

The Energising Futures Policy Paper is a deliverable of the WeGenerate project.

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A 2-minute introduction to WeGenerate

From planning for people to planning with people

Cities may be built for everyone, but not all neighbourhoods feel that way. Some boast modern infrastructure, abundant services, and economic opportunity, while others are left behind — derelict, outdated, and underinvested. Structural changes in the economy have deepened these divides, creating serious challenges for both residents and the city as a whole.

Addressing these disparities is not just about improving a city's image; it is about fostering territorial equality and ensuring that all residents have access to the same quality of life and opportunities. In this context, urban regeneration plays a crucial role in city planning. Once predominantly focused on physical improvements to the built environment, it now considers a more integrated approach that uses social, environmental, and economic interventions to holistically support the revitalisation and uplift of disadvantaged areas. Yet, the scale and strategic nature of urban regeneration processes make them inherently complex — and not without critics.

Chief among these is the risk of gentrification. While regeneration can create new economic opportunities and neighbourhood amenities in undervalued areas, it can also lead to profit-driven investments that displace low-income residents, widening inequalities instead of bridging them.[1]

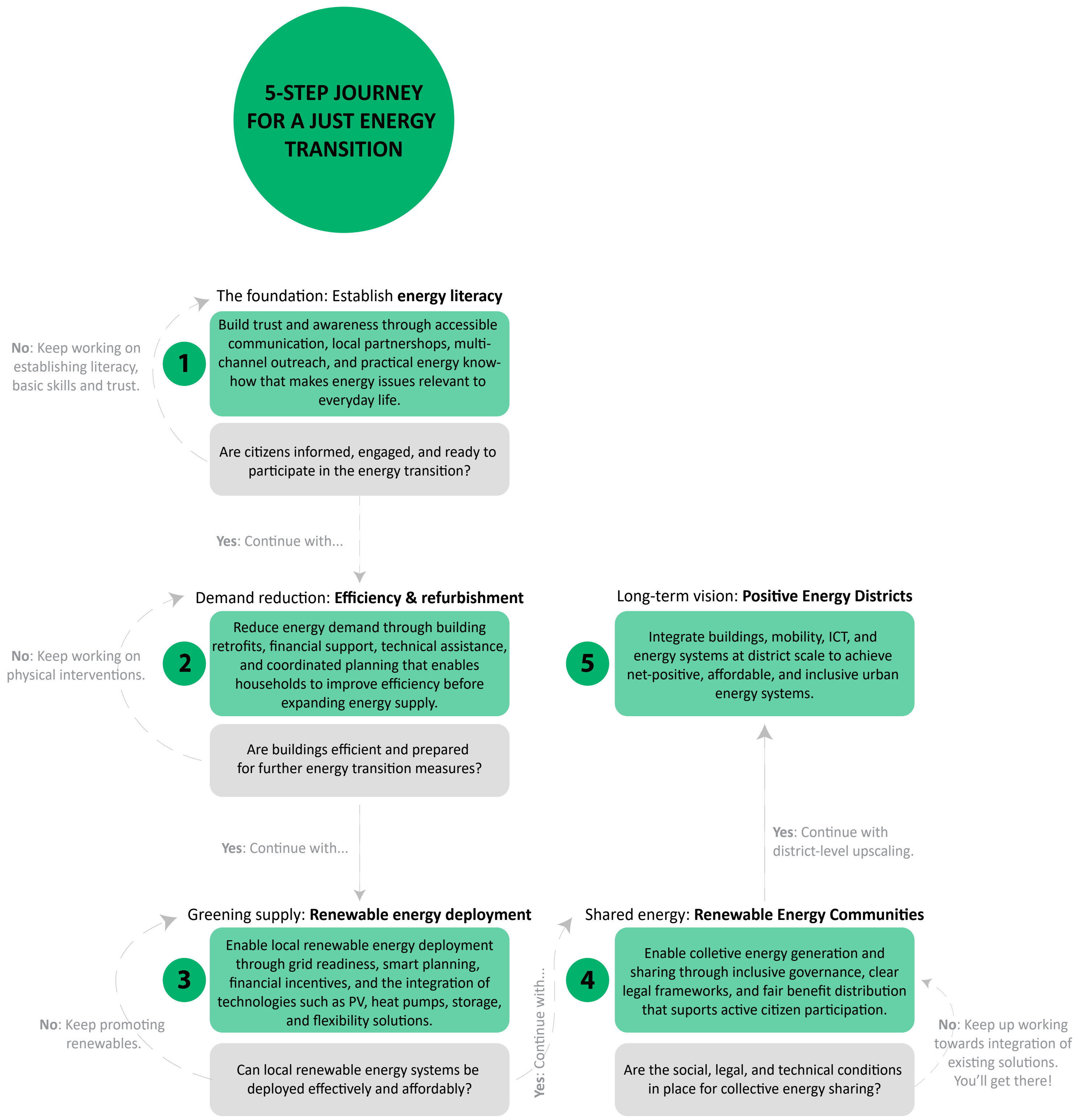
How can we ensure that locals benefit from processes that are set in motion in their surroundings? How can they be made aware and, most importantly, be actively engaged? And can technology play a larger role in such a context?

The WeGenerate project, which advocates for an innovative regeneration model at the district level, encourages municipalities and their partners to go beyond business as usual to identify, amplify, and accelerate state-of-the-art practices. Four Demo Cities will pave the way, all selected to represent a wide range of emerging urban regeneration trends that also capture broad geographical coverage and diverse stakeholders. These cities will contribute to crafting a new way of thinking, through their urban regeneration projects. In addition, five Fellow Cities will be active and early adopters of new approaches and techniques to replicate solutions developed through the project. State-of-the-art practices will be identified and accelerated across four innovation clusters:

- Integrated Planning and Digitalisation
- Social Innovation and Participatory Actions
- Energy in the Built Environment
- Sustainable Mobility

The WeGenerate Policy Papers will present the project results, latest findings, and trends, highlighting their relevance to EU policy processes and local practices. They will focus on topics from the four innovation clusters and provide actionable recommendations to local and national governments on how to best support urban regeneration with people at the heart of the solutions.

1 Ernesto López-Morales, definition provided as part of Session 2, UN-Habitat, "Urban Regeneration as a tool for Inclusive and Sustainable Recovery," UN-Habitat, 2022



Executive Summary and EU Recommendations

The European energy transition is increasingly framed as a just transition, yet its social dimension remains unevenly embedded in policy design and implementation. While energy communities and citizen participation are widely referenced in European Union (EU) strategies, the practical delivery of these ambitions continues to lag behind technical and market-oriented progress. At the heart of this gap lies a persistent delivery–democracy dilemma (Cowell & Devine-Wright, 2018): the tension between accelerating decarbonisation and ensuring inclusive decision-making.

Energy communities are often presented as a key model for a decentralised and democratic energy system. However, despite strong policy support on paper, their scaling remains limited in practice. This reflects not only regulatory fragmentation and administrative complexity, but also a deeper disconnect between policy design and real-world implementation conditions.

EU energy policy has evolved significantly over the past decade, particularly through initiatives such as the Clean Energy 4 All (CE4All) Package, the Social Climate Fund, and the Renewable Energy, Energy Efficiency and Electricity Market Directives. These frameworks increasingly recognise vulnerability, energy poverty, and energy communities. However, implementation remains non-binding, uneven across Member States, and weakly connected to participatory governance models. As a result, social innovation in the energy sector is often treated as an add-on rather than a structural component.

Local evidence from the WeGenerate project highlights that this gap is not only regulatory but also operational. Cities face social, technical, and institutional bottlenecks when implementing energy measures, particularly where shared energy models are introduced without sufficient preconditions being met: social conditions and technical readiness; financial accessibility; and enabling governance structures. These experiences confirm that successful implementation depends on a sequenced set of enabling conditions.

The analysis developed in this paper presents a hierarchy of transition mechanisms, conceptualised as a layered pyramid. At its foundation lies energy literacy, followed by efficiency and refurbishment, renewable energy, and finally the formation of Renewable Energy Communities (REC) and Positive Energy Districts (PED). Across all pyramid layers, socio-institutional conditions determine whether technical measures can succeed or reinforce inequalities. The core insight is that **inclusive energy transitions are not the result of individual instruments, but of their sequencing and interdependence**.

Against this background, current EU and national policy tools fall short because they frequently:

- prioritise top-layer solutions (e.g. energy communities) without ensuring foundational conditions first;
- operate in a fragmented policy landscape across energy, housing, and social domains;
- rely heavily on compensatory instruments rather than structural transformation;
- and insufficiently address implementation capacity and local governance constraints.

To close this gap, the paper proposes a set of targeted policy directions. At EU level, **key recommendations** and priorities include strengthening social conditionality in energy legislation, shifting towards enabling-condition frameworks, and reinforcing funding for social infrastructure such as energy literacy, one-stop-shops, and citizen-led renovation support. Energy poverty and vulnerability monitoring should be standardised through harmonised, multi-level indicators. Crucially, RECs should be explicitly treated as socio-technical systems, supported through governance standards, community benefit criteria, and harmonised regulatory frameworks.

Finally, a key but often overlooked lever is improving the visibility and accessibility of existing instruments. Many enabling programmes already exist but remain underused at local level. Strengthening communication and operational uptake – such as an enabler service provision programme for citizen-led renovation as pre-steps for energy community development (Directorate-General for Energy, 2025) – could significantly accelerate implementation without requiring new legislation.

Overall, a just and equitable energy transition will not emerge automatically from technological deployment or market expansion. Instead, it depends on sequenced, planned, socially grounded, and institutionally supported pathways, where cities act as essential implementation brokers between EU ambition and lived reality.

Glossary

Energy citizenship: The active participation of citizens in the energy transition through decisions and actions in energy production, consumption, distribution and governance, individually or collectively, to support a sustainable, democratic and just energy system.

Energy justice: The principle that the benefits and burdens of energy systems and policies should be distributed fairly, with recognition of vulnerable groups and inclusive participation in decision-making.

Energy literacy: The knowledge, skills and awareness that enable people to understand energy use and systems and to make informed decisions about energy consumption, efficiency and participation in the clean energy transition.

Energy poverty: According to the Social Climate Fund Regulation (2023, pg.13), "energy poverty is a situation in which households are unable to access essential energy services that underpin a decent standard of living and health." This includes adequate heating. cooling, lighting and power for appliances, all secured at an affordable cost. Similar definitions appear in the Commission Recommendation on Energy Poverty (2020) and the Energy Efficiency Directive (2023).

Energy vulnerability: The condition in which people are at heightened risk of falling into energy poverty because of low income, poor building efficiency, high energy needs or limited ability to adapt to energy price or supply shocks.

Just energy transition: The shift to a climate-neutral energy system carried out in a fair and inclusive way so that no person or place is left behind and social inequalities are reduced rather than intensified.

Shared energy: Energy that is jointly produced, owned, managed or consumed by multiple users- such as through energy communities or collective self-consumption - to increase local access, affordability and participation.

Abbreviations

CEC: Citizen Energy Community

EU: European Union

PED: Positive Energy District

REC: Renewable Energy Community

RES: Renewable Energy Source

Introduction

For a long time, social aspects were largely disregarded in energy debates. Only in the recent years attention has shifted to the societal dimension of energy policy, notably energy justice, poverty, vulnerability, resilience, and energy citizenship (Bouzarovski, 2018; Kajoskoski et al., 2025; Thalberg & Hajdinjak, 2024). Within this shift, energy poverty has emerged as a key analytical lens, typically understood through three interconnected dimensions: access and/or availability, affordability, and efficiency. Energy poverty is a multidimensional and measurement-sensitive phenomenon, with estimates varying significantly depending on the indicator used (Maier & Dreoni, 2026). While EU-wide prevalence is often estimated at around 9% of households (Pistore, 2025), this figure conceals substantial regional and socio-economic heterogeneity, with, e.g., rates exceeding 15% in parts of Greater Lisbon (EPAH, n.d.).

Energy vulnerability arises from the intersection of multiple factors (Del Río et al., 2025). Low-income households living in inefficient buildings face higher energy burdens due to inadequate insulation, outdated heating systems, and limited renovation capacity (Sapochetti et al., 2026, p.5f). At the same time, volatile or structurally high energy prices – whether linked to carbon pricing or external shocks – can restrict access to essential energy services and amplify the cost-of-living crisis (Bordagorry, 2025).

These challenges are particularly pronounced in Southern and Eastern Europe, where high energy vulnerability coincides with low resilience and adaptive capacity (Guarascio et al., 2025). Moreover, despite ongoing policy efforts, approximately 75% of the EU housing stock remains energy inefficient, reinforcing structural inequalities and limiting short-term mitigation options (EC , 2025a).

These vulnerabilities lie at the heart of the energy trilemma, balancing energy security, environmental sustainability, and social affordability (Giwah et al., 2024; Gunnarsdottir et al., 2020; Marti & Puertas, 2022). Yet in practice, affordability, access, and equity concerns are often sidelined, as debates frequently focus on decarbonisation, security, and competitiveness (e.g. IOGP, 2025; JDEC, n.d.).

Recent EU policy attention has focused on technical infrastructure (Amprion, 2025; ECGA, 2025; Energy Storage Europe Association, 2025; T&D Europe, 2025) and energy security (ENTSO-E, 2025a; SolarPower Europe, 2025; Zens, 2025), though some aim to broaden the concept of security to include resilience (EERA, 2025; REScoop EU, 2025). Conversations that do address inclusivity tend to be limited to social safeguards, e.g., disconnection prohibitions, often without embedding these protections in a broader systemic perspective (Bouzarovski et al., 2025; Hearn et al., 2022).

In this context, Renewable Energy Communities (RECs) and shared energy models are increasingly framed not merely as policy instruments, but as a normative end point of a just energy transition, shifting citizens from passive consumers to active participants in energy systems (Beber, 2025). Across the EU, more than 8,000 energy communities have already been established, demonstrating both the scalability and diversity of collective energy initiatives (European Commission, 2025b).

However, development remains uneven: although the ambition of establishing at least one energy community in every municipality with more than 10,000 inhabitants would represent a major step toward systemic inclusion (European Commission, 2022), only around 27% of this potential has currently been realised (European Court of Auditors, 2026). This gap highlights both the transformative potential and the structural barriers that continue to limit RECs' widespread adoption, particularly in urban contexts where social vulnerability and infrastructural constraints intersect.

Policy choices and stakeholder interests play a central role in shaping the energy transition. Balancing rapid technological change with more time-intensive, inclusive approaches remains a core challenge (IRENA, 2026, p.9), a tension known as delivery-democracy dilemma (Cowell & Devine-Wright, 2018). While the transition cannot solve all pre-existing inequalities, ignoring structural drivers of injustice in the energy sector and broader social systems risks reinforcing or creating new inequities (IRENA, 2026, p.10). A just energy transition should therefore be understood as both a continuous process and an outcome (IRENA, 2026, p.10).

In practice, there is often a substantial gap between the ambitions set out in European and/or national strategies and the realities on the ground: despite legislative and financial instruments aimed at promoting sustainability and social inclusion, implementation is frequently fragmented, hindered by procedural delays, limited administrative capacity, uneven regional deployment, and weak mechanisms for citizen participation (Rossi et al., 2025, p.2). Crucially, as IRENA emphasises: "[t]he overall 'justness' of the energy transition is not a guaranteed byproduct of technology deployment. Rather, the broader socio-economic contexts and policy choices significantly influence the success of just energy transition efforts" (IRENA, 2026, p.33).

Inclusive policy design is the only socially and environmentally sustainable way to ensure a just transition at EU, national, and local levels of governance.

While EU legislation formally recognises citizen energy communities as key vehicles for participation, their uptake remains uneven, reflecting persistent regulatory, financial, and administrative barriers at national and local levels.

State of Play

Over the past decade, EU energy policy has increasingly integrated social considerations, particularly energy poverty and vulnerability. However, even with a growing recognition at the legislative level, significant gaps persist in the transposition, implementation, and local delivery of these measures across Member States.

Explicit consideration of social aspects in EU energy **policy began with the Electricity Directive (2009),** adopted as part of the Third Energy Package. This directive introduced the legal concept of "vulnerable customers," creating a binding obligation for Member States to ensure customer protection.

Attention to energy justice was further institutionalised through the Governance Regulation (2018), which requires Member States to report on energy poverty in their **National Energy and Climate Plans** (NECPs), although without setting binding targets, thereby limiting their effectiveness in ensuring consistent action across Member States.

In recent years, particularly since **Fit for 55** and the **Renovation Wave Strategy** (EC Press Corner, 2020), the social dimension has shifted "from a peripheral concern to a structural priority" at least at the level of strategic framing (Sapochetti et al., 2026, p.2). Several legislative instruments address it through mutually reinforcing provisions from distinct angles.

The **Social Climate Fund Regulation** (2023) focuses on social compensation by providing earmarked funding (e.g., €1.2 billion) to support vulnerable households. From 2026 onward, access to these funds requires Member States to submit NECP-aligned **Social Climate Plans**.

The **Energy Efficiency Directive** (2023) addresses energy poverty through efficiency and targeting measures, including prioritising low-income households, and supporting one-stop-shops for technical-administrative and financial assistance. The **Electricity Market Directive** (EMD, 2024) strengthens citizen participation in the energy system by recognising citizen energy communities and introducing the right to energy sharing, enabling local actors to jointly produce, consume, store, and share electricity within and across communities.

Meanwhile, the **Energy Performance of Buildings Directive** (2024) addresses housing by requiring **National Building Renovation Plans** to prioritise worst-performing buildings while including safeguards against eviction or disproportionate rent increases following renovation. While these instruments collectively represent a strengthening of the EU's social energy framework, their effectiveness depends heavily on national transposition and administrative capacity, leading to uneven implementation across Member States.

Alongside legislation, several initiatives and support mechanisms complement this framework. The **CE4All Package** (EC, 2019) established obligations to monitor energy poverty and introduced the concept of renewable energy communities in both **Renewable Energy Directives** (2018 & 2023). Additional guidance has been provided through Commission recommendations on energy poverty (2020 & 2023), the **Energy Poverty Coordination Group** (2022), and the **Energy Poverty Observatory and Advisory Hub** (2025).

Building on the **Affordable Energy Action Plan** (2025) and energy community funding programs (CINEA, 2025; Citizen Energy Advisory Hub, 2026; DG for Research and Innovation, 2025), the recently adopted **Citizens Energy Package** (DG for Energy, 2025; Conti, 2026) that transforms citizens from passive consumers into active participants in energy systems, further signals the growing emphasis on citizen participation in local energy transitions. Yet, these initiatives often remain fragmented, project-based, or advisory in nature, limiting their ability to address structural inequalities on the ground.

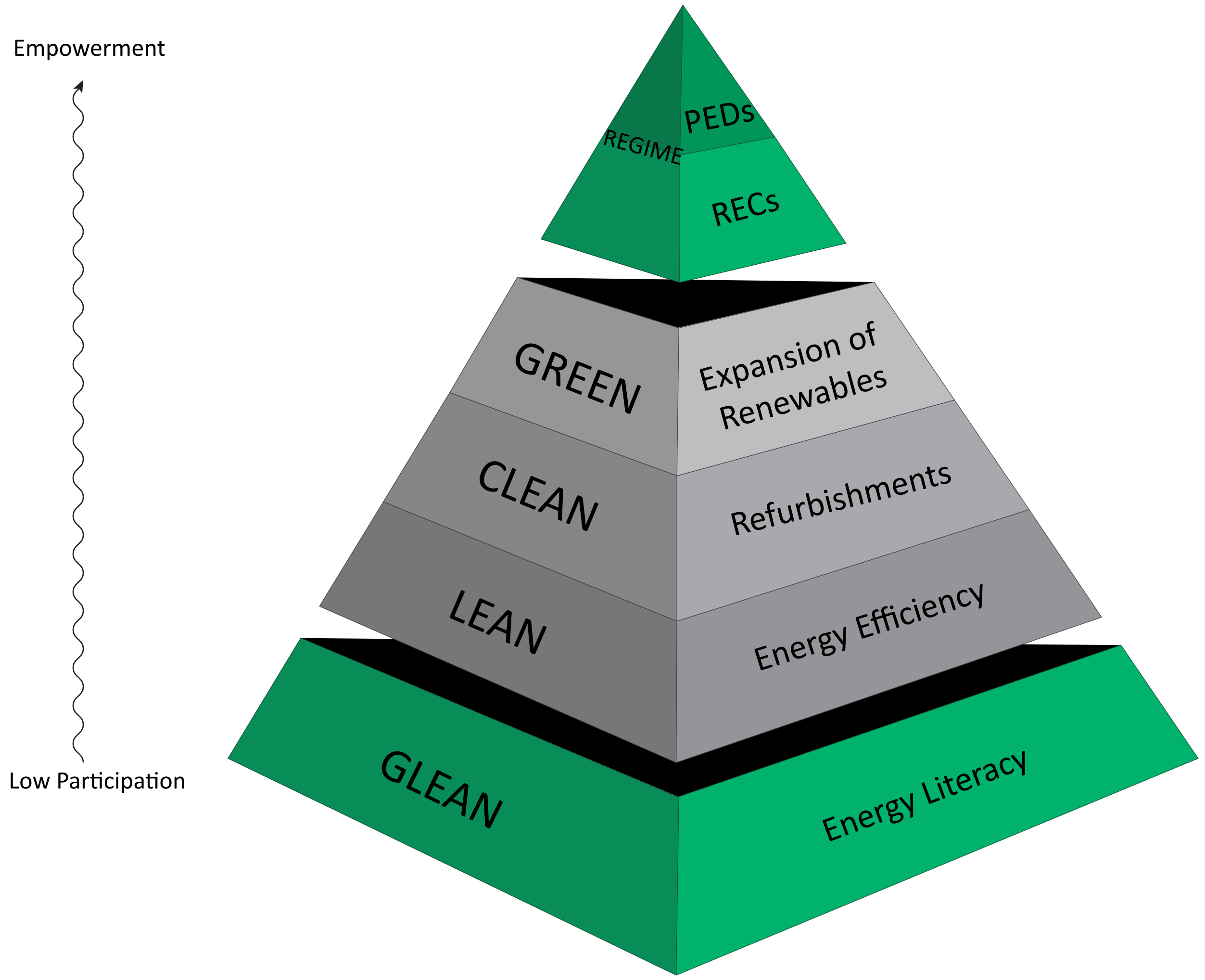


Figure 1: Just Energy Transition Pyramid
(Source: ICLEI Europe, based on the energy hierarchy concept, e.g. Goel & Kumar, 2023)

Five Steps Towards a Just Energy Transition

The Sequencing Problem

Mechanisms for a just energy transition are often treated as a set of parallel policy tools. However, they function more effectively when implemented in a structured sequence, as certain interventions establish the minimum social, technical, and institutional conditions required for subsequent measures to succeed. Rather than a menu of interchangeable options, these mechanisms therefore form a hierarchical and interdependent progression.

This sequencing approach draws on the energy hierarchy and related frameworks (e.g. Goel & Kumar, 2023, Figure 2). At the base, "lean" measures reduce overall energy demand. These are followed by "clean" interventions that improve energy efficiency, reflecting the energy efficiency–first (EE1) principle. Finally, at the top, "green" solutions deploy renewable energy systems (see **Figure 1**, which showcases a pyramid graph). Depending on context, additional elements may complement this hierarchy. These include carbon offsets (Greater London Authority, 2022), corporate reputation considerations ("seen" actions; Bull, 2023), and the treatment of fossil-based high-emissions sources as last-resort options (McLaughlin & Harvey, 2021).

However, existing energy hierarchies remain predominantly techno-economic and often overlook the social preconditions that determine whether measures can be implemented effectively in practice. These include factors such as energy literacy, trust, and participation. This paper therefore extends the conventional energy hierarchy by introducing both a social foundation and a participatory endpoint, transforming it into a socio-technical transition pyramid. Adding this social dimension broadens the framework beyond technical systems at household level. It establishes a shared individual understanding as the foundation of the pyramid and culminates in decentralised, fair energy systems as the ultimate objective.

Sequencing is critical for a just energy transition because each instrument addresses different objectives and enables subsequent measures. Interventions should therefore be designed to reinforce one another rather than operate in isolation. At the foundation of the social dimension is a shared understanding of energy systems. This requires energy literacy as the first step ("glean"), enabling households and communities to engage with energy transition measures.

Only once this foundation is established can more transformative innovation policies scale effectively (Boni et al., 2025). Demand-reduction measures and interventions (i.e., energy efficiency upgrades and building refurbishments) should precede the expansion and diversification of supply through renewable energy and prosumer models. Once energy-efficient, refurbished buildings are embedded in functioning social and technical networks, RECs can integrate these approaches while actively engaging citizens in energy governance.

Across all stages, a robust institutional and policy framework is essential to ensure sequencing, inclusivity, and systemic transformation are maintained (Hanke et al., 2021; Heldeweg & Saintier, 2020). Skipping or weakening foundational layers does not merely reduce effectiveness; it can actively undermine subsequent measures and interventions, leading to policy failure or social backlash.

In short, the pyramid summarises how technical and social mechanisms are sequenced to enable a just energy transition. It provides a structured framework to understand prerequisites, interdependencies, and inclusivity considerations. Building on this framework, the following sections explore how these mechanisms are applied in practice across some of the WeGenerate Demo Cities in Cesena (IT), Bucharest (RO), and Cascais (PT). The analysis focuses on implementation experiences, patterns of social engagement, and lessons learnt from engaging with vulnerable populations.

Step 1: Glean - Energy Literacy

Energy literacy represents the critical foundation for all subsequent actions, establishing a basic shared understanding among citizens to act as a "catalyst in accelerating the adoption of cleaner energy technologies" (Poimenidis et al., 2025, p.249). However, cities commonly face **bottlenecks** in establishing energy literacy. Limited trust in public actors, low perceived relevance of energy issues in everyday life, and low perceived value of participation all reduce engagement (Süsser et al., 2023), alongside citizens' disillusionment stemming from previous engagement processes that did not yield meaningful influence (Radtke, 2025).

In addition, cities often struggle with constrained administrative capacity and resources to design and sustain outreach, as well as limited coordination between planning, housing, and energy departments (Süsser et al., 2023). On a technical level, some cities also lack centralised, usable, localised data to make the impact of household energy actions tangible.

Regulatory frameworks at EU, national, and local levels can both enable and complicate implementation. While policies such as the EU Energy Efficiency and the Building Directives encourage information provision and citizen engagement, they do not provide dedicated funding for structured local outreach, leaving cities to operationalise these goals within their own municipal strategies and means. Further, inclusivity challenges persist in reaching diverse populations due to language barriers, digital divides, and differing levels of prior knowledge (Süsser et al., 2023). As a result, cities often face a gap between policy expectations for citizen engagement and the practical capacity, coordination, and trust-building required to implement energy literacy effectively at scale.

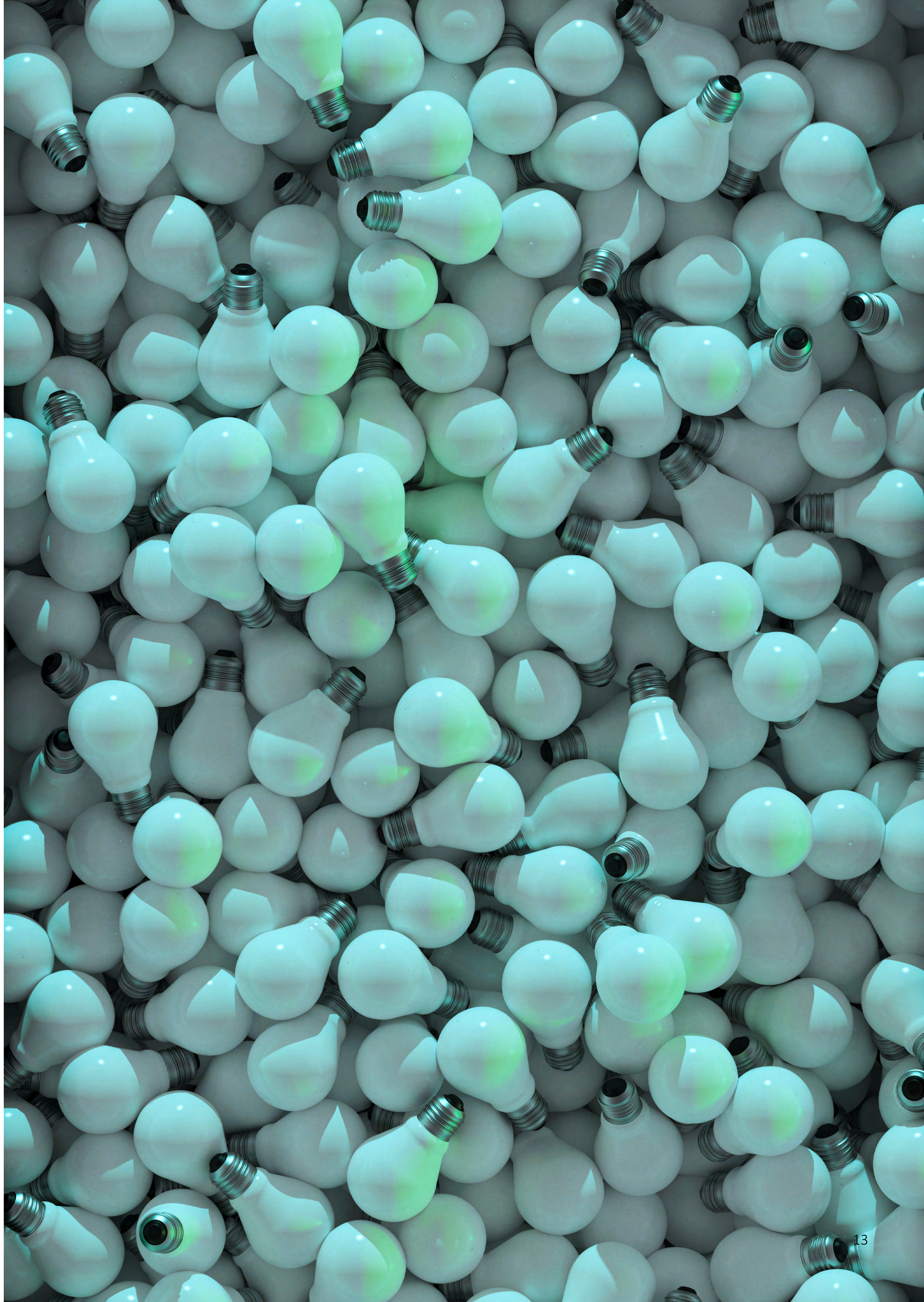
Policy implication: Energy literacy is not merely an awareness-raising tool, but a foundational system condition. Without it, downstream investments in efficiency, renewables and participation will systematically underperform or fail, undermining the effectiveness of the wider transition sequence.

Energy literacy can be strengthened under the following **enabling conditions**:

- **Development of trust**: Local actors, such as municipalities or utility companies, are perceived as credible and trustworthy (Süsser, 2024).
- **Peer-to-peer diffusion** (snowball effect / social spillovers): Informed local actors become trusted "energy champions" within their communities and transmit knowledge through peer networks, thereby amplifying engagement and enabling the formation of local energy initiatives (e.g. ENPOWER pilot experience with a farmer-led energy community in Ireland; SEAI, n.d.).
- **Relevance**: Citizens see energy as relevant to their everyday lives in terms of cost, comfort, and well-being and recognise that their actions matter (Süsser et al., 2023).
- **Accessible communication**: Clear, transparent, and locally meaningful information is provided using non-technical language and relatable equivalences, such as translating kWh into everyday activities (e.g. hours of oven use or air conditioning, or kilometres driven in an electric vehicle), supported by consistent and easy-to-understand messaging (Radtke, 2025).
- **Multiple channels**: Communication reaches people through diverse formats and entry points, including in-person, printed, and digital channels (Süsser et al., 2023).

In addition, inclusivity must be embedded from the onset by acknowledging diverse starting points across income, education, language, digital access, and tenure to avoid exclusion and ensure meaningful participation, including opportunities for feedback and dialogue.

To move from awareness-raising to action, factual knowledge gained through energy literacy initiatives must be coupled with practical energy know-how developed through skills-based training, such as open house demonstrations or in-home energy audits (CEES, n.d.; Andolfi & Pavić, 2025). Together, these conditions enable a low-barrier environment in which diverse urban residents can understand, relate to, and meaningfully engage with energy topics.



INSIGHTS FROM

BUCHAREST, ROMANIA

The WeGenerate demonstration in Bucharest District 2, led by the Technical University of Civil Engineering of Bucharest (UTCB), explores **how a deep building retrofit can serve as a stepping stone toward district-scale energy integration**.

The site was selected because UTCB has full operational control over the buildings, enabling coordinated planning and implementation. This controlled environment allows the project to test approaches that can later be replicated across Bucharest's District 2 and beyond.

The demonstration focuses on a small campus comprising a university canteen, student dormitories, and a nearby elementary school. All buildings are currently connected to district heating and lack local renewable energy generation. The canteen and school show particularly high demand, making them suitable anchor buildings for coordinated retrofit and potential heat sharing, while the dormitories present complementary demand patterns. Together, these characteristics make the site suitable for testing multi-building energy optimisation and local energy exchange.

A key challenge was not only technical integration, but also the social and regulatory complexity of connecting different buildings, actors, and funding mechanisms. This was addressed through a phased, evidence-based approach that combined retrofit actions with broader urban regeneration efforts and strengthened cooperation between the university, local administration, and stakeholders. A digital twin supports this process by simulating renovation pathways and informing iterative decision-making.

Key lessons: Deep retrofit is most effective when planned across multiple buildings; anchor buildings such as canteens, schools, or dormitories can initiate shared energy approaches; and district-scale integration requires coordination across buildings, governance, and investment structures. Together, these insights demonstrate how energy efficiency and refurbishment can enable the transition toward local energy communities at district scale.

Step 2: Lean & Clean - Energy efficiency & Refurbishment

Energy efficiency and refurbishment shift the focus from awareness to structural changes in energy demand. Together, they form a critical second step in the transition toward shared energy systems, reducing energy demand before diversifying supply. This includes interventions across the building envelope (insulation; window glazing), systems (heating, cooling, domestic hot water), distribution (pipes, ducts), controls and management (smart meters, building automation, demand-side management), and end-use efficiency measures, such as lighting (LEDs) and energy-efficient appliances. As part of the Renovation Wave (EuroCities, 2020), these interventions structurally reduce energy consumption while creating preconditions for local renewable integration.

Cities face multiple **bottlenecks** in implementing efficiency and refurbishment measures. Many buildings are old or heritage-protected, making renovations technically complex and costly (EC, 2025a; Hunkin & Krell, 2026). Economic barriers represent the main constraint to deploying energy-efficient technologies in the residential sector (Camarasa et al., 2021). These include high upfront costs, long payback periods, limited public subsidies, rising material costs, and split-incentive problems between landlords and tenants, including uncertainty over how energy savings are distributed (DeTroy et al., 2025; Klöckner & Nayum, 2016).

Bureaucratic complexity in accessing EU funds, lack of on-bill financing or innovative finance frameworks, and opaque pricing structures further hinder adoption (Hunkin & Krell, 2026). Regulatory constraints are less frequently cited (Camarasa et al., 2021), but can still arise where building codes make compliance economically unfeasible or permitting processes are restrictive (DeTroy et al., 2025).

Additional barriers include fragmented property ownership, which reduces coordination capacity, particularly in private residential buildings where collective buy-in is required and awareness may be low (Pérez-Navarro et al., 2023). Workforce shortages, skills gaps in emerging technologies and integrated retrofit approaches, and shifting or unclear policy signals further complicate implementation (Beillan et al., 2011; Camarasa et al., 2021; Klöckner & Nayum, 2016; Hunkin & Krell, 2026). Co-ownership arrangements are especially sensitive to cost-sharing disputes, while citizen reluctance driven by disruption, inconvenience, or uncertainty can further delay renovation decisions (Johansson & Davidsson, 2023; DeTroy et al., 2025).

Efficiency and refurbishment can be strengthened under the following **enabling conditions**:

- **Awareness of benefits**: Building on established energy literacy, tenants and owners must see the financial, environmental, and comfort benefits of renovation and be willing to invest (Johansson & Davidsson, 2023).
- **Regulations**: Minimum energy performance standards, "green" building codes, and heritage protection regulations mandate direction for renovation activities (DeTroy et al., 2025; Camarasa et al., 2021).
- **Economic incentives**: Subsidies, grants, tax incentives, and public support schemes reduce upfront costs and improve investment feasibility (Pérez-Navarro et al., 2023; Camarasa et al., 2021).
- **Co-benefit framing**: Non-energy benefits, such as improved comfort, noise reduction, and asset value increases, can increase participation (Jakob, 2007; Pérez-Navarro et al., 2023).
- **Coordination and technical support**: District-level planning, municipal leadership, standardised retrofit solutions, accessible building data, and mapping tools enable more efficient and targeted interventions (Hunkin & Krell, 2026).

Policy implication: Applying the energy efficiency first principle ensures that planning and investment prioritise energy demand. Energy refurbishment operationalises this principle by structurally lowering energy consumption in buildings, reducing long-term financial lock-in, and creating the necessary preconditions for integrating renewable energy systems (IEA, 2023).

Step 3: Green - Diversify supply through renewable energy expansion

Once demand is reduced and buildings are prepared through efficiency and refurbishment measures, the transition can advance toward decarbonising the energy supply through renewable energy expansion. Distributed generation technologies, such as rooftop and façade photovoltaics (PV), small-scale wind, biogas, and other local renewable energy sources (RES), reduce reliance on fossil fuels, diversify supply, and increase system resilience. Urban areas can contribute substantially where available surfaces and decentralised infrastructure are effectively utilised, for example by aggregating assets into virtual power plants (Manske et al., 2025).

Cities face multiple **bottlenecks** deploying renewable energy systems, with the most significant challenges being technical in nature. A primary constraint is aging infrastructure and gridlock; most distribution networks were designed in the mid-20th century for centralised, one-way power flows and are not equipped to accommodate decentralised and variable renewable generation. In many regions, connection queues are long and the grid capacity is insufficient to absorb new generation.

At the same time, rising electricity demand from electric vehicles, heat pumps, and data centres is placing additional pressure on existing networks. As a result, grid constraints limit RES-generated power, wasting energy. For example, Germany curtailed an estimated 19 TWh of renewable electricity in 2023 due to grid bottlenecks (Renewable Advisory Experts, 2025), while over 120 GW of renewable energy projects across Europe are currently delayed or at risk due to insufficient grid capacity (Cremona, 2026).

Closely linked to this is the intermittency of renewable energy supply. Solar and wind generation rarely match peak urban demand, creating a structural need for large-scale storage and flexibility solutions that remain costly or insufficient for managing demand (Regen Power, n.d.). At the local level, many cities also lack smart metering and automated control systems, aggregated platforms, and standardised interfaces (ENTSO-E, 2025b), which limits the integration of decentralised assets. These data and infrastructure gaps further constrain modelling, planning and optimisation of urban energy systems (C40 Cities Climate Leadership Group, 2021; Manske et al., 2025; Ulpiani et al., 2023).

Beyond technological constraints, social, financial and regulatory barriers remain significant. Limited citizen buy-in limits uptake of renewable technologies, closely linked to earlier gaps in energy literacy and engagement (ENTSO-E, 2025b; Manske et al., 2025). Even where willingness exists, financial feasibility remains a key barrier due to high upfront costs, long payback periods, and limited access to financing and funding for both households and municipalities (C40 Cities Climate Leadership Group, 2021; Manske et al., 2025).

These challenges are further compounded by interdependencies between technologies. For example, solar PV is often most effective when combined with complementary systems, such as heat pumps, which in turn require energy-efficient buildings to operate optimally. As a result, RES deployment often implies coordinated investment across building systems, increasing complexity and affordability challenges (European Commission, 2024). This helps explain the reliance on public buildings in many municipal renewable strategies (Ulpiani et al., 2023), as also observed in cases such as Cascais (PT) and Bucharest (RO).

Regulatory uncertainty and fragmented market frameworks further hinder deployment. Differences and inconsistencies in permitting procedures, grid connection rules, support schemes, and tariff structures across governance levels can slow or limit implementation, particularly when they conflict with land-use planning or biodiversity requirements (ENTSO-E, 2025b; C40 Cities Climate Leadership Group, 2021; Ulpiani et al., 2023). In addition, shifting policy signals and lobbying by incumbent energy actors can further contribute to unstable investment environments and cyclical "boom-bust" development dynamics.

Finally, structural and spatial constraints in urban areas limit the scale and diversity of RES deployment. High urban energy demand density concentrates consumption in areas where local self-sufficiency is often not feasible. At the same time, limited available space restricts large-scale solar and wind deployment, increasing dependence on imported energy (Manske et al., 2025).

INSIGHTS FROM

CESENA, ITALY

The municipality of Cesena is piloting an integrated and inclusive urban regeneration process in the Vigne–Railway Station district, which aims to assess how renewable energy expansion can be embedded within large-scale neighbourhood retrofitting while helping prevent future energy poverty in socially-mixed and potentially vulnerable communities. In the INA-Casa Vigne area, an ageing neighbourhood with inefficient buildings and rising affordability pressures, the city is combining urban regeneration with clean energy planning to create a scalable pathway toward climate-neutral neighbourhoods (Boulanger et al., 2025).

Through the Energy2Act initiative (Giovannini et al., 2026) together with WeGenerate (Boulanger et al., 2025) and Poseidon (Saez et al., 2025) projects, Cesena is testing an integrated model that links deep renovation potential of multi-family housing with coordinated technology packages for demand reduction, local renewable generation, flexibility measures, citizen-centred governance, and future renewable energy community schemes. In alignment with emerging European Positive Clean Energy Neighbourhoods (PCENs) initiatives, the municipality aims to test multiple regeneration scenarios combining retrofit measures and renewable deployment at neighbourhood scale through the use of an Urban Digital Twin (UDT), as a planning and simulation environment based on detailed geospatial and building-performance data. This allows comparison of energy savings, emissions reductions, renewable energy shares, and affordability indicators and implementation phasing, in view to support the city assessing which intervention pathways are most viable for lower-income households and which require targeted public support.

A major challenge for the project is the fragmented ownership structure of the existing housing blocks and the risk that transition costs exclude vulnerable residents. Cesena addresses this by combining technical modelling as part of the Cesena Energy Living Lab (CELL), which includes One-Stop Shop services, citizen engagement, and scenario-based financial planning to help align subsidies, incentives, and phased investments with social need.

Key lesson: The Cesena Demo shows that renewable energy expansion can become a driver of energy poverty reduction when it is integrated into large-scale retrofit strategies, guided by digital planning tools, and designed to ensure that vulnerable households share in the economic benefits of the transition.

Urban planning must therefore balance competing land uses, including renewable infrastructure, building density, green space, and public functions. Despite these constraints, significant untapped potential remains in rooftops, façades, parking lots, and other underused urban spaces (Manske et al., 2025). In addition, diversification beyond solar remains limited, with storage solutions and alternative renewable sources still underexploited (Ulpiani et al., 2023).

These barriers can be overcome under the following **enabling conditions**:

- **Stakeholder engagement and energy literacy**: Cooperation between utilities, civil society, and residents under municipal coordination, building on energy literacy to ensure participation and acceptance (C40 Cities Climate Leadership Group, 2021; Ulpiani et al., 2023).

- **Building stock readiness**: Energy-efficient and refurbished buildings that reduce integration costs and improve system performance for renewable technologies (European Commission, 2024; Manske et al., 2025)

- **Technical capacity**: Local expertise for installation, operation, and maintenance of renewable technologies and associated systems (C40 Cities Climate Leadership Group, 2021).

- **Data and smart tools**: Effective planning and operation of decentralised energy systems relies on three interlinked layers. First, planning data inputs such as energy demand data, local resource maps, and city energy surveys provide the basis for system design. Second, real-time operational data, enabled through smart metering, allows continuous monitoring and management of energy flows. Third, digital planning and optimisation tools – including Digital Twins, virtual power plants (VPPs), and AI-based modelling – integrate these data streams to simulate, coordinate, and optimise urban energy systems (ENTSO-E, 2025b; C40 Cities Climate Leadership Group, 2021; Ulpiani et al., 2023).

- **Finance and market incentives**: Instruments, such as power purchase agreements, lease models, dynamic tariffs, flexibility incentives, and targeted subsidies to improve project bankability and participation (ENTSO-E, 2025b; C40 Cities Climate Leadership Group, 2021).

- **Policy alignment and planning**: Integration with climate strategies building codes, zoning regulations, and RES acceleration areas to streamline deployment and reduce permitting barriers (C40 Cities Climate Leadership Group, 2021; Ulpiani et al., 2023).

- **System integration and aggregation**: Use of virtual power plants, sector coupling (e.g., EV charging, retrofits, agrovoltaics, waste-to-energy), and district-level integration to balance variability and prepare for REC and/or PED frameworks, and enable participation in wider energy system services (ENTSO-E, 2025b; Ulpiani et al., 2023; Manske et al., 2025).

Policy implication: Following demand reduction and efficiency improvements, renewable energy expansion represents the next structural step in the energy transition, shifting supply towards decarbonised sources while enhancing long-term system resilience through diversification and decentralisation.

INSIGHTS FROM
KADIKÖY, TÜRKIYE

In the Caferağa neighbourhood of Kadıköy, renewable energy deployment is being advanced through municipal assets and planning frameworks, but its implementation is constrained by limited access to detailed energy data and the need for incremental planning approaches. Within its Sustainable Energy and Climate Action Plan (SECAP), the municipality is installing solar photovoltaic systems on public buildings, combined with energy-efficient retrofits and smart energy management, forming the basis for a decentralised energy approach at neighbourhood scale (Making City, 2024).

At the same time, Kadıköy is developing GIS-based planning tools to compensate for incomplete energy datasets, integrating building typologies and estimated consumption to identify priority areas for retrofitting and support scenario-based emissions planning. This proxy-data approach enables progress without full monitoring infrastructure, but also reflects underlying data limitations.

The district is also expanding electrification of mobility through the installation of electric vehicle charging stations at municipal facilities, as part of a broader strategy linking renewable energy production with rising electricity demand from transport (Kadıköy Municipality, n.d.). However, these interventions remain largely pilot-based and depend on gradual scaling due to technical and institutional capacity constraints.

Key lesson: Kadıköy's approach demonstrates how municipal-led renewable deployment can progress under conditions of data scarcity and limited implementation capacity, through incremental planning tools, pilot infrastructure, and integrated municipal action.

INSIGHTS FROM

LIEPĀJA , LATVIA

Central Karosta neighbourhood in Liepāja demonstrates why energetic refurbishment must be the essential first step towards any viable REC. The neighbourhood consists of 12 Soviet-era steel-concrete apartment buildings, of which only two have been renovated, one is vacant, and nine remain in use, housing around 1,440 to 1,800 residents. Built with poor insulation, inefficient heating systems, and no ventilation, the housing stock represents a starting point with huge potential of increasing energy efficiency and implement renewable energy technologies for the energy transition. The main barrier is therefore not renewable ambition, but the physical condition of the buildings themselves.

Energy performance data confirms this gap: renovated buildings reach significantly better efficiency levels (e.g. B-class at 46 kWh/m²), while non-renovated buildings remain at E-class levels above 100 kWh/m². Heating is currently provided by a woodchip boiler system, while domestic hot water is produced individually using electric boilers, and no local renewable generation for electricity is yet installed. This demonstrates that without first reducing demand through refurbishment and system upgrades, new renewable capacity risks compensating inefficiencies rather than enabling a fair transition.

Regulatory conditions further reinforce this sequencing logic. Under Latvia's energy community framework (2024), electricity sharing across buildings requires complex arrangements with a single supplier and involves settlement losses when energy is exchanged via the grid. As a result, cross-building energy sharing delivers limited value in practice. In this context, the most effective near-term approach is building-level self-consumption, with renewable generation located as close as possible to demand.

A final constraint is financial and institutional instability. Although Liepāja has solid experience with renovation programmes, national funding schemes (e.g. ALTUM, n.d.a and n.d.b) have been discontinuous and are currently fully allocated, creating uncertainty and slowing implementation. This weakens trust and delays collective action at neighbourhood level.

Key lesson: Central Karosta shows that without stable renovation support, clear regulatory incentives, and reduced energy demand, REC development remains premature. The priority is therefore clear: refurbish first, reduce demand, and only then scale shared renewable energy systems.

Renewable Energy Communities (RECs) sit at the top of the transition pyramid as a form of system integration through collective organisation. They consolidate individual and household/building-level actions from preceding layers into district – or community-scale energy – sharing arrangements, integrating local generation, efficiency, and social participation into coordinated systems that generate broader energy, economic, and social benefits. RECs therefore represent not only a technical configuration, but also energy citizenship in practice.

In practice, cities face multiple **bottlenecks** in creating RECs, with regulatory barriers being among the most frequently cited. Definitions, legal frameworks, and national transpositions of EU directives differ across countries, creating uncertainty for implementation (Nikolic et al., 2025). High upfront costs, lack of warranties, absent stable financial schemes, and a lack of mature long-term business models hinder deployment. Administrative procedures are often complex and opaque, limiting accessibility and, in some cases, favouring private actors over communities. In addition, transposition of the Social Climate Fund Plans and central REC legislation into national law is often slow, particularly with respect to transparency, targeting vulnerable groups, and overall policy coherence (REScoop, 2026).

Social barriers are equally significant. Trust, fairness, and cooperation are often limited, while legal and procedural knowledge is limited and scepticism toward energy communities persists (NetZeroCities, 2024). Many municipalities lack experience with structured citizen collaboration, particularly with vulnerable groups. Participation is further constrained by a limited willingness to dedicate time and an overreliance on volunteer-based engagement models (Nikolic et al., 2025).

From a technical perspective, non-diverse participant bases - often reflecting a concentration of participants among comparatively affluent, well-educated male homeowners (Shejale et al., 2025) - can create production-consumption imbalances and saturation effects. Grid constraints, insufficient infrastructure, and early-stage flexibility markets restrict scalability. In addition, shortages of suitable generation sites, limited grid access, and insufficient storage capacity remain key barriers to community-scale implementation (Nikolic et al., 2025).

Overall, RECs "are often treated as technical projects, when in reality they are socio-technical systems" (Adela Bara in DUT Partnership, 2026). Their successful establishment requires not only infrastructure and finance, but also digital literacy, social engagement, and active citizen participation. However, establishing viable, scalable business models remains challenging (Amann & Puig, 2025), and evidence from stakeholder processes suggest that there is insufficient attention given to the social-behavioural mechanisms required to sustain long-term citizen participation (Mahoney et al., 2025).

Despite these challenges, some **enabling conditions** help facilitate REC development:

- **Citizen participation**: Inclusive and active engagement, enabled through community ownership, trust via prior cooperation, transparent governance, and strong energy literacy, ensures social benefits and equity, including energy poverty mitigation (Beber, 2025; Nikolic et al., 2025; Pioletti et al., 2024).
- **Pre-prepared infrastructure**: Refurbished buildings and existing RES provide a ready foundation for REC development, enabling communities to focus on system integration and optimisation rather than basic asset deployment.
- **Legal clarity**: Harmonised regional, national, and municipal framework reduce regulatory uncertainty and facilitate faster implementation (Beber, 2025; Pioletti et al., 2024).
- **Flexible multilevel governance**: Coordinated governance across administrative levels, combining EU alignment with local autonomy to allow tailored decentralised solutions (Beber, 2025; Pioletti et al., 2024).
- **Public engagement and integrated planning**: Strong municipal-regional coordination linking climate, energy, and spatial planning, supported by clear regulatory frameworks and access to land and infrastructure (Pioletti et al., 2024).
- **Accessible financing**: EU, national, and regional funding instruments combined with public-private cooperation improve feasibility and scalability. (Pioletti et al., 2024). Crowdfunding mechanisms

Policy implication: Renewable Energy Communities (RECs) provide an integrative governance framework that builds on prior demand reduction, refurbishment and renewable deployment by combining generation, efficiency, and local coordination within a single socio-technical system. Their effectiveness depends on strong institutional, financial, and social preconditions, but they offer a pathway toward a more stable, inclusive, and locally-coordinated energy systems.

linked to RECs can also lower entry barriers, strengthen trust, and create structured participation and governance models, with citizen energy schemes enabling longer-term financial stability and governance continuity (Beber, 2025).

- **Scaling and cross-border frameworks**: Legal and organisational instruments such as European Grouping of Territorial Cooperation (EGTCs), European Economic Interest Grouping (EEIGs), and European Cooperative Societies (ECSs) enable RECs to scale beyond local boundaries, supporting knowledge exchange, resource pooling, and broader participation (AEBR, n.d.).

Photo credit: Cascais Ambiente, Municipality of Cascais.

INSIGHTS FROM
CASCAIS, PORTUGAL

The main objective in the Cascais WeGenerate Demo is to demonstrate how municipal photovoltaic (PV) generation, collective self-consumption, and energy-efficient building rehabilitation can be combined to reduce energy poverty, improve comfort, and foster inclusive, community-driven energy transitions in a social housing neighbourhood, while creating a scalable model for the wider municipality.

Photovoltaic (PV) systems were installed on municipal buildings in the Demo area, creating a collective self-consumption scheme linked to a social housing neighbourhood, where renewable surplus energy is shared with vulnerable households. A total of 141 kWp of PV were installed in six municipal buildings, with excess energy redirected to provide clean and affordable electricity for residents of Bairro de Alcabideche. The Demo directly benefits 131 residents across 50 households, a school community of 2,500 people, and over 1,500 users of public facilities. In parallel, social housing buildings have been energetically refurbished, energy literacy and engagement actions are ongoing, and the municipality has contracted an external company to develop digital tools to support participation, monitoring, and replication.

Enabling conditions include Recovery and Resilience Programme (RRP) funding, which enabled refurbishment of social housing buildings, improving thermal comfort and reducing energy demand. Strong institutional support from the municipal social housing management department facilitated communication and trust-building with residents. In addition, abundant solar resources in Cascais ensure strong PV production and meaningful surplus energy for sharing.

The main challenge relates to the regulatory framework for collective self-consumption, particularly limitations on municipal participation due to potential revenue-generation constraints and uncertainty regarding long-term financing of community management platforms (currently covered by the WeGenerate project but intended to remain free for end-users). This has been addressed through the development of alternative free and/or self-managed energy-sharing schemes used by other Portuguese renewable energy communities and collective self-consumption initiatives. A second challenge concerns upscaling, as expanding generation beyond public buildings and enlarging the member base requires coordination with private actors and external partners, with each implementation cycle taking approximately three months due to regulatory and procedural requirements.

Key lesson: Cascais demonstrates how municipal photovoltaic generation combined with collective self-consumption can translate renewable energy deployment into tangible social benefits, provided that regulatory flexibility and sustained institutional support enable inclusive participation and scalable community energy models.

INSIGHTS FROM

BARCELONA, SPAIN

Barcelona illustrates how Positive Energy Districts (PEDs) can evolve beyond a purely technological model and become a vehicle for inclusive urban transformation. Rather than starting from energy infrastructure alone, the city offers a pathway in which long-standing anti-energy-poverty policies, neighbourhood regeneration, and building renovation create the enabling conditions for district-scale positive energy systems (Ajuntament de Barcelona, 2021).

The city has built a strong social foundation through its Energy Advice Points (Punts d'Assessorament Energètic – PAE) (Energy Poverty Advisory Hub, n.d.), a municipal service that supports households facing payment difficulties, risk of disconnection, inefficient energy use, or limited knowledge of consumer rights. This network has become a practical interface between vulnerable residents and the energy transition, combining advice, mediation, awareness-raising, and referral services. Such mechanisms are particularly relevant because they strengthen trust, improve energy literacy, and help identify priority households before large-scale investment begins.

At the same time, Barcelona is advancing PED-related strategies through initiatives such as PEDRERA (Civiero, n.d.), the MES Barcelona Sustainable Energy Mechanism (Ajuntament de Barcelona, n.d.), and regeneration frameworks, such as in the Besòs area (Barcelona Distrito de Sant Martí, 2026). These programmes promote energy renovation, photovoltaic self-consumption, local flexibility, and new collective governance models. Their strategic value increases when linked to districts where social vulnerability and poor building performance overlap.

This creates a clear opportunity for Barcelona to position vulnerable neighbourhoods as next-generation PED demonstrators. In 1950-80s multifamily housing areas, large-scale retrofit programmes can first reduce structural demand through insulation, envelope upgrades, and efficient heating and cooling systems. Once this foundation is secured, PED components such as shared solar PV, storage, heat pumps, digital energy management, and collective self-consumption can generate neighbourhood-scale positive energy balances while lowering household costs (Energy Cities, 2018; Hearn & Castaño-Rosa, 2021; Síndic de Greuges de Catalunya, 2023).

Barcelona urban regeneration policies aim to promote inclusive PEDs through required governance safeguards. If regeneration raises rents or accelerates displacement, the social benefits of energy transition would be lost; hence, PED planning is being integrated with housing affordability measures, tenant protections, and targeted support for vulnerable residents.

Key lesson: Barcelona urban policies and plans position PEDs as the highest stage of a just urban energy transition , with energy poverty services as the social gateway, deep renovation as the structural bridge, and district energy systems as the long-term outcome.

Step 5: Regime - Positive Energy Districts

At the highest level, all elements of the pyramid converge into fully integrated district-scale systems. Positive Energy Districts (PEDs) represent the culmination of local energy transitions at the district scale ("regime"), achieving net-positive energy and emissions while prioritising high energy efficiency, flexibility, diversified renewable technologies, and inclusive, affordable, and sustainable lifestyles over purely economic gains (Shtjefni, 2025).

They integrate multiple systems – buildings, mobility, ICT, storage, and EV charging – and enable better balancing of energy supply and demand across the neighbourhood, avoiding mismatches common at the building scale (Shtjefni, 2025). Their realisation depends on the successful implementation of all preceding layers of the transition pyramid; missing elements such as citizen engagement, infrastructure, or governance will prevent success.

Policy implication: As policy target, PEDs serve as a guiding star for long-term planning, illustrating the potential of district-scale transitions while most cities should focus immediate efforts on establishing the foundational layers that make them achievable.

Bonus Step:
Price Mechanisms (as a Last Resort Scheme)

Price mechanisms – often the go-to choice in policy-making – can buffer residual inequalities and provide short-term relief during crises and energy price spikes, such as reduced energy taxes, direct assistance to households in the form of one-off payments, or price breaks for gas and electricity (e.g., Iberian Exception; Bordagorry, 2025). Yet these interventions have limits: they create permanent fiscal obligations and dependencies; subsidise inefficiencies (e.g., poorly insulated buildings remain inefficient); and send weak transformation signals, addressing welfare symptoms rather than structural transition drivers.

Further, lump-sum transfers primarily secure distributional justice of burdens but rarely tackle procedural, recognition, restorative, or intergenerational forms of energy justice (IRENA, 2026). Hence, while lump-sum transfers represent the most direct inclusivity instrument, they primarily address symptoms rather than structural drivers. Alternatives that simultaneously improve affordability and structural efficiency include social tariffs, progressive electricity pricing, time-of-use billing, and targeted subsidies for appliances or heating systems to directly improve energy efficiency and reduce demand, not just tackle income in an isolated manner.

Nevertheless, pricing mechanisms can be necessary additions but are not sufficient on their own, and as extra scheme do not form part of the core layered hierarchy. Their role is therefore complementary, providing distributive stabilisation without replacing the foundational steps of literacy, efficiency, refurbishment, renewable deployment, and community engagement.

Policy implication: As a compensatory instrument operating at the level of distributional correction, price mechanisms provide targeted financial transfers that offset residual costs induced by structural transition measures without altering the underlying energy system. In isolation, price mechanisms can stabilise the system – but they cannot transform it. Instead of representing the first solution, they should be deployed as last-resort add-ons to address remaining social imbalances and support the political feasibility and acceptance of the transition.

POLICY RECOMMENDATIONS

Across all governance levels, the effectiveness of policy interventions depends not only on their individual design, but on their alignment with the sequenced, interdependent nature of the energy transition. Policies that fail to account for these dynamics risk reinforcing existing inequalities, while those that integrate social, technical, and institutional dimensions can unlock more inclusive and scalable pathways.

European Level
Set the Framework for Sequenced and Inclusive Transitions

EU-level policy should focus on defining system-wide rules and standards that ensure coherence across Member and Partner States to prevent fragmented implementation.

1

Embed social conditionality across all energy legislation

While the EU has significantly strengthened the social dimension of energy policy, inclusivity and vulnerability considerations remain unevenly integrated across instruments. For example, the EU Just Transition Mechanism focuses on industry support and justice at regional scale while remaining weak on citizen participation. Future legislation should systematically embed social criteria as binding requirements, ensuring that energy poverty, accessibility, and citizen participation are not treated as add-ons but as core design principles (Sapochetti et al., 2026; IRENA, 2026).

2

Shift from outcome targets to enabling-condition frameworks

Current EU policies often focus on end goals (e.g., RES targets, REC uptake) without ensuring that foundational conditions – such as trust and administrative capacity – are in place. EU frameworks should therefore incorporate sequencing logic, requiring Member States to demonstrate how enabling conditions across all layers are being developed (Hanke et al., 2021). For this, the EU should focus on:

- Establishing binding renovation trajectories aligned with climate goals.
- Ensuring simplification of regulatory procedures for implementation (e.g., by streamlining permitting procedures through standardised contracts and procurement templates).
- Enabling balanced incentive–obligation frameworks that support uptake while safeguarding fairness.

3

Strengthen and ring-fence funding for social infrastructure

Existing instruments, including the Social Climate Fund, primarily address distributional impacts but remain limited in supporting structural social enablers such as outreach, citizen engagement, and local capacity-building. Implementing the Energy Citizens Package could provide an opportunity to address this gap. Such EU funding should prioritise:

- Expand support for energy literacy, one-stop-shops, and community facilitation.
- Support pre-investment and project development phases in addition to infrastructure delivery (Hunkin & Krell, 2026).
- Promote blended finance models combining EU, national, and private capital, such as revolving funds, Energy Service Companies (ESCOs), and on-bill financing (Hunkin & Krell, 2026)

4

Standardise and improve monitoring of energy poverty

A lack of consistent indicators limits effective targeting and evaluation. The EU should develop harmonised, multidimensional metrics for energy poverty that include bottom-up and local-level data collection (JRC, 2025), and align monitoring frameworks with international principles such as the G20 Principles for Just and Inclusive Transitions (Global Commission for the People-Centred Clean Energy Transitions, 2025).

5

Enable Renewable Energy Communities as socio-technical systems

EU legislation recognises RECs, but implementation remains uneven. Policy should move beyond technical definitions and support RECs as socio-technical systems (Roberts & Rossetto, 2020) by:

- Introducing community benefit and inclusivity criteria (Tamanis et al., 2026).
- Supporting scalable governance and business models (Makridou, 2025).
- Aligning regulatory frameworks across Member States to reduce fragmentation.

National Governments: Translate Frameworks into Enabling Conditions

At the national level, the priority is to translate EU frameworks into coherent, stable, and operational systems, ensuring legal certainty, data availability, and long-term policy continuity. National governments play a bridging role between EU system design and local implementation by ensuring legal coherence, financial stability, and data infrastructure.

1

Accelerate and clarify transposition of EU legislation. Delays and inconsistencies in transposing EU directives – particularly regarding energy communities and social measures – create uncertainty and slow implementation. National governments should prioritise clear, timely, and coherent transposition, ensuring alignment across energy, housing, and social policy domains (REScoop, 2026; NetZero Cities, 2024).

2

Develop fine-grained energy poverty mapping. Effective policy design requires accurate targeting. National governments should establish granular energy poverty assessments (e.g., NUTS3 level), as demonstrated in Portugal (Observatório Nacional Pobreza Energética, 2024), to close data gaps, better identify vulnerable populations and support local implementation.

3

Create stable, long-term renovation support. Stop-start funding cycles undermine trust and slow down renovation efforts. Governments should ensure continuity of funding programmes, predictable subsidy schemes, and integration of financial tools (grants, loans, guarantees), addressing key barriers identified in the residential sector (Camarasa et al., 2021; Hunkin & Krell, 2026)

4

Align regulatory frameworks with sequencing logic. Policies should reflect the interdependencies between mechanisms by supporting self-consumption models where grid-based sharing is inefficient (European Commission, 2024). Regulatory frameworks should avoid penalising local optimisation and instead facilitate integrated approaches across sectors.

5

Enable accessible financing and reduce administrative burden. Complex procedures and fragmented funding channels remain key barriers. Governments should simplify application processes, standardise contracts and procurement, and support intermediaries such as aggregators and cooperatives to improve access and scalability (Hunkin & Krell, 2026).

Local Governments: Deliver Integrated and Inclusive Implementation

At the local level, the focus shifts to implementation, integration, and citizen engagement, ensuring that transition measures work in real urban contexts and across diverse social groups.

1

Adopt a sequenced, place-based transition strategy. Cities should move away from fragmented interventions and instead apply a stepwise approach, ensuring that energy literacy and engagement precede technical deployment, and that efficiency and refurbishment precede renewable expansion (C40 Cities Climate Leadership Group, 2021; Ulpiani et al., 2023). For this, cities should:

- Conduct integrated energy assessments and spatial planning to guide sequenced investments.
- Deploy mixed financing combinations (EU, national, and private capital) to enable scalable renewable and efficiency investments across buildings and districts.
- Enable integration through digital infrastructure, smart metering, aggregation models, and district-scale flexibility that connect distributed resources into urban energy systems.

2

Establish one-stop-shops as central delivery hubs. Local one-stop-shops can address fragmentation by providing integrated support across all layers, including technical, financial, and legal assistance. These models have proven effective in supporting households and coordinating complex interventions (Hunkin & Krell, 2026). Successful implementation requires integrating inclusivity into all actions by using multi-channel engagement, tailoring approaches to vulnerable groups, and embedding participation into planning processes (Süsser et al., 2023; Radtke, 2025).

3

Act as facilitators and knowledge brokers. Municipalities play a key role in enabling citizen participation by building partnerships, supporting community-led initiatives, and sharing knowledge. Strong local leadership is critical for scaling inclusive energy solutions (DUT Partnership, 2026; Hunkin & Krell, 2026). For example, energy (poverty) considerations should be proactively integrated into local development plans to ensure that social vulnerability is addressed in a structured and forward-looking way rather than as an afterthought in project implementation.

4

Don't re-invent the wheel. Local governments should avoid reinventing existing solutions and instead leverage other cities' willingness to share knowledge, and implementation experience (DUT Partnership, 2026). This includes drawing on tested approaches, pilot results, and transferable governance models to accelerate implementation and reduce duplication of effort. In this context, the Fast & Fair (2025) principles for a just transition provide a framework to ensure measures remain inclusive, transparent, participatory, and fairly distributed in their impacts.

5

Develop viable and inclusive business models. At the local level, long-term success depends on financial sustainability. Cities should promote collective investment models such as RECs and cooperatives, aggregate projects via group procurement or district approaches to reduce costs, and combine EU, national, and private funding sources (Pioletti et al., 2024; Beber, 2025).

Conclusion

A just energy transition must be understood as a sequenced and interdependent system in which technical, social, and institutional dimensions jointly determine outcomes. Rather than a linear shift driven solely by decarbonisation goals, the transition unfolds through a layered structure in which foundational conditions – such as energy literacy and social engagement – enable efficiency improvements, which in turn allow for renewable deployment and ultimately more advanced forms of shared energy systems such as Renewable Energy Communities (RECs) and Positive Energy Districts (PEDs).

The energy transition pyramid highlights that policy effectiveness depends on respecting this sequencing logic. Interventions at higher levels of the system cannot compensate for missing foundations, and premature focus on complex solutions risks reinforcing fragmentation and inequality rather than enabling systemic transformation. In this sense, structural interventions must precede compensatory ones, and enabling conditions must be actively built rather than assumed.

Within this framework, cities play a central role as implementation brokers, translating multi-level governance frameworks into place-based action and ensuring that technical deployment is embedded in social and institutional realities. Their capacity to coordinate actors, build trust, and integrate policy domains makes them essential for moving from abstract policy goals to operational energy systems.

Ultimately, inclusivity is not an inherent property of technologies such as energy efficiency measures, renewable energy systems, or community energy models. Instead, it is an outcome of system design, governance choices, and sequencing. The same instruments that can reduce inequality and empower citizens can also deepen exclusion if implemented without attention to access, participation, and local capacity.

A just and shared energy future therefore depends not only on accelerating technological deployment, but on deliberately designing transitions that are socially grounded, sequenced, and institutionally coherent from the outset.

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