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Transbuild Working Paper

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Decarbonising the building sector is critical to achieving climate neutrality in Europe, yet progress remains constrained by low renovation rates, continued reliance on fossil-based heating, fragmented governance, and persistent social and financial barriers. This paper examines which policy instruments and governance approaches are considered effective for building decarbonisation in the European Union and how these are perceived by stakeholders in Austria. It combines a structured literature review of recent research on EU and Austrian building decarbonisation with qualitative evidence from semi-structured interviews and a focus group involving stakeholders from public administration, housing, construction, civil society, and academia.

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The paper argues that building decarbonisation in Austria is primarily a governance and implementation challenge. Accelerating the transition therefore requires a stronger focus on the existing building stock, a reform of housing-related legal frameworks, improved coordination across governance levels, more predictable policy signals, strengthened implementation support, and explicit attention to affordability and social justice.

Keywords: building decarbonisation; heat transition; policy instruments; multi-level governance; housing policy; Austria; European Union

JEL Codes: Q48, Q54, Q58

1. Introduction

For several reasons the building sector has become a key focus of climate and energy policy in Europe. Buildings account for a substantial share of final energy consumption and greenhouse gas emissions in the European Union (EU), through space heating, hot water, cooling, and electricity use. Energy costs place a particular burden on lower-income households and raise the question of affordable housing. This aspect has gained more attention following the energy crises in recent years. Because of the long service life of buildings and the related impacts on future energy consumption and emissions, achieving climate neutrality depends not only on improving standards for new buildings but, above all, on accelerating the deep renovation[1] of the existing building stock and replacing fossil-based heating systems with low-carbon alternatives (Economidou et al., 2020; Maduta et al., 2023; Rosenow & Hamels, 2023). Latest developments like the energy crises following Russia's invasion of Ukraine and the Iran war highlighted that the building sector is not only highly relevant for achieving climate targets, but also for ensuring energy security and social equity. Furthermore, in this area technological options, governance, financing mechanisms, and individual household decisions intersect. Recent policy-oriented research also highlights that building decarbonisation should be understood not only as a climate and energy challenge, but equally as a housing policy issue shaped by affordability, resilience, and the lifecycle impacts of buildings, thereby requiring more integrated policy approaches across sectors and governance levels (Köppl et al., 2026).

Since the launch of the European Green Deal in 2019 the European Union has significantly strengthened its policy framework for building decarbonisation. With the Renovation Wave, the Fit for 55 package, and the recast of the Energy Performance of Buildings Directive (EPBD) policy ambition has increased and the focus was shifted from incremental energy efficiency improvements toward more comprehensive decarbonisation pathways. These include minimum energy performance standards, stronger requirements for energy performance certificates, the gradual move from nearly zero-energy buildings to zero-emission buildings, and stronger links between building policy, heating system transformation, and carbon pricing (Braungardt et al., 2023; D'Agostino et al., 2021; Maduta et al., 2025). At the same time, the literature consistently shows that policy ambition alone is insufficient. Renovation rates remain too low, heating transitions are uneven across Member States, and implementation gaps persist due to financial constraints, fragmented governance, behavioural barriers, and limited administrative and technical capacity (Bertoldi et al., 2021; Conforto, 2024; Maduta et al., 2023; Obergassel et al., 2023).

In this context Austria combines an ambitious national climate neutrality target for 2040, relatively strong standards for new buildings, and an accelerating uptake of renewable heating

[1] We understand deep renovation as a whole-building, integrated retrofit aimed at very large energy and emission reductions, typically through a coordinated package of envelope and systems upgrades. In Directive (EU) 2024/1275 (the recast EPBD), Article 2(20) defines deep renovation as: "a renovation which is in line with the 'energy efficiency first' principle, which focuses on essential building elements and which transforms a building or building unit: (a) before 1 January 2030, into a nearly zero-energy building; (b) from 1 January 2030, into a zero-emission building."

technologies with persistent weaknesses in the decarbonisation of the existing stock. In particular, insufficient deep-renovation rates, continued dependence on fossil gas in parts of the building sector, and fragmented regulation and implementation across federal states limit overall progress. There is a lack of sufficient ambition in the uptake of innovative building concepts for new buildings and renovation that combine efficiency, building technology, renewable energy use and serial renovation or even take a broader view on buildings for instance considering neighbourhood approaches. Austria therefore illustrates both the opportunities and the governance challenges of building decarbonisation: multiple support instruments coexist with fragmented implementation structures, varying regional approaches, persistent renovation bottlenecks, and unresolved questions concerning social justice, market design, and stakeholder coordination (Gerdes et al., 2025; Heidenthaler et al., 2022; Narula et al., 2022).

The growing policy relevance of building decarbonisation is also mirrored by an expanding academic literature on policy instruments, financing models, technological pathways, and social barriers. Existing research shows that effective building decarbonisation requires integrated policy mixes rather than isolated interventions. Regulatory standards, financial incentives, awareness raising and consultancy services, infrastructure planning, and social protection measures need to be coordinated in order to generate large-scale and socially acceptable renovation and heating system change (Barbosa & Almeida, 2025; Billerbeck et al., 2023; Edmondson et al., 2020; Keliauskaite et al., 2025; Rosenow et al., 2016).

Against this background, this paper analyses the following research question: Which policy instruments and governance approaches are considered effective for decarbonising buildings in the European Union, and how are these instruments, barriers, and enabling factors perceived and experienced by stakeholders in Austria? Therefore, the paper combines the following subquestions: (1) What does the recent literature identify as the main regulatory and policy instruments for building decarbonisation in the EU? (2) What barriers and enabling factors are most frequently discussed across the literature and across actor groups? (3) How do Austrian stakeholders assess the effectiveness, feasibility, and social acceptability of current and future policy approaches?

Methodologically, the paper combines a structured literature review with qualitative empirical research. The literature review summarises peer-reviewed studies and relevant analytical publications on EU and Member State (especially Austria) building decarbonisation, with particular focus on policy instruments, governance frameworks, barriers, and enabling conditions. To complement the results from the literature review, the empirical part draws on semi-structured interviews with a broad range of Austrian stakeholders, including public administration, actors from the construction and renovation sector, housing associations, energy utilities, NGOs, architects and researchers. These interviews are supplemented by a focus group designed to validate, contrast, and condense the main empirical findings across stakeholder perspectives. This mixed qualitative design makes it possible to connect macro-level policy developments and academic debates with actor perceptions, implementation realities, and governance challenges.

The paper contributes to the literature in three ways. First, it provides an up-to-date synthesis of the building decarbonisation literature. Second, it offers an empirically grounded analysis of

Austria as a federal case study embedded in the EU regulatory context. Third, by combining literature review and stakeholder evidence, it sheds light not only on what policies are discussed in research and regulation, but also on how these policies are perceived in practice.

The remainder of the paper is structured as follows. Section 2 synthesises the literature on barriers, enabling factors, and effective policy mixes. Section 3 reviews the evolution of regulatory frameworks and policy instruments for building decarbonisation in the EU and Austria. Section 5 presents the empirical methodology and findings from semi-structured stakeholder interviews and the focus group. Section 6 discusses the implications of the combined literature and empirical findings for policy design and governance in Austria and the EU. The final section concludes and outlines recommendations for future research and policy development.

2. Literature review

Building decarbonisation depends not only on overarching regulatory frameworks, but also on the concrete instruments, constraints, and technological options that shape implementation in practice. This chapter therefore reviews the literature on four interrelated dimensions: policy instruments used to drive renovation and heating system change, the main barriers slowing progress, the enabling factors that improve policy effectiveness, and the technological pathways underpinning the transition. Taken together, these dimensions help explain why building decarbonisation outcomes differ across contexts and why successful implementation requires coordinated policy mixes rather than isolated measures. The chapter also provides the analytical basis for interpreting the Austrian case and the empirical stakeholder findings in the following sections.

2.1 Methodological approach

This paper applies a structured literature review[2] methodology informed by the Reporting Standards for Systematic Evidence Syntheses (ROSES) framework. ROSES was developed specifically for environmental and sustainability research to promote transparency, reproducibility, and methodological rigour in systematic evidence synthesis (Haddaway et al., 2018). The approach is particularly suited to interdisciplinary fields such as sustainability policy, where research draws on multiple methodological traditions including policy analysis, governance studies, and socio-technical transition research.

The objective of the present literature review is to synthesise research on building decarbonisation in Europe, with particular emphasis on policy instruments, governance frameworks, barriers to deep renovation, enabling factors, and effective policy practices in EU Member States.

The literature search followed a structured protocol consistent with ROSES guidelines for systematic evidence synthesis (Haddaway et al., 2018). AI-assisted searches were conducted using

[2] Structured literature reviews aim to synthesise existing knowledge through transparent and replicable procedures for identifying, selecting, and analysing relevant publications (Snyder, 2019). Compared with traditional narrative reviews, structured approaches reduce the risk of selection bias and improve the reliability of conclusions by clearly documenting the search and screening process.

major academic databases commonly used in sustainability and energy policy research, including Scopus, and Google Scholar. In addition, a snowball literature search was added for sources with a focus on Austria (including grey literature) and proceedings of specific scientific conferences. The search focused primarily on publications published between 2020 and 2026 to capture recent developments in European climate and building policies.

Search terms were developed through preliminary scoping of the literature and were designed to capture studies addressing building decarbonisation, energy efficiency policies, and heating system transitions in the European context with particular focus on Austria. Details on search terms, inclusion and exclusion criteria, as well as limitations can be found in the annex.

The literature selection process followed a multi-stage screening procedure. First, the initial search produced a broad pool of publications from the selected databases. Duplicate records across databases were identified and removed. Second, titles and abstracts were screened to determine whether publications addressed building decarbonisation, energy efficiency policy, or related topics in the European context. Studies clearly unrelated to the research objectives or focussing on very specific issues or technological aspects were excluded at this stage. Third, full-text screening was conducted for the remaining publications. During this stage, studies were assessed to ensure that only relevant and high-quality sources were included in the final literature corpus.

The synthesis of the literature followed a qualitative thematic analysis approach. Publications were grouped into thematic clusters based on recurring research themes identified in the literature.

Five main thematic categories were identified:

1. Policy instruments and financing mechanisms
2. Barriers to deep renovation and heating system transformation
3. Supporting factors and effective policy practices in EU Member States
4. Technological pathways for building decarbonization
5. Policy framework and governance of building decarbonisation in the EU and Austria

The results from the literature review are summarised in the following sections.

2.2 Policy Instruments for building decarbonisation

The literature consistently shows that building decarbonisation depends on policy mixes rather than isolated instruments. Effective frameworks generally combine regulatory measures, financial support, organisational assistance, and long-term strategic planning (Barbosa & Almeida, 2025; Economidou et al., 2020; Lassandro et al., 2025; Maduta et al., 2023).

Regulatory instruments play a central role in shaping building sector transformation. Building codes, minimum energy performance standards (MEPS), and regulations governing heating technologies establish mandatory requirements that influence construction and renovation decisions. Increasingly, EU Member States are implementing policies to phase out fossil fuel heating systems, including bans on the installation of new fossil fuel boilers (Braungardt et al., 2023). Comparative studies of EPBD implementation show that regulatory ambition is

increasing, but the practical effects depend heavily on how these rules are implemented and enforced at national level (Maduta et al., 2023).

Financial instruments are central to overcome economic constraints to deep renovation and heating system replacement as these measures require substantial capital investment. Studies emphasise that large-scale investment is required to achieve EU decarbonisation targets, and that current investment levels remain insufficient (Bertoldi et al., 2025; Keliauskaite et al., 2025). Research on EU building finance highlights renovation subsidies, concessional loans, tax incentives, green mortgages, and other support instruments as essential for overcoming investment barriers, especially in residential buildings (Keliauskaite et al., 2025). At the same time, the literature increasingly stresses that financial effectiveness depends not only on the existence of subsidies, but also on the interdependencies between instruments and the governance structures in place. This includes the accessibility of support schemes, the combination of different types of instruments, and the degree to which public support can leverage private investment (Rosenov et al., 2016, Bertoldi et al., 2020).

Recent work adds a more specific argument: not all financing instruments are equally suitable for all segments of the building stock. Social housing, low-income housing, and buildings requiring coordinated multi-actor decisions (owner-occupied housing) often need more than standard subsidies. In these contexts, alternative finance, citizen finance, and hybrid funding models are discussed as potentially important complements to conventional public support (Brown & Watson, 2022; Topouzi, 2024). Likewise, energy-efficiency mortgages are discussed as a specific sustainable finance tool that can connect energy performance improvements to household borrowing conditions (Dell'Anna et al., 2022).

Carbon pricing mechanisms represent another important economic instrument. The extension of the EU Emissions Trading System to buildings and transport (ETS2) is expected to increase incentives for reducing fossil fuel consumption in buildings (Braungardt et al., 2023). However, research indicates that carbon pricing alone is insufficient to drive large-scale renovation due to the long investment cycles and behavioural barriers present in the building sector.

Another important group of instruments includes organisational and informational support. One-stop shops, integrated home renovation services, renovation passports, and structured advisory services are intended to reduce transaction costs and lower the complexity of renovation decisions. This strand of literature suggests that building owners often do not fail to renovate due to missing incentives, but because the process itself is too complex, decision making is complicated by a lack of information on technical requirements and adequate decision-making tools, and because deep renovation projects are administratively burdensome. One-stop shops therefore matter not only as information providers, but as practical coordination mechanisms linking technical advice, funding access, sequencing of measures, and implementation support (Bertoldi et al., 2021). More recent work deepens this perspective by treating one-stop shops as implementation platforms rather than merely advisory structures. These studies emphasise that scaling integrated home renovation services requires bundling technical support, financing guidance, sequencing of measures, and trust-building functions (Milin & Bullier, 2021; Refabert et al., 2021, Bertoldi et a., 2021).

2.3 Barriers to building decarbonisation

Despite technological progress and expanding policy frameworks, several barriers continue to slow the decarbonisation of the building sector. Economic barriers remain particularly significant, as renovation projects often require substantial upfront investments and involve long payback periods with uncertain returns (Galvin, 2024; Galvin & Galvin, 2025). Research shows that deep renovation projects often involve costs that are substantially higher than conventional maintenance or incremental renovation measures (Keliauskaite et al., 2025), which discourage households, landlords, and firms from taking action. Even where lifecycle savings appear favourable, many actors are unwilling or unable to absorb short-term financial burdens of comprehensive renovation projects. This challenge is particularly pronounced in residential buildings, where renovation decisions are typically made by individual homeowners with limited access to capital.

Recent literature confirms that cost-effective renovation and heating decarbonisation measures are still not adopted, due to persistent interactions between financing constraints, behavioural inertia, social norms, split incentives, and institutional barriers (George et al., 2023; Lassandro et al., 2024; Niknafs et al., 2024).

Access to financing is one major financial barrier to building renovation. Many building owners lack sufficient financial resources, while traditional financing mechanisms are often poorly adapted to energy efficiency investments. This financing gap is particularly evident in multi-apartment buildings and social housing, where renovation decisions involve multiple stakeholders and complex ownership structures. In such cases, obtaining loans or coordinating investment decisions can be difficult. As a result, many potentially cost-effective renovation projects remain unrealised. In response to these challenges, innovative financing mechanisms are increasingly being explored. Energy efficiency mortgages, on-bill financing schemes, and energy performance contracting models aim to reduce financial barriers by spreading renovation costs over time and linking repayments to energy savings (Bertoldi et al., 2021; Bianco & Sonvilla, 2021).

Market fragmentation represents another major barrier. Renovation markets involve multiple stakeholders—including building owners, contractors, financial institutions, and public authorities—whose incentives are often misaligned (Lassandro et al., 2024).

The landlord–tenant dilemma remains one of the most persistent structural barriers which arises from misaligned incentives between property owners and tenants. In rental housing, landlords bear renovation costs while tenants benefit from lower energy bills. This split incentive discourages landlords from investing in energy efficiency improvements. Research shows that the landlord-tenant dilemma significantly slows renovation activity in rental housing markets, particularly in urban areas where rental housing represents a large share of the building stock (George et al., 2023). Addressing this issue requires policy interventions that align incentives between landlords and tenants, such as regulatory standards in combination with adequate cost-sharing mechanisms. Newer discussions suggest that collective self-consumption and revised cost-allocation models may offer partial solutions, but the basic split-incentive problem remains highly relevant (Braungardt et al., 2023; Domenig et al., 2024).

Distributional concerns and energy poverty have also become more prominent in the literature. Low-income households often live in the least efficient buildings and face the greatest difficulty in financing renovation or changing heating systems. As a result, policies such as carbon pricing, if introduced without strong support measures, may generate regressive effects and social resistance. Recent studies explicitly link decarbonisation policy to energy poverty, showing that the effectiveness and acceptance of building policy increasingly depend on whether vulnerable households are protected and included. Studies emphasise that targeted subsidies and financial support programmes are essential to ensure a socially just transition in the building sector (Behr et al., 2026; Müller et al., 2024; Rogulj et al., 2023; Noka et al., 2022). The same point is emphasised by contributions, which argue that CO_2 pricing must be analysed not only in terms of emissions efficiency but also in terms of distributional outcomes and affordability (Schumacher et al., 2022). A particularly important aspect in this context concerns social housing. In this segment, energy vulnerability, operating costs, and decarbonisation investment are closely intertwined (Mafalda Matos et al., 2022). The literature increasingly suggests that the assessment of affordability has to include operating costs, rent structures, and household budgets. This widens the understanding of barriers from "lack of capital" to broader questions of social protection and cost distribution (Großklos & Loga, 2021).

This broader housing perspective also strengthens the argument that affordability should be treated as a structural dimension of building decarbonisation rather than a secondary side effect. Recent work emphasises that housing related expenses already represent one of the largest expenditure items for households in Europe and that decarbonisation strategies will only be feasible if they reduce long-term user costs rather than merely shifting investment burdens. In this view, the relevant question is not only how to finance renovation, but how to integrate climate objectives with housing affordability and social resilience across the life cycle of buildings (Köppl et al., 2026).

Institutional and structural barriers also play an important role. Existing infrastructure systems, regulatory frameworks, and market structures create path dependencies that can slow down the adoption of low-carbon technologies. Research on heating sector transitions highlights the concept of transition inertia, where existing technological and institutional structures constrain system transformation (Semb et al., 2026). Multi-level governance structures in the EU create challenges in coordinating policies across EU, national, regional, and local levels. Differences in national policy frameworks and administrative capacity lead to inconsistent implementation of EU directives (Obergassel et al., 2023). A further insight is that technology deployment is politically mediated. Even when low-carbon technologies are technically mature, their uptake can be slowed or contested by public narratives, social conflict, and poorly sequenced regulation. The recent German debate around the Buildings Energy Act has been used as an example of how heating transition policies can become politically destabilising if distributional effects, communication, and implementation burdens are not handled carefully (Braungardt et al., 2024). This reinforces the broader conclusion that technological pathways must be analysed together with governance and public legitimacy.

2.4 Supporting factors and enabling conditions

In addition to barriers, the literature identifies several enabling factors that can accelerate building decarbonisation and increase public acceptance. A frequent conclusion across the literature (e.g. Keliauskaite et al., 2025; Maduta et al., 2023; Böheim et al., 2025; Narula et al., 2023; Rosenow et al., 2016) is that stable and credible long-term policy signals are essential. Actors throughout the renovation chain - households, landlords, contractors, financiers, technology providers - require predictability in order to make long-term decisions. Regulatory clarity on heating transitions, stable funding conditions, and credible long-term renovation trajectories can therefore act as important enabling conditions.

A second enabling factor is the availability of integrated support structures. The literature on one-stop shops and integrated renovation services shows that households are more likely to engage in deep renovation when complex technical, financial, and administrative processes are simplified and bundled (Bertoldi et al., 2021; Elgendy et al., 2024). Réfabert et al., (2021) or Milin – Bullier, (2021) strengthen this argument by suggesting that scaling integrated renovation services across Europe may be a promising policy approach, particularly where markets remain fragmented and household decision-makers face low institutional capacity.

Third, the literature increasingly points to financing ecosystems as enabling conditions. Rather than viewing subsidies, loans, and capital-market instruments separately, recent work suggests that their interaction determines whether renovation becomes investable at scale (Keliauskaite et al., 2025). This includes not only state support but also sustainable finance classification, credit conditions, social housing finance, and alternative finance models (Conforto – Hummel, 2024).

Fourth, social fairness is increasingly understood as an enabling factor as policies designed to protect vulnerable households, reduce energy poverty, and distribute costs fairly, contribute to achieving public acceptance and upscaling of project implementation (Behr et al., 2026; Kettner et al., 2026; Klingler et al., 2025; Müller et al., 2024; Noka et al., 2022). The enabling role of social housing finance is increasingly emphasised in this context. Alternative finance and citizen-finance models are discussed as potentially valuable complements to traditional subsidy regimes, particularly where renovation in social housing requires socially legitimate and locally embedded funding arrangements (Brown – Watson, 2022, Topouzi et al., 2024). Decentralised energy systems and renewable energy communities can support citizen participation and local energy transitions. These models allow communities to produce and share renewable energy locally while reducing energy costs (Frieden et al., 2021; Krug et al., 2022).

Finally, workforce capacity, training, and stakeholder cooperation function as enabling conditions. Building decarbonisation at scale depends on a human capital capable of designing, financing, coordinating, and implementing complex renovation and heating transitions. The literature on skills, training, and institutional ecosystems suggests that policy effectiveness is strongly conditioned by whether these capacities are deliberately developed rather than assumed to emerge automatically (Koukou et al., 2025).

2.5 Technological pathways for building decarbonisation

Technological innovation represents a key component of building sector decarbonisation. The literature identifies several technological pathways capable of significantly reducing building emissions. The literature widely emphasises that heating system change alone is insufficient. Deep renovation of building envelopes remains necessary to reduce heat demand and improve the effectiveness of low-carbon heating systems. Improvements to building envelopes, insulation, windows, and ventilation systems can significantly reduce heating requirements (Mc Guire et al., 2024). Industrialised renovation methods such as prefabricated building elements are increasingly being explored as a way to accelerate renovation processes and reduce costs[3] (Secondo-Maglia et al., 2024). However, another strand of literature contests the prioritisation of fabric improvements arguing that there is uncertainty about the optimal balance between heat demand reduction and heat supply decarbonisation and the focus on deep renovations could slow down building decarbonisation (Eyre et al., 2023; Gillett et al., 2025; Rosenow & Hamels, 2023).

Electrification of heating systems, particularly through the deployment of heat pumps, is widely considered a central pathway for decarbonising residential heating. Modelling studies demonstrate that large-scale heat pump deployment can substantially reduce emissions when electricity systems are increasingly supplied by renewable energy sources (Arvanitopoulos et al., 2025; Eyre et al., 2023; Thomaßen et al., 2021). Regulatory frameworks supporting heat pump adoption therefore play an important role in accelerating heating sector transformation (Adamo et al., 2024).

District heating systems represent another important decarbonisation pathway, particularly in densely populated urban areas. Policy frameworks supporting district heating expansion have been implemented in several European countries, although deployment remains uneven across regions (Billerbeck et al., 2023). At the same time, studies highlight barriers related to infrastructure costs, regulatory complexity, and technological competition (Sneum et al., 2025).

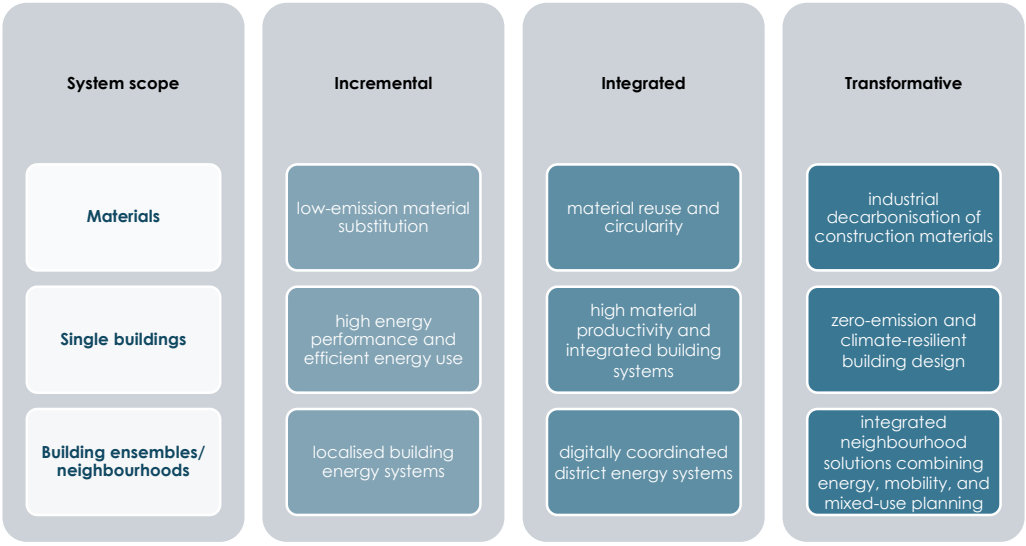
Recent literature also adds a novel point: energy performance should not be addressed only at the individual building level, but increasingly at district, quarter and neighbourhood scale. These approaches can improve coordination between building renovation and local energy infrastructure, enable more coherent integration of district heating, renewable generation, and storage, and reduce transaction costs through spatial clustering of projects (Rosenow & Hamels 2023). Recent work on district-level policy instruments highlights that area-based renovation can create organisational and financial advantages that are difficult to achieve through isolated building-level interventions (Mlecnik & Hidalgo-Betanzos, 2022). This perspective is reinforced by research on integrated urban decarbonisation, which shows that linking building policy with local planning and urban governance can strengthen implementation

[3] One such innovative example is the project "RENVELOPE - Energy Adaptive Shell" (https://renvelope.at/reports/; accessed 21.05.2026) which aims for developing a cost-efficient, circular, all-in-one solution for upgrading the existing building stock by conditioning buildings from an outer shell. As tested in several demonstration projects the approach combines serial, multifunctional CO_2 -neutral building renovation with integrated, intelligently controlled building technology.

capacity and facilitate more systemic transition pathways (Urrutia-Azcona et al., 2021). These findings are consistent with recent reviews of multi-building retrofitting and zero-emission neighbourhood renovation, which identify economies of scale, better infrastructure alignment, and improved coordination as important advantages of neighbourhood-based approaches (Bjelland et al., 2024; Kertsmik et al., 2025).

This perspective is reinforced by recent policy analysis arguing that future-proof building decarbonisation should increasingly move from isolated building-level interventions toward integrated approaches for groups of buildings and neighbourhoods. Such approaches are seen as particularly relevant where localised energy systems, low-temperature heating and cooling networks, mixed-use planning, and reduced mobility demand can be combined. This supports the argument that the technological transformation of buildings should not be understood solely in terms of envelope renovation or heating system replacement, but also in terms of spatial and infrastructural integration (Köppl et al., 2026). Thus, building decarbonisation can be conceptualised not only through individual technologies, but also through the system level at which interventions occur and the ambition with which they are pursued. Figure 1 illustrates this by distinguishing between material-level, single-building, and building-ensemble approaches, and by differentiating between incremental, integrated, and transformative approaches.

Figure 1: Scope and ambition in the transformation of buildings



Source: own illustration; adapted from Köppl et al. (2026).

In addition to operational emissions, recent research increasingly emphasises the importance of lifecycle emissions in buildings. Life cycle assessment studies demonstrate that embodied carbon in construction materials can represent a significant share of total building emissions in highly energy-efficient buildings, highlighting the need for policies addressing whole-life carbon (Maierhofer et al., 2022). Recent research also indicates that building decarbonisation should increasingly address embodied emissions alongside operational energy use, particularly as high-efficiency buildings reduce the relative importance of use-phase emissions. Evidence from

Austria suggests that major reduction potentials lie in improved cement and concrete production, greater use of recycled materials, renewable energy in material production, and increased timber and hybrid construction, although these pathways vary in scalability across building types and supply chains (Kettele et al., 2026). More broadly, this implies that technological pathways for building decarbonisation need to be framed through a life-cycle perspective, extending beyond heating systems and envelope performance to include material choice, construction methods, and economy-wide supply-chain effects.

3. Policy Framework for the Decarbonisation of Buildings

Reducing emissions from buildings is essential for achieving the EU's climate neutrality objectives and intermediate emission reduction targets. Recent research emphasises that building decarbonisation requires a comprehensive transformation involving regulatory frameworks, financial mechanisms, technological innovation, and behavioural change (Barbosa & Almeida, 2025; Bertoldi et al., 2025; Gillett et al., 2025; Maduta et al., 2023). The literature thus increasingly frames building decarbonisation as a systemic transition that extends beyond improvements in energy efficiency and technological upgrades.

3.1 EU policy frameworks for building decarbonization

The governance of building decarbonisation in the European Union has become markedly more integrated since the European Green Deal and the Fit for 55 package. While earlier EU intervention focused mainly on building energy efficiency, the current framework increasingly links renovation policy, heating and cooling decarbonisation, renewable energy deployment, carbon pricing, and social compensation. Building decarbonisation is thus no longer governed solely through sector-specific building regulation, but through a broader climate policy architecture that combines binding emissions targets, market-based instruments, planning obligations, and social policy mechanisms (Böheim et al., 2025; Maduta et al., 2023; Nevara, 2025).

Recent policy-oriented literature further suggests that building decarbonisation in the EU should be framed not only as a climate and energy issue, but also as a housing policy challenge shaped by affordability, resilience, and material use. In this perspective, the existing EU framework already contains many of the main regulatory levers through climate policy, the EPBD, the EED, the RED, carbon pricing, and product-related regulation, but the central challenge lies in integrating these instruments more systematically around the combined objectives of climate mitigation, social affordability, and long-term resilience (Köppl et al., 2026). This broadens the policy discussion beyond operational energy demand toward the full life cycle of buildings, including embodied emissions, material productivity, and the wider social consequences of housing costs.

At the overarching level, the European Climate Law and the Fit for 55 package establish the strategic direction for emissions reductions in the building sector. The Effort Sharing Regulation remains particularly important because it assigns binding national emission reduction targets for sectors outside the original EU Emissions Trading System, including buildings. At the same time, the revised Energy Efficiency Directive (EED) strengthens the "energy efficiency first" principle and expands obligations related to heating and cooling, thus broadening the

governance of building decarbonisation beyond individual buildings toward local energy planning and infrastructure development (Böheim et al., 2025).

The Energy Performance of Buildings Directive (EPBD) forms the core regulatory framework governing building energy performance in the EU. The directive requires Member States to implement building energy standards, energy performance certification schemes, and long-term renovation strategies for improving the energy efficiency of the existing building stock (Maduta et al., 2023; Olasolo-Alonso et al., 2023).

Research shows that the EPBD has played a significant role in improving building energy standards across Europe, particularly through the introduction of Nearly Zero-Energy Building (NZEB) requirements for new construction (D'Agostino et al., 2021). However, the transition toward zero-emission buildings (ZEBs) reflects an evolving policy focus that extends beyond operational energy consumption to include renewable energy integration and lifecycle emissions (Maduta et al., 2025).

The broader EU climate policy architecture, including the European Green Deal and the Fit for 55 legislative package, has further strengthened the role of building decarbonisation in the European climate strategy (Kulovesi & Oberthür, 2020; Oberthür & von Homeyer, 2023). These policy frameworks emphasise deep renovation of existing buildings, electrification of heating systems, and large-scale deployment of renewable energy technologies.

Despite this comprehensive regulatory framework, studies consistently identify substantial variation in implementation across Member States. Differences in governance structures, administrative capacity, and policy ambition levels result in uneven progress toward building sector decarbonisation across Europe (Maduta et al., 2023, Obergassel et al., 2023).

The Renewable Energy Directive (RED) complements this framework by requiring a rising share of renewables in heating and cooling and by supporting the modernisation of district heating systems, the use of waste heat, and decentralised renewable energy solutions. Together, the EPBD, EED, and RED indicate a shift from an efficiency-only approach to a combined demand-and-supply transformation of the building sector, in which energy savings, low-carbon heat supply, and infrastructure planning must be addressed simultaneously (Böheim et al., 2025; Rosenow & Hamels, 2023).

Additional incentives for building sector decarbonisation is expected to result from the new emissions trading system for buildings and road transport (ETS2), scheduled to become operational in 2028. However, both the literature and recent policy analysis emphasise that the regressive nature of carbon pricing gives rise to distributional concerns as heating demand is relatively inflexible in the short term and cost burdens may fall disproportionately on lower-income households and vulnerable regions. The Social Climate Fund and comparable measures are therefore crucial complements to ETS2, linking carbon pricing with targeted support for vulnerable households and other affected groups (Böheim et al., 2025; George et al., 2023; Kettner et al., 2026; Müller et al., 2024; Perdana & Vielle, 2026; Rogulj et al., 2023).

The EU's sustainable finance agenda adds another indirect incentive for building decarbonisation by steering private capital toward low-carbon construction and renovation. In particular, the EU Taxonomy establishes common sustainability criteria for activities such as new

buildings, renovation, and building ownership, while disclosure rules increase the strategic importance of taxonomy-aligned assets for investors and lenders (Regulation (EU) 2020/852; Commission Delegated Regulation (EU) 2021/2139; Regulation (EU) 2019/2088). Recent research suggests that the sustainable finance layer can complement traditional building policies by improving transparency, reducing greenwashing, and supporting the mobilisation of private finance for building renovation and decarbonisation (Bertoldi et al., 2021; Keliauskaite et al., 2025).

Overall, the EU policy framework for building decarbonisation has become more coherent and ambitious, but also more institutionally complex. Its effectiveness increasingly depends on Member States' capacity to translate overlapping EU instruments into coordinated national policy mixes. The literature therefore points to implementation capacity, administrative coordination, and policy integration as central determinants of success (Maduta et al., 2023; Obergassel et al., 2023).

3.2 Austrian policies and governance for building decarbonisation

Austria provides a particularly relevant case for analysing the implementation of EU building and heating decarbonisation policies because it combines ambitious national climate goals with a fragmented federal governance structure. Austria has committed to climate neutrality by 2040, thereby exceeding the EU-wide 2050 target. At the same time, however, the implementation of building and heating policies is shaped by the division of competences between the federal level and the Länder, making Austria an ambitious but institutionally constrained case (Narula et al., 2022; Gerdes et al., 2025; Böheim et al., 2025).

Austria's building policy framework is closely embedded in EU law, particularly the EPBD, EED, RED, and the Effort Sharing Regulation. Austria's national climate policy framework is defined through several strategic documents, including the National Energy and Climate Plan (NECP), and the Long-Term Renovation Strategy. These policy frameworks outline pathways for reducing greenhouse gas emissions in the building sector through energy efficiency improvements and the transition to renewable heating systems. Research analysing Austrian building decarbonisation pathways indicates that achieving climate neutrality requires significant increases in renovation rates combined with large-scale adoption of low-carbon heating technologies (IIBW & UBA, 2025; Narula et al., 2022).

In practice, however, the Austrian approach has historically relied more strongly on financial incentives and voluntary uptake than on stringent regulatory obligations for the existing stock. This distinguishes Austria from some other European countries that combine support schemes with binding performance standards or mandatory phase-out schedules[4] (Narula et al., 2022; Böheim et al., 2025).

A recent development is the Renewable Heat Act, which entered into force in 2024 and prohibits the installation of fossil heating systems in new buildings. Although this represents a clear

[4] EU countries that have at least partially banned fossil fuel heating systems from existing buildings include Finland, Denmark, the Netherlands and parts of Belgium (https://ehpa.org/news-and-resources/news/whos-banning-fossil-fuel-boilers/; retrieved 07.05.2026)

legal signal, its transformative effect is limited by the fact that it does not impose a comprehensive phase-out for fossil heating systems in the existing stock (focussing on single family and detached houses), where most emissions arise. As a result, Austrian heating decarbonisation still relies primarily on financial support rather than binding regulatory transformation of the installed stock (Böheim et al., 2025 Gerdes et al., 2025).

This support-oriented policy mix is most visible in the federal subsidy schemes for heating replacement and renovation. Austria has introduced substantial financial support for replacing fossil heating systems with heat pumps, district heating, biomass, or solar thermal technologies. A major national programme is "Raus aus Öl und Gas", which provides substantial subsidies for replacing fossil fuel heating systems with renewable alternatives such as heat pumps, district heating, or biomass heating systems. Evaluations suggest the programme significantly increased heat pump adoption but also revealed supply chain constraints and installer shortages (Biermayr et al., 2025). The programme has been expanded significantly between 2022 and 2024 in response to the European energy crisis and the objective of reducing dependence on fossil fuels. However, budgetary restrictions led to the introduction of a more restricted funding model with reduced subsidy rates in 2025.

For low-income households, dedicated programmes[5] can cover a very large share of total costs. These schemes have become a driver of heating system replacement and are frequently identified as one of the main strengths of the Austrian approach, particularly from a social policy perspective (Böheim et al., 2025; Müller et al., 2024).

At the same time, Austria's federal structure creates a second layer of policy variation. The Länder provide additional subsidies, building regulations, and implementation programmes tailored to regional conditions such as climate, biomass availability, or district heating potential. While this allows context-specific policies, it also leads to uneven support structures and administrative complexity. Studies highlight that variations in regional policies, administrative procedures, and enforcement mechanisms can create institutional fragmentation and complicate policy implementation (Narula, et al., 2022; Gerdes et al., 2025). This fragmentation has been repeatedly identified as a constraint on policy coherence and accessibility, especially for actors operating across regional boundaries (Narula et al., 2022; Böheim et al., 2025).

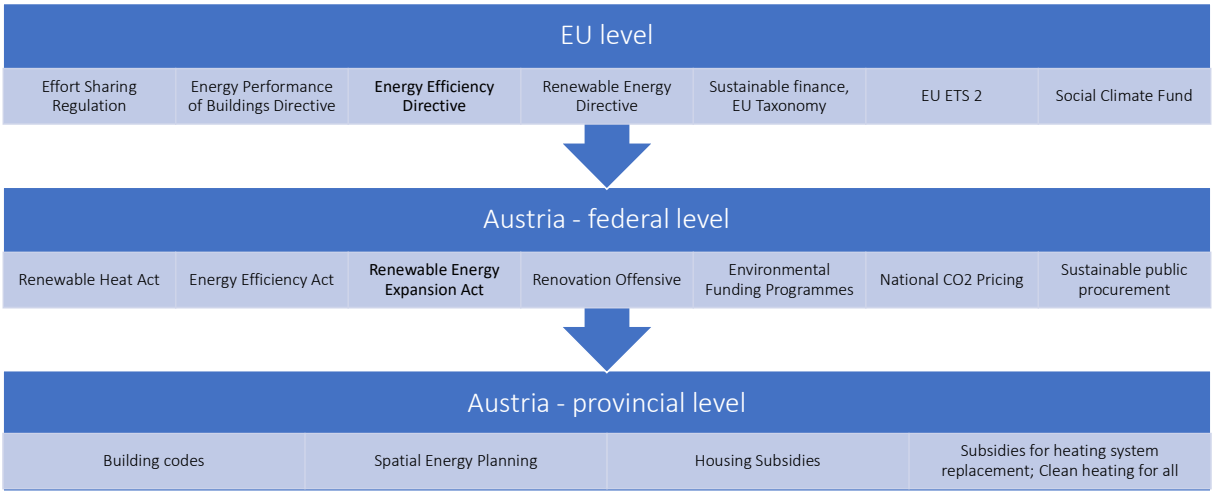
Austria's Renewable Energy Expansion Act adds a further dimension by supporting decentralised renewable electricity generation, storage, and energy communities. Although not limited to the building sector, it is relevant to building decarbonisation because heating electrification, rooftop photovoltaics, and local renewable supply are increasingly interdependent. However, the practical uptake of decentralised energy communities in the heating domain has been slower than expected due to regulatory and administrative hurdles (Böheim et al., 2025).

The overall policy landscape for building decarbonisation in Austria is shaped by a dense and increasingly interdependent multi-level governance structure in which EU legislation, federal

[5] "Sauber heizen für alle" is an Austrian subsidy program that covers up to 100% of the costs for low-income households (owners of single-family houses or detached houses below certain income thresholds) to replace fossil fuel heating with renewable systems like heat pumps or district heating. For the subsidy free energy consultation is mandatory.

policy, and provincial implementation interact (see Figure 2). The EU framework provides strategic direction and increasing regulatory pressure, particularly through the EPBD, EED, RED, the Effort Sharing Regulation, and the forthcoming ETS2. However, these EU instruments do not operate directly in a uniform manner; rather, their effectiveness depends on how they are translated into national law, subsidy schemes, planning frameworks, and administrative routines (Maduta et al., 2023; Böheim et al., 2025).

Figure 2: Illustrative overview of multi-level governance and policy instruments for the decarbonization of buildings



Source: own illustration.

At the Austrian federal level, this translation has produced a policy mix that is focused on financial support but is less comprehensive in terms of binding obligations for the existing stock, where the largest decarbonisation challenge remains (Böheim et al., 2025; Gerdes et al., 2025; Narula et al., 2022). Austria's federal government provides strategic direction, and recent legislation such as the Renewable Heat Act signals a move away from fossil heating at least in new buildings.

Austria's federal structure introduces a further layer of complexity. The Länder play a central role in building regulation, implementation, and complementary support programmes. This allows adaptation to regional conditions, such as differences in topographical features, population density, biomass availability, district heating potential, and socio-economic structure. However, it also generates fragmentation, as households, firms, and authorities face varying rules, incentives, and administrative requirements across provinces. The resulting heterogeneity can reduce transparency, raise transaction costs, and complicate the scaling of renovation and

heating system change across the country[6] (Böheim et al., 2025; Heidenthaler et al., 2022). This fragmentation affects the accessibility of support schemes, the consistency of implementation, the comparability of standards, and the predictability of investment conditions. In practice, the policy environment appears complex and difficult to navigate, especially for private households, building owners, and smaller market actors.

Summarising, the Austrian building decarbonisation landscape can be characterised as an increasingly ambitious but institutionally fragmented multi-level system. The EU provides the strategic and regulatory framework, the federal level supplies major elements of funding and legislative direction, and the provinces shape practical implementation. The central governance challenge is therefore not the absence of policy instruments, but their coordination, simplification, and consistent operationalisation. The acceleration of building decarbonisation will thus require improved coherence across governance levels, reduced administrative complexity and ambitious yet socially inclusive policy design.

4. Stakeholder Perspectives on Building Decarbonisation in Austria

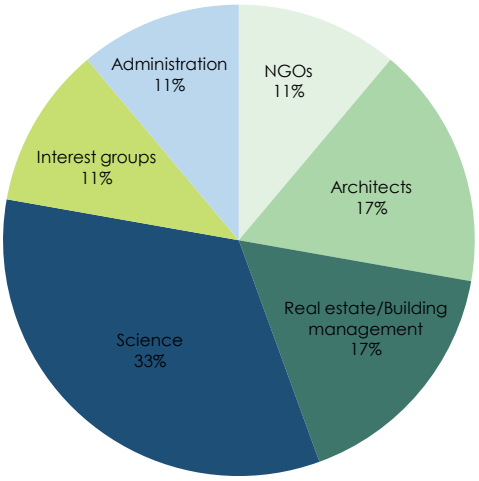
4.1 Insights from interviews with relevant stakeholders

This section assesses how key stakeholders perceive the decarbonisation of the building sector in Austria. It focuses on questions of relevant regulations, implementation barriers, conflicts of objectives, actor constellations, and possible solution approaches. To this end 17 interviews were conducted with a total of 21 stakeholders. The development of the interview guide was based on the results of the previously described literature review. The aim was to examine the institutional and political conditions of building decarbonisation in Austria from a stakeholder perspective.

The analysis is based on qualitative expert interviews with actors from public administration, the housing sector, building management, architecture, academia, interest groups, NGOs, and industry organizations, all of whom are involved in different ways in the decarbonisation of the Austrian building sector (Figure 3). The sample was not intended to be representative but rather to capture a broad range of institutional perspectives on regulations, implementation barriers, and solution approaches. The interviews were conducted online, using a semi-structured format.

[6] For instance, several regional databases for Energy Performance Certificates (EPC) exist and various software tools for their calculation are used. However, no mechanisms are in place for centralising the information on a national level or standardising calculation methods (Heidenthaler et al., 2022).

Figure 3: distribution of interviewees across stakeholder groups



Source: own illustration. N=21.

The analysis was carried out based on interview transcripts using MAXQDA. Methodologically, the analysis follows a thematic structuring qualitative content analysis. The coding system was developed deductively from the research questions (see Annex 2), and the interview guide was further differentiated inductively during the analysis. Coding was conducted across cases and comparatively in order to identify recurring patterns of interpretation, lines of conflict, and proposed solutions across different actor groups. The findings should therefore be understood as an analytical condensation of expert perspectives.

Cross-case coding shows that, despite the different institutional positions of the interviewees, their statements converge around several central problem areas. Most notably, the importance of the existing building stock, the key role of regulatory frameworks, especially of housing law, the ambivalence of subsidy-based instruments, questions of affordability, and deficits in political and administrative coordination stand out clearly. At the same time, the material contains a broad spectrum of proposed solutions, ranging from housing law reform and regulatory measures to spatial planning and technical strategies.

First, the existing building stock is described across almost all interviews as the key lever for transformation. While new construction is considered easier to regulate, the actual decarbonisation challenges are located in the existing stock. Interviewees repeatedly point out that renovation rates are too low, and that current progress is insufficient to meet climate targets. Many statements highlight the need to prioritise refurbishment, heating system replacement, and efficiency improvements in the existing stock much more strongly. Key technical solutions mentioned include thermal refurbishment, with potential cost reductions through the use of prefabricated façade systems, the replacement of fossil heating systems and the centralization of heat supply in multi-unit buildings through district heating, heat pumps, ground-source systems and anergy networks. However, technical issues are rarely discussed in isolation; rather, they are almost always linked to regulation, cost allocation, and planning.

Second, the analysis highlights the major importance of regulatory frameworks (Figure 4). At the European level, the Energy Performance of Buildings Directive (EPBD), the EU Taxonomy, the Green Deal, the Corporate Sustainability Reporting Directive (CSRD)[7], and carbon price-related instruments such as emission trading are described as important drivers. These instruments increase pressure on public and private actors and create new requirements concerning sustainability reporting, development of target pathways, as well as building and investment assessment. At the national level, the focus is put primarily on legal framework conditions like the Tenancy Act (Mietrechtsgesetz, MRG), the Condominium Act (Wohnungseigentumsgesetz, WEG), the Limited-Profit Housing Act (Wohngemeinnützigkeitsgesetz, WGG), the Heating Costs Billing Act (Heizkostenabrechnungsgesetz, HeizK-G), the Renewable Heat Act (Erneuerbare-Wärme-Gesetz, EWG), and OIB (Austrian Institute of Construction Engineering) guidelines. On the regional level housing subsidies and the respective requirements regarding thermal qualities and heating systems are regarded as relevant instruments.

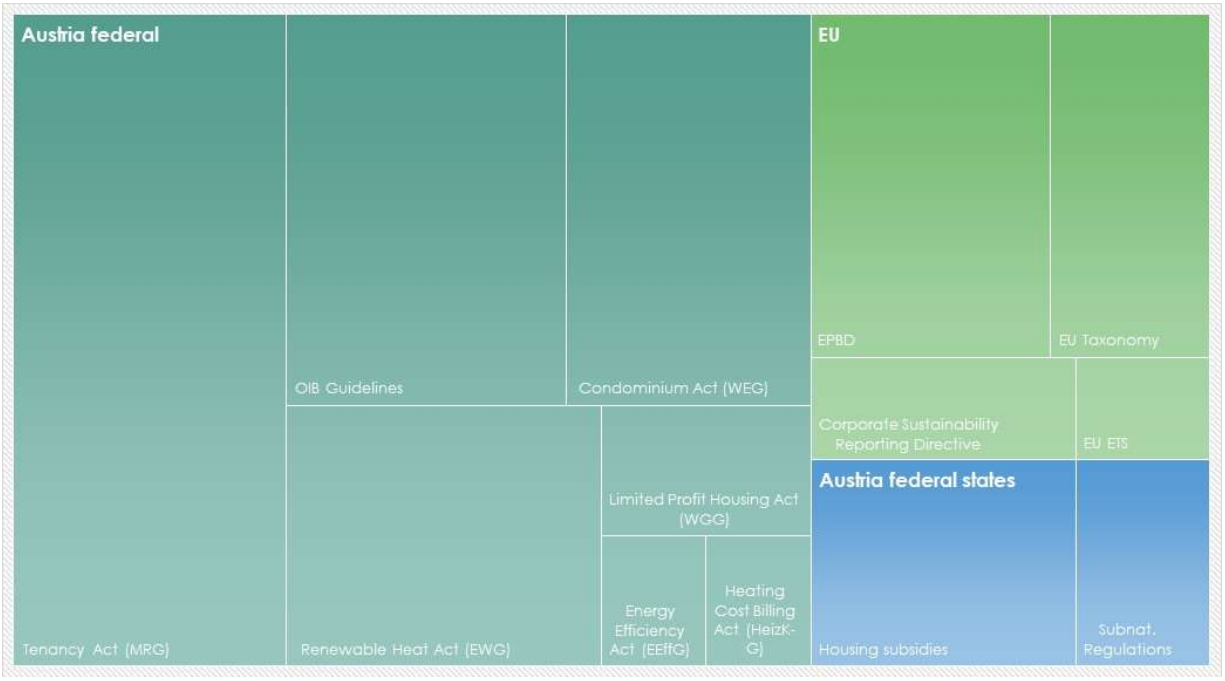
While European regulations are widely perceived as drivers, their Austrian implementation is often seen as fragmented, inconsistent, or insufficiently binding. The main legal barriers to building decarbonisation are perceived to lie in the Tenancy Act (MRG), the Condominium Act (WEG), and related cost-allocation rules, as these often separate investment responsibility from benefits, make collective decisions difficult, and limit the ability to implement or refinance heating system replacement and deep renovation in multi-unit buildings. Additional barriers arise from the fragmented implementation of building-related regulation across federal states, the complexity and volatility of subsidy schemes, and the lack of an obligation to exchange fossil fuel heating systems in the existing stock in the Renewable Heat Act (EWG). Other instruments such as housing subsidies, OIB guidelines, and elements of the WGG, where these provide stricter or uniform standards and financial support, particularly in the limited-profit housing sector, are widely regarded as enabling factors.

Third, housing law emerges as a particularly relevant barrier for decarbonisation in multi-unit residential housing. Recurring issues include insufficient toleration obligations, majority rules, consent requirements, and limited possibilities for passing on costs. Interviewees thus describe a situation in which investment responsibility, distribution of benefits, and decision-making power are institutionally decoupled. Accordingly, the most pronounced legal reform proposals concern housing law: interviewees call, in particular, for stronger toleration obligations (so-called Duldungspflichten), more practicable rules for cost pass-through, majority decision-making instead of unanimity under condominium law, reforms of reserve and maintenance contributions, and improved legal conditions for collective heating and electricity-based solutions. Mandatory replacement requirements for fossil heating systems are also repeatedly mentioned as necessary levers.

[7] In the meantime, however, the EU Omnibus simplification package reduced reporting and disclosure requirements. In the context of buildings, this means fewer firms must provide detailed disclosures on activities such as energy-efficient renovation and taxonomy-aligned building investments, thus reducing incentives for corporate building decarbonisation.

Fourth, cost and financing issues constitute another relevant form of barriers. Interviewees refer to high construction and renovation costs, a lack of economic feasibility, insufficient incentives, and uncertainties regarding amortisation and refinancing. The latter is exacerbated by unstable regulatory conditions and frequently changing subsidy programmes. At the same time, the interviewees emphasise that economic viability in the building sector is politically and regulatorily shaped. Frequently mentioned solution approaches therefore include cost transparency, more comprehensive assessments through stronger consideration of carbon costs, life-cycle assessments (LCA) or total cost of ownership. Other enabling factors include sustainable finance approaches like the introduction of brown penalties for emission-intensive building stocks, or carbon budgets for buildings. Several respondents stress the fact that decarbonisation becomes more economically feasible when long-term operating, material, and emissions costs are considered alongside initial investment costs.

Figure 4: Regulations and instruments regarded as relevant for building sector decarbonisation



Source: own illustration. The larger the area shown, the more often the regulations were mentioned.

Fifth, subsidies are assessed ambivalently. On the one hand, they are seen as indispensable, since many measures would not be implemented without public support. On the other hand, they are described as volatile, complex, in parts poorly coordinated, and not always sufficiently targeted. Subsidies are therefore considered useful by interviewees above all when they are predictable over the long term, easy to access, socially targeted, and aligned with other binding regulatory requirements. Thus, the solution is seen less in expanding (isolated or regional) subsidy programs than in improving the coherence of regulation and subsidies and the coordination across federal levels and provinces.

Sixth, the social dimension emerges as increasingly important issue. Affordability, the risk of energy poverty, and the protection of vulnerable groups are emphasized by many interviewees as key conditions for the public acceptance of decarbonisation. Several socio-political solution approaches emerge from the interviews: cost-efficient technical solutions, fair distribution of investment and operating costs, transparent pricing, stronger involvement of social institutions, participatory procedures, and models ensuring that households are not made worse off by decarbonisation measures. Warm-rent models, social tariffs, and a fairer distribution of carbon costs between owners and users are also discussed. Even though some of these models are assessed controversially, there is a clear consensus that decarbonisation without social safeguards will hardly be politically feasible.

Seventh, spatial planning and infrastructure are described as central yet often underestimated levels of transformation. Important solution approaches here include energy spatial planning, district or neighbourhood development (e.g. Quartierslösungen), densification, prioritising district heating areas, mandatory connection where district heating is available, and stronger regional and supra-regional planning. In the interviews, buildings are often not viewed as isolated units but in relation to their location, the surrounding neighbourhood, and available infrastructure. This shifts attention from individual building-level measures to a decarbonisation strategy embedded in infrastructure and spatial development.

Eighth, the role of actors becomes particularly visible. The federal government is most frequently addressed as the key rule-setter, especially with regard to housing law, target-setting, and strategic planning. The federal states appear, on the one hand, as important actors through building codes, housing subsidies, and spatial planning, but on the other hand also as part of the problem where federal fragmentation undermines coherence and implementation. Municipalities are mainly mentioned as local planning and permitting authorities, though in some statements they are described as overburdened. In contrast, limited-profit housing providers are identified in several interviews as comparatively capable and supportive actors, as are regional energy agencies. Banks and financial market actors are gaining importance particularly through sustainable finance requirements and financing conditions. Energy suppliers are viewed ambivalently: as necessary infrastructure actors, but also as potential forces of inertia or monopolistic actors.

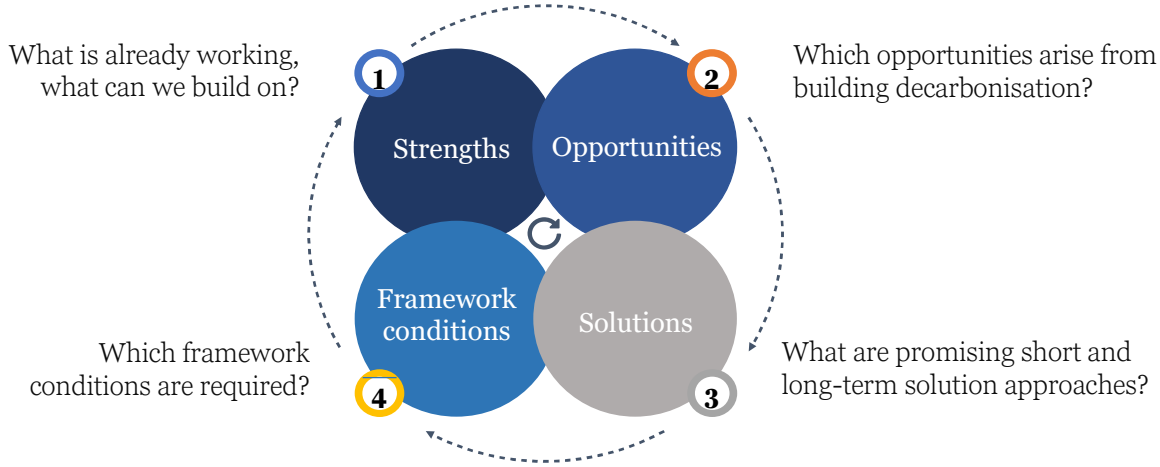
Overall, the interviews make clear that decarbonisation is understood as a coordination task involving different levels of government, owners, residents, utilities, planners, and financial actors. Furthermore, it is seen as a governance problem. At the centre are not missing technical options, but rather institutional, legal, and socio-political framework conditions that facilitate or obstruct implementation. This shifts the analytical focus away from technology availability toward the question of under which conditions decarbonisation in the existing building stock becomes organisationally, financially, and politically feasible.

4.2 In-depth analysis with focus group

To validate and refine the findings from the expert interviews, a focus group was conducted with participants from academia, architecture, real estate management, circular economy, and the Austrian energy poverty competence centre. Participants were chosen on the one

hand from interview participants and on the other hand from participants in a Delphi study on life-cycle assessment of buildings (see Kettele et al., 2026). Building on the interview analysis and the broader project work, participants were presented with interim findings and invited to discuss four thematic areas (see Figure 4): (1) existing strengths and positive developments in Austria, (2) opportunities arising from building decarbonisation, (3) promising short- and long-term solution approaches, and (4) the framework conditions needed to scale implementation. The discussion was documented through a transcript and whiteboard inputs and analysed thematically in relation to the interview findings.

Figure 4: Thematic areas for focus group discussion



Source: own illustration.

In response to the first question, participants identified several existing strengths on which further decarbonisation efforts could build. These included the gradual harmonisation of building regulation through the OIB guidelines, the availability of certain targeted public support schemes such as Clean Heat for all (Sauber Heizen für Alle) as social safeguards, the relatively strong institutional capacity of limited-profit housing providers, and the existence of established frameworks such as klima:aktiv or the national action plan for sustainable public procurement. Participants also pointed to the increasing importance of EU Taxonomy requirements, sustainability reporting, and finance-related disclosure obligations as developments that have begun to create incentives for change. More broadly, Austria was seen as having substantial strengths in research, construction-related innovation, and parts of the construction products industry.

At the same time, these positive developments were described as partial and unevenly distributed. What is working well was often linked to specific segments rather than to a system-wide transformation. This largely confirms the interview finding that Austria has important building blocks for decarbonisation but lacks broad-based implementation.

The second question shifted the discussion to a wide set of potential gains associated with building decarbonisation. These included avoiding carbon lock-ins, reducing long-term fossil energy dependence, and preventing future cost increases associated with carbon pricing, energy infrastructure maintenance, and fossil fuel price volatility. Decarbonisation was also

linked to greater resilience, future-proofing of the building stock, improved building quality, asset value preservation, and, in some contributions, to macro-economic opportunities such as strengthening Austria's competitive position in green industries.

A particularly important topic was the opportunity to combine decarbonisation with social benefits, especially where low-income households are prioritised and protected from future energy price risks. Participants also referred to the possibility of creating budgetary room for action through instruments such as the Climate Social Fund and ETS2-related resources. In addition, decarbonisation was framed as a way to support energy system transformation, for example by enabling buildings to play a more flexible role in renewable-based electricity systems.

Regarding the third question, participants agreed that effective decarbonisation strategies must combine energy efficiency measures with decarbonised heat supply, rather than relying on fuel switching alone. Thermal renovation was therefore repeatedly emphasised as a necessary complement to heating system replacement, particularly in order to avoid negative outcomes for low-income households. In addition, several participants argued for increased use of life-cycle approaches, circular construction, material efficiency, and the use of recycled and low-carbon construction materials.

At the same time, the discussion clarified that the problem is not the absence of technical options. Many participants agreed that core solutions are already available in principle. However, some participants argued that many options are not yet sufficiently tested, standardised, or scalable, and that the key challenge is to move from isolated lighthouse projects to widespread implementation. In this context, the issue is less technological absence than incomplete maturity, diffusion, and uptake.

The discussion also highlighted the importance of public procurement, standardisation, open-access tools, and usable assessment systems in helping available solutions reach wider markets. In the material-related discussion in particular, participants stressed that innovation in the construction products sector is already underway, but that market demand and implementation frameworks do not yet sufficiently reward these efforts.

The discussion related to the fourth question strongly reinforced the interview results. Above all, participants stressed the need for long-term stability, consistency, and predictability in framework conditions. This applied to legal rules, subsidy schemes, data requirements, and the coherence of EU, federal, and Länder-level policies. Regulatory volatility and stop-and-go politics were repeatedly criticised as counterproductive, especially where ambitious signals are followed by retrenchment or delay. Such instability was seen as undermining not only investment and planning, but also broader motivation and social acceptance.

A second issue concerned data and information infrastructures. Participants argued that decarbonisation can only be governed effectively if comparable and harmonised data are available. This included better databases for building materials, harmonised environmental product declarations, transparent calculation methods (e.g. for EPC and EPDss), and low-threshold or open-access tools for practitioners.

Third, participants stressed the need to align public budgets, procurement, and life-cycle logic. A particularly important point was inconsistencies in public sector action: while climate

ambition may be high at the strategic level, concrete investments are often blocked by short-term budget constraints or by the institutional separation between those responsible for capital expenditure and those responsible for operating costs.

Fourth, the discussion reinforced the need for stronger public communication, professional awareness, and societal uptake. Several participants argued that a key challenge lies in bringing the broader population, as well as practitioners and smaller market actors, into the transition.

5. Discussion

The combined evidence from the literature review, stakeholder interviews, and the validating focus group suggests that building decarbonisation in Austria is best understood as a governance and implementation challenge rather than a narrowly technological one. Across all empirical components, the central obstacles were not described as a lack of general technical options, but as the result of fragmented regulation, unstable framework conditions, insufficiently aligned incentives, and limited implementation capacity. This finding is consistent with the broader literature, which increasingly frames building decarbonisation as a systemic transition requiring coordinated policy mixes, long-term investment signals, social safeguards, and institutional support structures.

A first central discussion point concerns the existing building stock. Both the literature and the stakeholder evidence clearly indicate that the decisive transformation challenge lies in the stock rather than in new construction. Austria has relatively strong standards in new buildings, but these are insufficient to offset the slow pace of stock transformation. Current renovation rates remain below what would be needed to meet climate goals, and the empirical evidence shows broad agreement that stock-focused decarbonisation must be prioritised more strongly. The focus group reinforced this point by linking low renovation rates not only to policy deficits, but also to labour, resource, and scaling constraints.

A second key issue concerns the role of housing law and related cost-allocation regimes. The literature frequently identifies split incentives, financing gaps, and landlord-tenant dilemmas as major barriers to building renovation. The Austrian evidence shows that these issues are institutionally embedded particularly in tenancy law, condominium law, and related rules for cost allocation. Stakeholders repeatedly described a structural decoupling of investment responsibility, benefit distribution, and decision-making power in multi-unit residential buildings. This makes housing law one of the central bottlenecks of Austrian building decarbonisation. The findings therefore suggest that decarbonising the Austrian building stock cannot be treated as a building-standards issue alone; it requires legal reform in adjacent domains that shape the feasibility of implementation in practice.

A third discussion point concerns the coherence of the policy mix. The literature emphasises that building decarbonisation depends on integrated combinations of regulation, financial support, information, and institutional coordination. The Austrian case confirms this. Stakeholders did not argue that policy instruments are missing. Instead, they described a dense but often poorly aligned landscape of EU directives, federal laws, federal support schemes, provincial

subsidies, and administrative procedures. In particular, support schemes were seen as indispensable but insufficient on their own. Their effectiveness depends on stability, accessibility, social targeting, and coherence with legal obligations. This points to a broader policy design challenge: the issue is less one of adding more individual instruments than of improving how existing instruments interact across governance levels and over time.

Related to this is the importance of policy stability and predictability. The focus group, in particular, highlighted the detrimental effects of stop-and-go policy, shifting political signals, and inconsistent implementation approaches. Such volatility undermines planning, discourages investment, and weakens the credibility of decarbonisation efforts among households, firms, and professionals. In a sector characterised by long investment cycles, stable framework conditions are especially important.

A fourth important issue is Austria's federal governance structure. The literature identifies Austria as a particularly relevant case due to the fragmented implementation across federal states. The empirical evidence confirms that this fragmentation has practical consequences. While the federal states allow adaptation to regional conditions, they also create variation in support structures, standards, and administrative procedures. Stakeholders repeatedly described this as a source of complexity, inconsistency, and reduced transparency. The resulting governance challenge is therefore not the existence of multi-level governance as such, but the lack of sufficient coordination, harmonisation, and simplification across levels. The same applies to the internal fragmentation of the public sector, which emerged more clearly in the focus group: climate ambition in legislation and procurement frameworks can be undermined by budgeting rules that prioritise short-term investment costs over life-cycle logic.

A fifth discussion point concerns data, standardisation, and implementation infrastructures. While the literature review identifies information barriers and enabling services as relevant factors, the Austrian stakeholder evidence gives this issue much greater practical specificity. Interviewees and focus group participants repeatedly stressed that decarbonisation can only be steered if it can be measured and integrated into planning and procurement. This requires harmonised methods, accessible databases, consistent environmental product declarations, and usable tools for practitioners. These findings are particularly important for embodied emissions and material-related decarbonisation, where participants described substantial inconsistencies between databases and methods. This suggests that information barriers in the building sector are not limited to a lack of awareness but include institutional deficits in the quality and usability of the underlying data.

Finally, both the literature and the empirical evidence underline the importance of social acceptability. Decarbonisation in the building sector entails distributional impacts. Investments costs for heating system change or deep renovation, and carbon pricing can create significant burdens, especially for low-income households. Stakeholders therefore consistently stressed the need for fair cost allocation, transparent pricing, and social protection measures. This supports the literature on just transitions and socially inclusive policy design. The focus group discussion showed that awareness, trust, and broader societal uptake are also critical. Successful building decarbonisation therefore depends not only on technical and legal reform, but

also on whether households and professionals regard the transition as understandable, manageable, and fair.

Overall, the Austrian case illustrates the central insight emerging from the broader European literature: achieving building decarbonisation depends on whether instruments are embedded in a coherent and stable governance framework that aligns legal obligations, financial incentives, infrastructure planning, and social safeguards. While in Austria many of these requirements are met and progress has been made, the policy fragmentation and lack of coherence impedes that the transformation takes place at the required scale and speed.

6. Conclusion and policy recommendations

This paper examined which policy instruments and governance approaches are considered effective for decarbonising buildings in the European Union and how these instruments, barriers, and enabling factors are perceived by stakeholders in Austria. By combining a structured literature review with stakeholder perspectives, the study shows that Austria represents a highly relevant but institutionally challenging case of building decarbonisation in a federal governance setting.

Three overall conclusions emerge. First, the existing building stock is the key lever of decarbonisation. While standards for new buildings remain important, a substantial increase in renovation and heating system change in the building stock is required. Second, the main constraints are not primarily technological. Instead, they lie in housing-law barriers, fragmented governance structures, unstable policy conditions, financing and cost-allocation problems. This means that building decarbonisation should be treated less as a narrow energy-efficiency agenda and more as a cross-sectoral governance objective involving housing, climate, energy, social policy, procurement, and spatial planning. However, the scaling of innovative approaches and demonstration projects also is an issue that has to be resolved. Third, decarbonisation in the building sector will only be accelerated if it is embedded in a coherent, stable, and socially inclusive policy framework. Support schemes are necessary, but they need to be linked to predictable long-term rules, harmonised implementation, better data basis, and fair distributional arrangements.

On this basis, the findings suggest several policy recommendations.

Strengthen the policy focus on the existing stock.

Building policy should prioritise renovation and heating transformation in the existing stock more clearly, including stronger targeting of the least efficient buildings and more systematic support for deep renovation rather than incremental improvement alone.

Reform housing-related legal frameworks.

Austrian tenancy and condominium law should be revised to better support decarbonisation in multi-unit residential buildings. This includes stronger toleration obligations, more practicable cost-pass-through rules, and collective decision rules better aligned with heating replacement and renovation needs.

Improve policy coherence across instruments and levels of government.

Support schemes, legal requirements, spatial planning, and implementation responsibilities should be better coordinated across federal, provincial, and local levels. Austria's federal structure requires stronger harmonisation and simplification if building decarbonisation is to be scaled effectively.

Increase stability and predictability of framework conditions.

Long-term planning security is essential in a sector characterised by long investment cycles. Frequent shifts in support schemes or legal expectations should be avoided. Instead, policy signals should be coherent and stable.

Strengthen socially targeted and fair policy design.

Decarbonisation policies should explicitly protect vulnerable households, reduce the risk of energy poverty, and ensure that heating transformation and renovation do not create disproportionate burdens. This includes transparent pricing, targeted support schemes, and fair allocation of costs and benefits.

Expand implementation infrastructures.

Integrated renovation services, advisory structures, one-stop shops, and workforce development should be strengthened to reduce complexity for households, building owners, and practitioners. This also includes support for municipalities and smaller market actors.

Use public procurement more strategically.

Public-sector demand can help scale low-carbon products, life-cycle approaches, and circular solutions as analysed in Kettele et al. (2026). To achieve this, public procurement and budgeting structures need to be aligned more closely with long-term sustainability and life-cycle cost logic. Also, the availability of harmonised methods, comparable product information, and accessible tools for planning and procurement are necessary preconditions for whole-life-carbon strategies and more effective steering.

Declaration of AI-assistance in the writing process

During the preparation of this paper the authors used GPT 5.4 to improve grammar and language, as none of the authors are native English speakers. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the article.

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Annex 1. Literature review approach

6.1 Table A1. Overview of literature review design

Component	Description
Review type	Structured literature review informed by the ROSES framework
Review objective	To synthesise recent research on building decarbonisation in Europe, with emphasis on policy instruments, governance frameworks, barriers, enabling conditions, and technological pathways, and to inform the empirical interview design
Analytical focus	EU-level building decarbonisation; Member State implementation dynamics; Austria as a case study; governance, policy, finance, barriers, and enabling factors
Time period covered	Primarily publications from 2020–2026; earlier publications included selectively where they were foundational, highly cited, or directly relevant to Austria
Evidence types included	Peer-reviewed academic literature; selected analytical and policy-oriented grey literature; Austria-specific analytical reports; selected conference-related outputs where relevant

6.2 Table A2. Search sources and identification strategy

Source type	Sources used	Purpose
Academic databases	Scopus; Google Scholar; Researchgate	Identification of peer-reviewed and widely cited literature on building decarbonisation, policy, governance, barriers, and enabling conditions
AI-supported search tools	GPT-based search support; AnswerThis; Semantic Scholar	Exploratory support for identifying relevant themes, search term combinations, publication clusters, and potentially relevant sources; results were screened and validated through manual checking

Snowballing	Backward and forward screening from key references	Identification of additional relevant sources from references and citation chains
Targeted website searches	Relevant institutional and project websites	Identification of Austria-specific and policy-relevant documents not easily captured in database searches
Conference proceedings	e.g. IEWT, ECEEE and other relevant conference outputs	Inclusion of current debate and emerging research where analytically relevant

6.3 Table A3. Search terms and illustrative search strings

Core search terms	Examples
Building decarbonisation	building decarbonisation; building renovation; deep renovation
Energy and heating transition	heating decarbonisation; heat pumps; district heating; renewable heating
Policy and governance	policy instruments; policy mix; energy governance; regulation; implementation
Barriers and enabling factors	barriers; split incentives; financing; enabling conditions; supporting factors
Geographical scope	European Union; EU Member States; Austria

6.4 Table A4. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Study addresses building decarbonisation, deep renovation, heating system transformation, or building energy efficiency	Study focuses solely on technical engineering issues without policy or governance relevance

Study addresses policy instruments, governance, barriers, or enabling factors relevant to sustainability transitions	Study focuses on non-European contexts without clear relevance to EU policy or Austria
Geographical focus includes the EU, one or more EU Member States, or findings transferable to Austria	Case studies for specific circumstances (business cases, etc.)
Publication is peer-reviewed or otherwise analytically credible and relevant	Duplicates or clearly irrelevant publications

6.5 Table A5. Screening and selection process

Stage	Description	Number of records
Initial identification	Records identified through database searches, AI-supported exploratory searches, snowballing, targeted website searches, and conference proceedings	144
Deduplication	Duplicate records removed	16
Title and abstract screening	Publications screened for relevance to building decarbonisation, policy, governance, barriers, enabling factors, EU, Austria	128
Full-text screening	Remaining publications assessed in full text for analytical relevance and fit with review scope	85
Final corpus	Publications included in the final review	69

Annex 2. Interview guide

Leitfaden Expert:innen Interview "Dekarbonisierung im Gebäudebereich"

Dauer ca. 30min

Dass Angaben anonym sind und nicht so veröffentlicht werden, dass Rückschlüsse auf einzelne Teilnehmer:innen möglich sind

Ziele: Institutioneller Rahmen für die Dekarbonisierung im Gebäudebereich, alle Fragen zielen auf bestehende oder noch notwendige Regulierungen ab

Fragen:

1) Was ist Ihre Funktion/ Tätigkeitsbereich? Was ist Ihr Bezug zu Nachhaltigkeit im Gebäudesektor und Dekarbonisierung des Gebäudesektors?

   Was Dekarbonisierung bedeutet im Bereich Gebäude/Kreislaufwirtschaft?

2) Welche Regulierungen (National/international) sind für Ihren Tätigkeitsbereich relevant?

   Gesetze, Richtlinien, Normen, Förderungen

   a. Wirken diese Regulierungen für die Dekarbonisierung fördernd oder hemmend?
   b. Wie konkret wirken die Regulierungen auf Ihren Tätigkeitsbereich?

3) Wo sehen Sie die größten Hürden für die Dekarbonisierung im Gebäudebereich? (Zuständigkeiten, Entscheidungsbefugnisse, one-stop-shop)
   a. Hürden im direkten Arbeitsbereich
   b. Hürden generell
   c. Welche Akteure wären notwendig, um die Hürden zu überwinden?
   d. Welche Akteure hemmen die Dekarbonisierung?

4) Wo sehen Sie die größten Fortschritte bei der Dekarbonisierung im Gebäudebereich?
   a. Welche relevanten Innovationen?
   b. Welche Akteure könnten diese Fortschritte stärken?

5) Wo sehen Sie Zielkonflikte zwischen verschiedenen Aufgabenbereichen/Verwaltungsebenen (Klimaschutz, Brandschutz, Ortsbildschutz, etc.) Wie werden diese Ihrer Erfahrung nach gelöst?

6) Welche Regelungen sind zusätzlich notwendig, um eine vollständige Dekarbonisierung zu erreichen?

7) Kennen Sie (internationale) best practice Beispiele für Regulierungen, Rahmenbedingungen oder Umsetzungen?