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UPSCALING INNOVATION IN RENOVATION

A CALL FOR A STRATEGIC APPROACH FOR A COMPETITIVE AND SUSTAINABLE CONSTRUCTION SECTOR

BPIE

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EXECUTIVE SUMMARY

Innovative renovation solutions offer benefits for companies, building owners, occupants and the environment. To realise this potential and address the challenges, a strategic approach is needed. The transposition of recent EU policy files offers Member States a key opportunity to boost innovation in renovation and increase the construction sector's productivity and sustainability while advancing climate goals.

The decarbonisation of the existing building stock is not only key to achieving climate targets in the European Union – it also represents one of the most powerful untapped drivers of economic growth. In most European countries, investment in the renovation of existing buildings exceeds investment in new construction. As the construction sector often makes the largest contribution to national GDP, even small increases in productivity in renovation could bring above-average economic returns. An **acceleration of renovation activities requires significant productivity gains in the construction sector. Innovation in renovation is therefore crucial** – especially since innovations and productivity gains in construction, like new materials, technologies and processes, often focus on new buildings and are not necessarily spilling over to the renovation market. Renovation value chains also tend to be more fragmented and projects more complex. This disconnect means that boosting productivity in renovation specifically - rather than construction generally - is critical to unlocking both climate benefits and economic value.

This is what we refer to as the **innovation in renovation challenge**: we cannot simply assume that by supporting innovative solutions for new constructions, a market for innovation in renovation will be established.

Innovation in renovation needs to:

- Speed up and scale up renovation
- Enhance productivity
- Make renovation more affordable.

The need to specifically address innovation in renovation is not yet recognised in policymaking. While barriers to renovation are described widely in literature, there is less research on specific barriers hindering the uptake of innovation in renovation. The general barriers are amplified when it comes to innovation: existing building codes, procurement rules, lack of skills and, possibly most importantly, a culture of common construction practices that remains resistant to wider uptake of innovative solutions. While some countries focus on certain innovations, like serial renovation using industrial prefabrication, or push for innovation in construction in general, there is a lack of data as well as strategic and comprehensive approaches to address the renovation challenge.

We have identified five areas of innovation in renovation: process and social innovations; innovation in digitalisation, technologies, material innovation and circularity innovations. However, policies often focus solely on innovations in technology. While this is important for decarbonising operational emissions in particular, it leaves many of the challenges across the renovation process unaddressed.

This study therefore argues that **process and social innovations as well as innovation in digitalisation should be a top priority**. This can have multiple benefits across the renovation stages and for various stakeholders. More productive teams and efficient processes can translate into more buildings being renovated and better use of available resources. **A push for innovation in processes and digitalisation will increase the productivity and competitiveness of smaller construction companies that are typically engaged in delivering renovation**. Innovation in these areas will enhance the uptake of other innovations, including material and technology innovations, and allow for the diffusion of circular renovation business models.

Our analysis, highlighting experiences from France, Germany and Spain, shows that a strategic approach is needed to boost innovation in renovation. **The transpositions of recently adopted EU policy files**, most importantly the Energy Performance of Buildings Directive (EPBD), **are important windows of opportunity for EU Member States to direct policy design towards rewarding innovative renovation solutions**. Member States should follow a strategic approach which includes three main pillars:

CREATE MARKETS FOR INNOVATION IN RENOVATION THROUGH TARGETED REQUIREMENTS

Regulation is important to create reliable targets for investors, guide investments and generate corresponding market demand. They should be designed to incentivise the deployment of innovative solutions. Most importantly, minimum energy performance standards (MEPS), as outlined in EPBD Article 9, should be implemented in combination with additional incentives to reward innovative solutions and project aggregation. Other key opportunities lie in mandating green public procurement for building renovation in national procurement frameworks, requiring life-cycle assessments, and using digital tools like building information modelling (BIM).

TRANSFORM THE VALUE CHAIN

Policy measures focused on data collection and monitoring – such as the database for the energy performance of the buildings stock (EPBD Article 22) and inventory of public buildings under the Energy Efficiency Directive – will facilitate the digitalisation of the sector. As a result, new business opportunities may emerge. Making good use of digital building logbooks and digital product passports under Construction Products Regulation will further help to link different databases and drive new business models. Public procurement plays a pivotal role here too: Member States should revise their procurement laws to enable digitalisation, e-procurement and performance-based specifications. Functional tenders, where the performance is specified but not the detailed steps of how the renovation is carried out, leave more room for suppliers to achieve these goals and enable innovative partnerships and collaborative procurement models. Lastly, workforce shortages and upskilling need to be addressed, for example by training vulnerable groups and creating stable working conditions.

DEVELOP EFFECTIVE FINANCE SOLUTIONS FOR INNOVATION

Financial support to incentivise renovation demand, such as a bonus to top up existing renovation support programmes, will continue to play an important role to scale promising solutions. However, it is important to enable investments by start-ups to develop and scale innovation and SMEs to adopt them. Investments should be de-risked through targeted public financing tools such as grants, venture capital, advanced market commitments and revenue-based financing. Member States should support early-stage innovation and help businesses – especially SMEs – adopt digital tools and new models.

1 THE NEED TO INCREASE INNOVATION IN RENOVATION FOR CLIMATE AND PRODUCTIVITY

Renovation rates are still not on track to reach the needed decarbonisation of the existing building stock. There is an urgent need to accelerate innovation in building renovation. This will not only support climate objectives but also boost the productivity and competitiveness of the EU construction sector.

The renovation of Europe's building stock is essential to meet the EU's climate goals and create healthy and affordable buildings. This was reflected in the EU Commission's Renovation Wave strategy in 2020.[1] However, renovation rates are still not at the pace needed to decarbonise the building stock by 2050.[2] The construction sector (both new build and renovation) is one of Europe's least innovative industries, despite existing promising technological solutions to tackle its climate, resource and energy problems. There is an urgent need to increase innovation to accelerate the renovation of existing buildings and address challenges in the renovation process. This will also support the competitiveness of the EU construction sector.[3]

This urgency has been recognised by, among others, the Special Committee on the Housing Crisis in the European Union, which was set up in December 2024. Among its several responsibilities are *"to map innovative technologies, processes, services and products to support the renovation wave"* and *"to map where administrative and regulatory burdens are hampering the renovation wave, with the aim of reducing unnecessary regulatory burden while ensuring quality work in the construction sector and quality standards for affordable housing."*[4] The need to scale up efforts in building renovation was reiterated by Dan Jorgenson, Commissioner for Energy and Housing, after reviewing Member States' national energy and climate plans in May 2025.[5] Simultaneously, the European Commission published a 'Startup and Scaleup Strategy' in May 2025 to foster an innovation-friendly environment that makes it simpler and faster for innovative European startups to grow and scale up in the single market.[6]

While we are seeing an increase in the application of building information modelling (BIM) and other innovations for sustainable new buildings, including regulation on whole-life carbon or life-cycle global warming potential (GWP) and a wider use of material passports, this will not suffice. It is essential to mainstream innovation in renovation, as existing buildings make up the largest share of the EU building stock. New renovation materials and practices, such as BIM-related tools and AI for data collection and analysis (e.g., laser scanners to create a digital copy of the building), face significant challenges in entering the renovation market. The same is true for prefabricated renovation solutions, optimisation of renovation processes, the use of new insulation materials, innovative envelopes (e.g., leak-sealing technologies, vacuum glass technologies, mycelium-based materials) or the incorporation of reused components. Various factors contribute to this: high initial costs and investments, risk aversion and concerns about quality, or simply lack of knowledge and awareness about alternative solutions. Also, a shortage of skilled workers capable of handling the innovations limits their implementation, as well as fragmentation of the construction industry, and regulatory and policy barriers.

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[1] 85% of the EU's building stock was built before 2001 and 85-95% of the buildings that exist today will still be there in 2050. See European Commission (2020), Communication A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives.
[2] BPIE (2024), EU Buildings Climate Tracker 3rd edition.
[3] While not specifically addressing the construction sector, the Draghi report (2024), highlights that the European Union faces an "existential challenge" in maintaining its industrial competitiveness. In response the European Commission's Clean Industrial Deal, unveiled on 26 February 2025, aims to bolster EU industrial competitiveness while accelerating decarbonisation. A significant focus is placed on workforce development, with up to €90 million allocated from Erasmus+ for training in strategic industries.
[4] European Parliament decision (2024), Setting up a special committee on the Housing Crisis in the European Union, and defining its responsibilities, numerical strength and term of office.
[5] Press remarks by Executive Vice-President Ribera and Commissioners Hoekstra and Jørgensen on the EU-wide assessment of the final National Energy and Climate Plans (28 May 2025).
[6] European Commission (2025), Communication EU Startup and Scaleup Strategy.

> **The time is right to bring attention to much-needed solutions to accelerate innovation in renovation.**

To implement the EU Renovation Wave, the Energy Performance of Buildings Directive (EPBD - (EU) 2024/1275) as well as the Energy Efficiency Directive (EED - (EU) 2023/1791) must be transposed into national legislation by September 2025 (EED) and May 2026 (EPBD). To meet the new requirements, among others for data collection on the existing building stock (e.g. Article 22, EPBD), for renovating individual non-residential buildings (Article 9(1), EPBD) or on improving the average performance of residential (Article 9(2), EPBD) and public buildings (Article 5-7 EED), Member States need to find solutions to scale renovation. Similarly, the Construction Products Regulation (CPR - (EU) 2024/3110), as another angle of the EU Green Deal, must be transposed in the coming years and initiatives are ongoing to increase the circularity of the sector (e.g. the planned Circular Economy Act). Public procurement rules are currently under revision, with the aim to strengthen sustainability and competitiveness of the Union.

While EU policymakers need to provide further guidance and support to accelerate the roll-out of innovative solutions, this new policy cycle encourages EU Member States to play a leading role by implementing the EPBD, EED and other policy files to accelerate innovation in renovation and future-proof the building sector.

The objective of this report is to provide policymakers with policy levers that can accelerate the widespread market adoption of innovative renovation solutions, unlocking the economic, ecological and social benefits they offer. To achieve this, it identifies the most relevant areas of innovation in renovation, assesses their benefits, and analyses the main barriers to large-scale market penetration. It zooms into the EPBD, along with other recent policies, to show how an ambitious implementation at EU Member State level can leverage innovation for renovation and drive wide market uptake.

OUR APPROACH

To identify key barriers to innovation in the renovation sector and derive recommendations, we employed various research methods as depicted in Figure 1. Through a series of background interviews with experts throughout the whole process, we iteratively refined and prioritised the research outcomes to identify the barriers, key levers and primary drivers.

Figure 1. Overview of the methodology

The first step was to gain an overview of existing innovations in the field of renovation. However, no comprehensive scientific articles or reports specifically on renovation-related innovations were identified. At best, reports on individual innovations are available (e.g. prefabrication for renovation), but most of this information is provided by companies. Typically, no distinction is made between innovations for renovation and those for new construction. To identify innovations specifically relevant to renovation, it was necessary to take a bottom-up approach: searching for individual solution providers that address specific challenges in the renovation process, both in Europe and in the US. All identified innovations were compiled into a comprehensive list and categorised into five thematic areas, even though some overlap exists. To validate the five identified innovation areas, experts were consulted. Additionally, based on a literature review, we gathered expected benefits associated with scaling up these innovations in the renovation sector and assessed the status quo of the market penetration of innovation in renovation clustered by innovation area.

Second, we shifted the focus from a general perspective to a more concrete analysis of three specific countries: France, Germany and Spain. This approach not only allowed us to pinpoint specific barriers but also ensured a focus on three potentially large markets where understanding obstacles – and consequently solutions – is crucial for mainstreaming innovations in renovation. In all three countries, we conducted focus groups and/or expert interviews to collect insights on the existing barriers for innovations in renovation within the national contexts, complementing the findings with insights from literature reviews.

To identify solutions, we analysed the EPBD and discussed with experts how key provisions e.g. on the renovation of the building stock (Article 9), zero-emission buildings (Article 11), financing frameworks (Article 17) and databases for the energy performance of buildings (Article 22) can bring opportunities to support the uptake of innovation in renovation. Other provisions and regulatory frameworks were analysed as part of the desk research as well. The final recommendations are structured around three main aspects to guide policymakers on 1) developing the market for innovations in renovation, 2) transforming the value chain for renovation, and 3) providing financial resources for innovation in this sector.

[7] More than 20 experts participated in the research input and/or validation processes.

2 KEY AREAS OF INNOVATION FOR RENOVATION AND BENEFITS

The renovation process encounters multiple challenges that can be mastered through existing and emerging innovative solutions. Scaling these innovations would deliver enormous benefits – for the environment, building owners and occupants, workers and the construction sector as a whole. However, to support and accelerate their uptake, it is essential to collect and showcase data on the benefits and market maturity, enabling the development of effective support strategies.

CHALLENGES OF THE RENOVATION PROCESS: WHY IS INNOVATION NEEDED?

Renovation rates across the EU must increase to considerably reduce the emissions of the building sector. Current renovation rates are low, often due to diverse challenges encountered by building owners and the renovation industry itself. The renovation of buildings is mainly carried out by small and medium-sized enterprises (SMEs) in a very fragmented supply chain. Moreover, the regulatory and financial frameworks, and therefore also the skill-set of construction workers and service providers, are mostly focused on new builds.[8] Homeowners and occupants often lack the knowledge and data about materials, technologies and needed renovation works. The following summarises the renovation stages and some of the challenges for actors involved in each stage.

Data collection is key to prioritise renovation decisions, optimise processes and scale solutions. However, there is often incomplete or a total lack of as-built information, leading to multiple uncertainties around the structural and physical characteristics of the building and its components; in many cases, data needs to be collected in used and occupied buildings. In the **renovation design and planning**, challenges appear due to the disconnection between planners and executors, leading to unclear accountability and potential liability issues. Design is further complicated by compatibility constraints with existing structures, numerous stakeholders with conflicting priorities, planning uncertainties and unreliable assessments.[9]

In the **procurement** stage, conventional renovation models require the (mostly inexperienced) customer to make all major decisions. While this may vary for large renovations or in some non-residential cases, customers frequently have to coordinate a highly fragmented supply chain with many suppliers and parties involved, leading to a high risk of timing, financing and quality problems.[10] The **renovation activities** often need to be carried out in occupied buildings, which complicates logistics and limits flexibility, leading to extended project timelines and therefore higher costs. For the owner it creates discomfort due to noise and reduced privacy, as well as limited functionality. Post-renovation, **building management** faces challenges such as energy performance gaps from poorly executed upgrades, hidden structural issues from substandard workmanship, unclear maintenance responsibilities, lack of proper commissioning, unpredictable occupant behaviour, and risks associated with untested technologies.[11]

At the end of a renovated building's life, **demolition and recycling** face challenges due to limited data and uncertainty about materials, their location in the building and their quality. Additional issues include complex or lacking regulations regarding demolition procedures and waste management, high reconditioning costs and time, and the fact that older buildings were not designed for disassembly.[12]

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[8] European Commission (2023), Transition pathway for construction.
[9] Prieto, A., Armijos-Maoya ,T. and Konstantinou, T. (2024), Renovation process challenges and barriers: addressing the communication and coordination bottlenecks in the zero-energy building renovation workflow in European residential buildings.
[10] Boza-Kiss, B., Bertoldi, P., Della Valle, N. and Economidou, M. (2021), One-stop shops for residential building energy renovation in the EU.
[11] Moradi, S., Hirvonen, J., Lastovets, N. and Sormunen, P. (2025), Energy efficiency through building renovation: a study of challenges and solutions.
[12] Amoli, M. R. J. (2023), Exploring challenges and institutional factors affecting circularity through material reuse in renovation.

Speeding up and enhancing building renovation activities in the EU is crucial to achieving key climate targets related to the energy transition and the reduction of greenhouse gas emissions.[12] The urgency in increasing the volume and quality of renovation activities increases considering that the renovation of the EU building stock also touches on key social elements such as reducing energy poverty, providing affordable housing and improving the health of building users.

As we approach 2030 and 2050 climate targets, the time window to enhance the renovation value chain to deliver all the required renovations is getting shorter. This calls for strategies to accelerate the adoption of innovative solutions and facilitate the transfer of well-established solutions from new construction into the renovation industry. It is important to note that for specific challenges, the particularities of building renovation projects require dedicated innovations to increase the competitiveness of this sector. Previous research has shown that traditional project management, decision-making and other tools commonly used in new construction address renovation needs only partially or are insufficient to address them.[14,15] The commonly expected spillover of innovations from new construction to renovation may not always occur and we cannot wait for them; instead, targeted mechanisms are needed to introduce innovation directly into the renovation sector.

Innovation in renovation can streamline tasks, reduce time and resource use and increase renovation rates, helping to cut greenhouse gas emissions by improving building performance sooner. Innovative materials and products can also lessen resource depletion, reduce embodied carbon, and support future reuse and recycling. Additionally, advanced communication and collaboration tools can improve decision-making, reduce supply chain fragmentation, and create a more cohesive renovation process. The following sections elaborate on the definition of innovation in renovation, the identified five innovation areas, and the potential benefits uptake of these innovations would bring for enterprises and industry, the environment, and building owners and occupants.

[13] European Commission, Renovation Wave.
[14] Wandahl, S., Perez, C. T., Salling, S., Neve, H. H., Lerche, J. and Petersen, S. (2021), The Impact of Construction Labour Productivity on the Renovation Wave.
[15] Amorocho, J. (2023), Decision-making and implementation of renovation solutions in residential buildings.

FIVE AREAS OF INNOVATION IN RENOVATION

DEFINITION: WHAT IS "INNOVATION IN RENOVATION"?

As a first step to identify the most relevant innovation areas for renovation and their potential benefits, it is crucial to define what we mean by innovation in renovation.

The statistical office of the European Union, EUROSTAT, describes innovation as:[16]

"...the use of new ideas, products or methods where they have not been used before. ... An innovation is defined as a new or significantly improved product (good or service) introduced to the market, or the introduction within an enterprise of a new or significantly improved process. Innovations are based on the results of new technological developments, new technology combinations, or the use of other knowledge, acquired by the enterprise..."

Our research aligns with the focus on improved goods, services and processes that are not yet widespread in the renovation market. However, we also see the need to select innovations that meet the needs of the renovation sector. Innovation in renovation needs to:

- **Speed up** and **scale up renovation**
- Enhance **productivity**
- Make renovation more **affordable**.

Diverse innovations have been and are being developed to support renovation practitioners and enterprises to tackle some of the challenges described in Section 2.1. Identified innovations cover diverse solutions, from innovative insulation materials to virtual reality for renovation planning. Some of these innovations address a specific stage of the renovation process, e.g. the use of drones for data collection, while others apply to several stages and support multiple activities, e.g. BIM. The innovations were identified by desk research and categorised into five areas[17] depicted in Figure 2. They were validated through interviews with experts from three EU Member States (Germany, France, Spain) and beyond.

[16] EUROSTAT Glossary, Definition of innovation.
[17] It needs to be highlighted that there are overlaps between certain innovation areas and a clear-cut categorisation of an innovation into one of the areas is sometimes difficult. However, clustering the diverse innovations in dedicated areas is useful, because it helps identify the barriers that similar innovations (and enterprises developing them) are facing and the levers to overcome them.

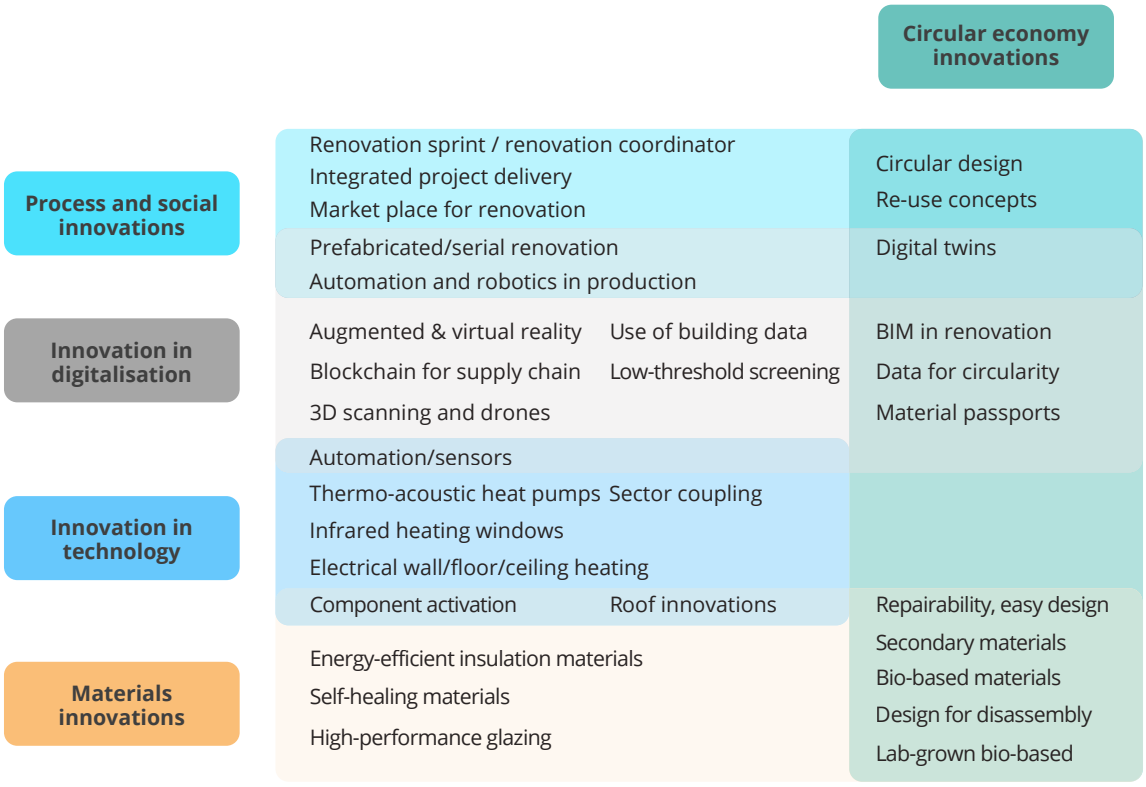

Figure 2. Areas of innovation including exemplary innovations

PROCESS AND SOCIAL INNOVATIONS FOR RENOVATION

This area includes new or improved methods for planning, executing and managing renovation measures to enhance efficiency and quality. Examples are automated manufacturing techniques such as modular prefabrication, innovative construction methods to shorten construction times or minimise disruptions for residents, and integrated project delivery (IPD), which involves all project stakeholders early in the planning and construction processes to maximise collaboration and efficiency. Other examples include marketplaces and sometimes one-stop shops offering support for the whole customer journey for renovation, from planning to financing and implementation; lean construction processes;[18] and renovation sprints, among others. It is increasingly understood that social innovation plays a pivotal role along with technological innovations.[19] The overarching aim of these process and social innovations is to lower costs, conserve resources, integrate the supply chain and optimise project execution.

[18] The lean concept emphasises actions towards creating value with fewer resources through continuous improvement.
[19] Geels, F. W., Cazzola, P., Ketter, W. and Kivimaa, P. (2024), Addressing European research and innovation challenges for system transitions in energy and mobility, European Commission: Directorate-General for Research and Innovation.

INNOVATIONS IN DIGITALISATION FOR RENOVATION

The solutions gathered under this innovation area involve new or improved digital tools and methods that make renovation tasks more efficient and precise. Examples include the use of BIM for accurate planning and simulation of renovation works; drones for building inspections and condition analyses; and digital platforms offering multiple services to construction companies to streamline the renovation process, including design tools, digital offers, project management, real-time coordination and monitoring in the same platform. These digital innovations help reduce costs, shorten construction times and improve the quality of renovations.

INNOVATION IN TECHNOLOGY FOR RENOVATION

This innovation area comprises technologies being developed for the direct enhancement of the performance of buildings through renovation. Examples include automation solutions for existing buildings, sensors, alternative heating systems such as thermoacoustic heat pumps, infrared-heating windows and panels, and solutions for electric heating. These technological innovations aim at reducing building operational costs and enhancing indoor conditions and energy performance.

MATERIALS INNOVATIONS FOR RENOVATION

This includes new or improved building materials that enhance the efficiency, sustainability and durability of renovation projects. Examples include high-performing insulation materials to improve energy efficiency, self-healing concrete to extend the lifespan of structures, and innovative insulation and construction materials to reduce the ecological footprint and improve indoor air quality. Materials innovations reduce the use of resources, facilitate reuse and reduce embodied carbon emissions.

CIRCULAR ECONOMY INNOVATIONS FOR RENOVATION

Innovations in this area span across the above four areas, covering process and social, digital, technological, and materials innovations. Since the market application of circular economy innovations faces additional barriers, keeping this as a separate innovation area can help to specifically address the barriers those innovations face. Examples include design-for-disassembly strategies, where buildings and components are designed for easy dismantling and reuse at the end of their lifecycle; digital material passports that provide information on used construction materials for future reuse; and recyclable or biodegradable materials such as recycled concrete or renewable resources like hemp or cork. The goal is to create a more sustainable building life cycle by keeping materials in circulation longer and reducing waste. These innovations enable a more comprehensive view of renovation projects and buildings; integrate the supply chain; and increase recycling and reduce waste to decrease the depletion of materials.

[20] Digitalisation of the operation of the building after renovation is considered within the innovations in technology area.

EXPECTED BENEFITS FROM UPSCALING INNOVATIONS IN RENOVATION

Diverse innovative solutions from the identified five areas can strengthen and enhance multiple tasks within the building renovation industry. This section presents examples of some of the benefits that innovations in each area bring to each renovation stage. Existing innovations for renovation have the potential to reduce time, cost and greenhouse gas emissions; enhance communication; increase quality; and integrate the supply chain and stakeholders. Figure 3 illustrates how innovations can address the multiple renovation challenges discussed in Section, "Challenges of the renovation process: why is innovation needed?".[21]

	Data collection	Renovation design and planning	Procurement	Renovation activities	Building management	Demolition and recycling
Process and social innovations	Data collected and managed across the project in a standardized way, usable by different actors	Integrated approach	Matchmaking. Enhanced communication	Faster installation	Clearer responsibilities. Lower risk of mismatches in design and final product	Enhanced disassembly
Innovation in digitalisation	Faster and more accurate data collection. Less disturbance	Faster analysis of multiple scenarios, improved visualization	Supply chain traceability	Better monitoring, increased safety, reduced waste	Optimised operation and maintenance (using data)	Easier matchmaking between customers and secondary materials
Innovation in technology	-	-	-	Easier installation	Lower maintenance, high efficiency, reduced emissions, flexible operation	-
Materials innovations	-	Flexible and modular design, high compatibility	Use of local resources/ materials, stronger supply chain	Easier installation	Easier maintenance/ replacement, reduced embodied emissions, IAQ (Indoor Air Quality) benefits	Easier disassembly, reduced waste
Circular economy innovations	For future renovations, higher traceability of building components and materials data	More complete design, considering the building lifecycle	-	Better waste management	Comprehensive management, considering integration among systems, and materials and resources flows	Enhanced disassembly, reduced waste

Figure 3. Expected benefits of innovations across the five innovation areas and building renovation stages

[21] The figure presents a simplified overview to highlight where the main contributions of the five innovation areas happen within the building renovation stages; in some cases, the contribution of an innovation crosses the stage boundaries. The figure includes only limited examples of the benefits; further benefits are present across the renovation process and value chain depending on the innovation solution.

PRIORITISING INNOVATION AREAS – STRENGTHENING PROCESS AND SOCIAL INNOVATIONS AND DIGITALISATION

As illustrated in Figure 4, many of the innovation areas have an effect on multiple renovation stages. However, policies often focus solely on innovations in technology at the operational stage, leaving many of the challenges across the renovation process unaddressed. This calls for prioritising other innovations, in particular process, social and digitalisation innovation, which can have multiple benefits across all the renovation stages and for various stakeholders. More productive teams and efficient processes can translate into more buildings being renovated and better use of available resources. Less fragmented and more efficient value chains could enable an easier adoption of circular economy approaches.

Social innovations and their role in sustainable energy and mobility transitions have gained increasing interest based on an understanding that technological development on its own is insufficient to solve the challenge of decarbonisation.[22]

Examples of specific impacts and benefits are described below. While the collected evidence is mostly tied to specific innovations within each area, the below summary highlights the combined potential of innovations in renovation to benefit renovation companies and industry, the environment, and building occupants and owners.

LACK OF DATA ON THE BENEFITS OF INNOVATIVE SOLUTIONS FOR RENOVATION

Examples of specific impacts and benefits are described below. While the collected evidence is mostly tied to specific innovations within each area, the below summary highlights the combined potential of innovations in renovation to benefit renovation companies and industry, the environment, and building occupants and owners.

[22] Geels, F. W., Cazzola, P., Ketter, W. and Kivimaa, P. (2024), Addressing European research and innovation challenges for system transitions in energy and mobility, European Commission: Directorate-General for Research and Innovation.

BENEFITS FOR RENOVATION ENTERPRISES, WORKERS AND INDUSTRY

Process innovations such as prefabrication in a factory can reduce construction time in renovation by 18%; with fewer builders needed on site and shorter installation times (1-30 days depending on the building size),[23] renovation companies can complete activities three to five times faster.[24] Serial renovation can reduce up to 20% of costs by shifting the work to standardised, industrial value-added stages such as planning, prefabrication and logistics.[25] The controlled environment of factories enhances quality control and minimises errors, significantly reducing rework,[26] and also increases worker safety. Other changes in conventional renovation processes, such as adopting lean strategies for renovation, have the potential to improve construction labour productivity in Europe by 45%.[27]

Digital platforms combining multiple services to support building renovation can help streamline and optimise workflows, manage stakeholder collaboration, simplify client transactions, and provide tools for planning and decision-making in an integrated manner. Digital innovations such as 3D scanning enable the collection of large amounts of data with high accuracy, improving project timing and reducing rework or additional measurements.[28] Site time for renovation can be reduced by up to 80%.[29] This data can then feed BIM models or digital twins to prepare 3D models of the current status of the building or the as-built situation after renovation. BIM tools can help evaluate diverse scenarios, in terms of building designs, cost, duration, labour resources and disruption potential.[30] Virtual reality can accelerate and enhance the learning process of the workforce for construction activities.[31,32]

Even though technological innovations mainly tackle the operation of buildings, technologies such as electric panel heaters and underfloor heating also bring benefits to the renovation activities since they are typically easier to install than gas systems, as electric radiators do not require ducts, pipes or vents.[33]

ENVIRONMENTAL BENEFITS

More productive teams and efficient processes can translate into higher renovation rates, saving around 6.9 $MtCO_2e$ from embodied energy from 35 million housing units to be renovated and 386 $MtCO_2e$ from annual operational energy through housing renovation across Europe,[34] considering a 50 year life span for the renovated buildings.

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[23] D'Oca, S., Ferrante, A., Ferrer, C., Pernetti, R., Gralka, A., Sebastian, R., & Op 't Veld, P. (2018), Technical, Financial, and Social Barriers and Challenges in Deep Building Renovation: Integration of Lessons Learned from the H2020 Cluster Projects.
[24] Deutsche Energie-Agentur GmbH (dena) (2024), Serielles Sanieren nach dem Energiesprong-Prinzip.
[25] Munich Strategy (2024), Whitepaper: Serial renovation – cost reductions, efficiency gains and new industry structures through industrial prefabrication in refurbishment.
[26] High Level Construction Forum (2024), Research Note on Offsite Construction.
[27] Wandahl, S., Perez, C. T., Salling, S., Neve, H. H., Lerche, J. and Petersen, S. (2021), The Impact of Construction Labour Productivity on the Renovation Wave.
[28] European Construction Sector Observatory (2021), Digitalisation in the construction sector.
[29] Historic England (2018), 3D Laser Scanning for Heritage.
[30] Doukari, O., Kassem, M., Scoditti, E., Aguejdad, R. and Greenwood, D. (2023), A BIM based tool for evaluating building renovation strategies: the case of three demonstration sites in different European countries.
[31] Seo, S., Park, H. and Koo, C. (2024), Impact of interactive learning elements on personal learning performance in immersive virtual reality for construction safety training.
[32] Man, S.S., Wen, H. & So, B.C.L. (2024), Are virtual reality applications effective for construction safety training and education? A systematic review and meta-analysis.
[33] Heat Electric (2022), The Benefits Of Electric Heating Systems For Homes.
[34] S., Perez, C. T., Salling, S., Neve, H. H., Lerche, J. and Petersen, S. (2021), The Impact of Construction Labour Productivity on the Renovation Wave.

In terms of environmental benefits, the growth of innovations such as serial renovation in countries like Germany can save around 25 $MtCO_2$ per year by 2045,[35] while the mainstreaming of smart building technologies by 2030 could save annually around 12 $MtCO_2$,[36] which represents around 12% of the observed operational emissions in 2023.[37]

Replacing an old heating system with a small air-to-water heat pump and infrared heaters can reduce heating energy use by up to 62%.[38] Bio-based insulation materials save emissions from a life-cycle perspective as they serve as a carbon sink. The use of new generation materials can save 114-259 MtCO2e for the renovation of buildings across the EU between 2020 and 2050.[39] This represents around ten times the direct emissions from the construction of new buildings during a year in the UK.[40] Using high energy performance glazing could save up to 30% of building operational energy use in Europe.[41,42]

Adopting circular economy principles can decrease material consumption in existing buildings and reduce emissions embedded in building materials. It can extend the lifespan of buildings and increase the intensity of building use.[43] In an ambitious scenario, a single circular construction action – designing products for disassembly and enabling reuse – can prevent around 2% of virgin materials extraction and around 142 $MtCO_2e$ of the emissions related to renovation.[44] The increase of use of secondary materials for renovation can prevent around 9% of virgin materials extraction and 229 $MtCO_2e$ of emissions.

BENEFITS FOR BUILDING OCCUPANTS AND OWNERS

Digital innovations reduce site time. The building owners and occupants benefit from better coordinating and monitoring of the renovation activities, and shorter periods with disturbances. Blockchain technologies in construction reduce the room for fraud and manipulation by recording every transaction, alteration and update, and making them accessible to authorised users (through a decentralised database with a consensus mechanism for validation). This can increase stakeholder trust, settle disagreements and make decision-making more efficient.[45]

Innovations such as marketplaces and one-stop shops can integrate the fragmented supply side – designers, suppliers, installers and financiers – and offer building owners a single point of contact. This can reduce the burden on building owners to identify and coordinate multiple contractors and potentially increase the number of building owners willing to start a renovation process. One-stop shops can also bring other benefits such as increased access to financial support, additional support to address split incentives, simple and better-informed decision-making processes and risk transfer, among others.[46]

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[35] Deutsche Energie-Agentur (dena) (2024), Serielles Sanieren nach dem Energiesprong-Prinzip.
[36] Bitkom (2024), Digitalisierung kann 2030 mehr als 70 Millionen Tonnen CO_2 einsparen.
[37] European Environment Agency (2025), EEA greenhouse gases — data viewer.
[38] Empower Europe (2024), Rethinking Heat: Electric Heating – The Latest Trend.
[39] European Environment Agency (EEA) (2024), Addressing the environmental and climate footprint of buildings.
[40] Drewniok, M., Dunant, C., Allwood, J., Ibell, T., and Hawkings, W.(2023), Modelling the embodied carbon cost of UK domestic building construction: Today to 2050.
[41] Glass For Europe (2023), Choosing 'High energy performance' glazing in windows.
[42] When it comes to materials and technologies, a careful assessment of their impact is necessary – particularly regarding which materials truly contribute to CO_2 reduction. However, this can often be difficult to determine, as available information frequently relies on manufacturer claims, which are not always transparent, as seen in the case of heating systems.
[43] European Commission (2023), Study on measuring the application of circular approaches in the construction industry ecosystem.
[44] European Environment Agency (EEA) (2022), Modelling the renovation of buildings in Europe from a circular economy and climate perspective.
[45] Neuroject (2023), Blockchain in Construction: Ultimate Guide for 2024.
[46] Bertoldi, P., Boza-Kiss, B., Della Valle, N. and Economidou, M. (2021), The role of one-stop shops in energy renovation - a comparative analysis of OSSs cases in Europe.

Bio-based materials can bring various benefits to building occupants, such as improved moisture and heat flows, lower energy bills and better indoor air quality.[47]

INITIAL INSIGHTS ON THE MARKET AND POTENTIAL

What is the market and market potential of the five innovation areas? Given the limited available data, this section provides initial answers, in some cases using proxies to illustrate the potential.

LACK OF DATA ON THE DEPLOYMENT OF INNOVATIVE SOLUTIONS

Like the benefits of innovation for renovation presented in the previous section, capturing the current state of the market for renovation innovations is difficult due to a lack of data. Available information often captures the broader construction sector rather than renovation specifically and – while most of what we define as innovations is already on the market – in many cases adoption is still in early stages. For instance, for innovations such as digital twins there is limited data, as they are mainly used in pilot or experimental projects. Even for well-established innovations such as BIM and heat pumps, there is not clear data about their adoption in renovation projects. The number of renovation projects including automation solutions is not available, even in countries with a high production volume such as Germany and France. The same is true for circular economy innovations, for which it is very difficult to find data about the rates of adoption in renovation projects only.[22]

A prominent renovation solution that represents **process and social innovations** is serial renovation, where industrially prefabricated facades or roof elements are used to deeply renovate the building envelope. This requires a central coordinator of the whole renovation process and includes innovative business models extending the payback period through long-term performance guarantees.[48] It has become popular through the Energiesprong initiative, present in a growing number of EU countries. Monitoring the Energiesprong market development is therefore a proxy to understand the market penetration of process innovation.

In countries such as Germany, where the Deutsche Energie-Agentur (German Energy Agency) has adapted the Energiesprong programme to the German market, the number of renovation projects using this approach has increased more than tenfold, reaching 110 projects (around 2000 dwellings) by 2024.[49]

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[47] Bourbia, S., Kazeoui, H. and Belarbi, R. (2023), A review on recent research on bio-based building materials and their applications.
[48] It leverages the "warm rent" scheme, in which energy costs are bundled into the rent and provided by the building owner as part of the rental agreement.
[49] Energiesprong (2024), Serielles Sanieren auf dem Sprung in den Breitenmarkt.

Mid-2025, around 17,000 dwellings are in the planning or preparation phase for serial renovation, and the market volume for serial renovation in the multi-family building segment is estimated to be at least €120 billion.[50] In France, the prefabrication industry is expected to grow in upcoming years from €5.85 billion in 2023 to €7.54 billion by 2028.[51] Energiesprong has also been active in France with an increasing number of projects being renovated with prefabricated elements. Energiesprong France claims that 14 million dwellings in France could be renovated following this model.[52]

While in 2022 less than 2% of deep energy renovations were carried out as serial renovations in Germany, the number grew significantly with the introduction of a support bonus in 2023. In 2024, 26% of all publicly supported deep renovations were claiming the bonus for serial renovation, representing 6,701 dwellings.[53] While the figures grew fast within a year, the market is still far from reaching its potential: estimates suggests that at least 7.9 million dwellings in Germany and as many as 20 million or more could benefit from serial renovation.[54]

In Spain, there is growing interest in using lean approaches to enhance the different renovation processes.[55] At least 22 EU Member States have at least one one-stop shop in their renovation markets, with levels of EU-wide activity estimated to be around 100,000 projects per year facilitated by one-stop shops, representing about 4-5% of current renovation projects. If the one-stop-shop renovation volume was to increase, they could cover about 5-6% of the total renovation volume of 35 million buildings by 2030.[56] France is a frontrunner in developing innovative one-stop shops, involving third-party financing and guaranteeing quality of renovation works.[57] In addition, there are several EU projects promoting prefabrication in renovation and often linking it e.g. to neighbourhood approaches or circular renovation (MORE-CONNECT, BIM4REN, INFINITE, oPEN Lab, REHOUSE).[58]

Increasing numbers of start-ups offer **innovation in digitalisation for renovation**, but there are few incentives to widely apply their innovations. Spending of construction companies on information technologies and digitalisation does not exceed 1% of the revenue; this has led to labour productivity growing at only a quarter of the rate observed in manufacturing.[59] Data for BIM, the most developed and used digital technology in the construction sector, still only shows a moderate market adoption in the EU. For example, only 6% of companies use 4D BIM (combining 3D models with time and scheduling related information), most of which are large companies.[60]

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[50] Energiesprong, Wo sind Energiesprong Projekte?
[51] Harman and Well, France Prefabricated Buildings Industry Study - Growth, Trends, Covid-19 Impact, And Forecasts (2023 - 2028).
[52] Greenflex (2021) Observatoire Coûts, Qualité et Impact des rénovations EnergieSprong, 1ère édition du baromètre de l'Observatoire.
[53] Deutsche Energie-Agentur (dena) (2025), Markthochlauf für serielle Sanierung beschleunigt sich.
[54] Agora Energiewende, ifok, BPIE (2024), Serielle Sanierung. Effektiver Klimaschutz in Gebäuden und neue Potenziale für die Bauwirtschaft.
[55] Lean Construction (2023), Colección guías prácticas de Lean construction Kit Lean Rehabilitación - KLR.
[56] European Commission (2021), One-stop-shops for building renovation: an integrated solution to close the gap between customers and suppliers.
[57] Energy Cities (2024), In France, a specific one-stop shop model shakes up the deep energy renovation market.
[58] Bergmans, I., Bhochhibhoya, S. and van Oorschot, J. (2023), Assessing the circular re-design of prefabricated building envelope elements for carbon neutral renovation.
[59] European Construction Sector Observatory (2019), Integrating digital innovations in the construction sector: The case of 3D Printing and Drones in construction – March 2019.
[60] European Construction Sector Observatory (2021), Digitalisation in the construction sector.

This is also confirmed in national markets. As a survey among construction companies in Germany shows, the potential for digitalisation and BIM is seen as large but its adoption remains very low across the construction sector as a whole, let alone for renovation.[61] In recent years, there have been multiple large research projects across Europe such as BIM-SPEED, BIM4EEB, and BIMERR supporting and promoting BIM for renovation, acknowledging the low market penetration of BIM for renovation despite its transformational potential. Other examples of innovation in digitalisation include the use of drones for data collection and monitoring of renovation activities.[62]

In terms of **technology innovation for renovation**, European countries leading the production of building automation products include Germany, Switzerland, France and Italy. About half of the installed building management systems have more than an elementary energy-management capacity.[63] In Germany, 36% of buildings use smart heating thermostats (from 25% in 2022). In France, approximately 6% of commercial buildings were equipped with a building management system by the end of 2023.[64] In France and Germany, sales of heat pumps peaked in 2023[65] with decreasing trends since, failing to reach government targets.[66] Per capita, Germany has among the lowest sales figures of heat pumps in Europe. However, sales data for heat pumps in building renovations specifically is limited.[67]

Data on **innovative materials for renovation** (e.g. buildings using bio-based materials) does not distinguish between new build and renovation projects. In Germany, the share of bio-based insulation materials is approximately 9%.[68] Bio-insulating materials are increasingly competing with mineral wool and plastic foam; sales of these materials are expected to grow in Europe to more than €2.3 billion by 2032.[69] In Germany, there are around 500 straw buildings, and in France 6,000,[70] the latter with 500 straw buildings newly constructed every year.[71] Other innovative materials, like self-healing or mycelium, are so far only being used in new build and/or infrastructure pilot projects.

Some of the most frequent **circularity approaches** consistently applied relate to improving durability of construction works, improving material efficiency, increasing recycled/secondary content of construction materials/products, and (designing for) flexibility and adaptability, which are linked mostly to manufacturing activities. Providers of material passports have expanded across several European countries, offering digital material passes to support circular construction.[72]

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[61] PWC (2025), The construction industry is still in transition: the skills shortage and bureaucracy are hampering progress.
[62] European Construction Sector Observatory (2019), Integrating digital innovations in the construction sector: The case of 3D Printing and Drones in construction – March 2019.
[63] DecarbEurope, Building Automation.
[64] Adeunis, Energy transition for buildings: the impact of the French BACS Decree.
[65] Clean Energy Technology Observatory (2024), Heat Pumps in the European Union - 2024 Status Report on Technology Development, Trends, Value Chains and Markets.
[66] EHPA (2024), Market data.
[67] BPIE (2024), Wärmewende in Europa. Gute Praxis aus ausgewählten Ländern & Empfehlungen für Deutschland.
[68] Bundesministerium für Bildung und Forschung (BMBF)/Bundesministerium für Ernährung und Landwirtschaft (BMEL) (2022), Biooekonomie in Deutschland, Chancen für eine biobasierte und nachhaltige Zukunft (p. 35).
[69] Ceresana (2025), Marktstudie Biobasierte Dämmstoffe – Europa.
[70] Göswein, V., Galimshina, A. and Habert, G. (2023), Bio-based renovation in Europe: Investor and homeowner prospects.
[71] Le Réseau Français de la Construction Paille, Historique.
[72] Çetin, S., Raghu, D., Honic, M., Straub, A. and Gruis, V. (2023), Data requirements and availabilities for material passports: A digitally enabled framework for improving the circularity of existing buildings.

While there are numerous innovations for the renovation sector emerging across the five areas, a consolidated overview of the market is not feasible because of the early stage of adoption and lack of data – in many cases, only anecdotal evidence is available. However, the initial overview presented in this section shows that there is potential for a larger adoption of innovative solutions to enhance the renovation sector. Even though market segments such as serial renovation and innovative materials are expected to grow in the upcoming years, there may be uncertainty on the market evolution for many other innovative solutions for renovation.

3 IDENTIFYING BARRIERS AND GOOD PRACTICES

Innovative solutions encounter various barriers to their adoption within the renovation value chain. Complex regulation, outdated requirements, cultural resistance, restricted business models, and lack of workforce availability and skills are preventing the renovation value chain from leveraging the benefits that innovation can bring. A strategic approach to remove these barriers is a must if the EU wants to increase renovation rates and the competitiveness of the renovation industry.

BARRIERS TO THE UPTAKE OF INNOVATION IN RENOVATION AND EXAMPLES OF PRACTICES TO TACKLE THEM

The European Commission's transition pathway for construction[73] identifies multiple barriers to the uptake of innovative solutions in the sector. These relate to:

- The **market**, including regulatory barriers, lack of demand to drive innovation, mismatch between innovative solutions and the needs of stakeholders.
- The **value chain**, due to high numbers of enterprises and fragmentation, a culture averse to change, lack of awareness and skills to implement innovations.
- **Financing**, due to high costs of using innovative products/services.

Most of these barriers also appear when zooming in on the renovation industry. The following section is not an exhaustive description, but highlights the most important barriers for each innovation area, as identified by experts and complemented by findings from related literature.[74]

BARRIERS TO PROCESS AND SOCIAL INNOVATION IN RENOVATION

In all three countries, **regulatory** and **cultural barriers** dominate when it comes to process and social innovations. A common example is resistance to changing established procedures. The status quo is also reinforced by concerns about potential cost increases, even when innovations promise long-term economic gains.[75]

One core barrier, mentioned in all three countries, is the **narrow scope of building codes** when defining requirements. Regulatory requirements frequently favour traditional construction methods, restricting the flexibility needed to incorporate innovative solutions such as prefabrication. This is highlighted also by the Technical Secretariat supporting the EU High Level Construction Forum.[76] In Spain, for instance, the technical building code lacks clear specifications and formal recognition of off-site construction. This in turn makes it difficult to secure traditional bank financing. In France, the existing building codes are a barrier to various innovations including prefabricated solutions, especially regarding fire safety and acoustics. Germany faces barriers related to the uncertainty of regional building codes setting out different requirements; standardisation is key to process innovation and attempts to harmonise regional rules are only progressing slowly.[77]

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[73] European Commission (2023), Transition pathway for construction.
[74] While this report aims to summarise the most relevant barriers identified by the experts interviewed in the three analysed countries, other barriers should not be disregarded.
[75] Sachverständigenrat für Umweltfragen (SRU) (2016), Umweltgutachten 2016.
[76] High Level Construction Forum (2024), Research Note on Offsite Construction.
[77] Heisenberg, E. (2025) Serielle Sanierung auf dem Weg zum Massenmarkt. In: Meuser, P. and Taher Saleh, K. (Eds.) Baupolitik im Wandel, DOM publishers.

EXAMPLES OF HOW BARRIERS ARE BEING ADDRESSED TO SUPPORT PROCESS AND SOCIAL INNOVATIONS

The **bonus for serial renovation as part of the regular renovation support scheme** in Germany amounts to 15% of the eligible costs and can be combined with other funding options such as the Worst-Performing-Building-Bonus (WPB-Bonus) or the Efficiency House Bonus.[78] The German Energy Agency has recorded a significant increase in serial renovations of residential buildings. The bonus has increased the proportion of serial approaches in subsidised energy efficiency projects (Effizienzhaus-40- und -55) from less than 2% to around 23%.

Several federal states in Germany have introduced **a new regulatory category in their state building codes: "Gebäudetyp E" (Building Type E, where E stands for "einfach" (simple) or "experiment")**. This classification allows simplified approval for buildings that deviate from standard construction norms but still ensure essential safety. For renovation, this opens the door to innovative approaches: prefabricated and serial renovation systems can be more easily applied, and non-standard materials – such as recycled or biobased components – can be used without full conformity to traditional norms. While this options is particularly relevant for piloting, not necessarily for mass application, it seems to be an important step to scale and standardise innovative solutions – especially when combined with targeted funding programmes, public procurement or when this alternative is taken up by bigger housing associations in the future.

The French government has demonstrated willingness to **promote off-site renovation and construction using industrialised prefabricated building elements through initiatives such as reporting missions[79] and calls for tenders**,[80] for instance as part of the French Recovery Plan.[81]

In Spain, key actors[82] in the construction sector developed **an implementation kit to optimise workflows and teamwork, minimise waste and enhance communication in building renovation** (including the implementation of lean approaches such as Kanban, 5S, Just in Time, Informe A3, Agile teams, and Communication strategies).[83]

[78] KFW, Bundesförderung für effiziente Gebäude (BEG).
[79] Ministère chargé du Logement (2021), L'industrialisation de la construction.
[80] ADEME, Développement de la Construction et de la Rénovation Hors Site (CRHOS) | Agir pour la transition écologique.
[81] Ministère de l'Économie des Finances et de la Souveraineté industrielle et numérique, Plan de relance.
[82] Including: Consejo General de la Arquitectura Técnica de España, Instituto de Tecnología de la Construcción – IteC, and Cluster Habitat Eficiecnte – AEICE.
[83] Lean Construction (2023), Colección guías prácticas de Lean construction Kit Lean Rehabilitación - KLR.

Both in France and in Germany, **public procurement** was identified as a main barrier, as the current rules require tenders to be issued in several smaller lots by default[84] – making it more cumbersome to allow one single renovation solution provider to coordinate all actors.[85,86] **Long authorisation procedures and uncertainties regarding liability** were mentioned by German experts as an obstacle to systemic innovations making use of prefabrication. Other barriers for prefabricated façade approaches relate to a **lack of support tools, expensive financial models, lack of trained staff and low stakeholder engagement**.[87]

Experts mentioned other obstacles such as local actors having difficulties coordinating and using new digital tools. In addition, there is the **uncertainty of investing in new tools without knowing whether the investment will pay off. Resistance to integrated project management and other optimised processes** is very common among renovation practitioners and companies and includes all actors along the renovation phases, from planning to facility management.[88]

BARRIERS TO INNOVATIONS IN DIGITALISATION

The most important barriers encountered by innovative digitalisation solutions for renovation, in particular the realisation of a seamless digitised renovation process, relate to **cultural values, incompatible supply chains, workforce skills** and **the additional upfront investment** needed for digital tools. These barriers have also been identified by the EU projects on BIM for renovation, which also highlight SMEs as a bottleneck towards adopting BIM technologies for renovation.

In Germany, the high resistance to using digital tools among construction and renovation suppliers is explained by the fact that there is **little capacity and affinity for digitalisation in the workforce**.[89] Additionally, uptake is complicated by a **lack of integration across the supply chain**, with different actors using incompatible tools (e.g. the planner uses software with different data formats and data definitions compared to the provider of façade renovation).[90] This fragmentation is often due to renovation projects being split into many small contracts rather than managed as a single comprehensive one, which is the default approach in **public tendering**. As a result, digitalisation efforts remain disjointed. Another reason is cultural in nature and stems from **concerns about surveillance and hacking**.

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[84] This measure aims to protect SMEs, which should be considered within alternative procurement procedures.
[85] Though specifically related to public procurement, this is still how renovation tends to be approached in other contexts.
[86] Ministère chargé du Logement (2021), L'industrialisation de la construction.
[87] European Commission (2021), Overview: Modular and industrialised solutions for building renovation.
[88] See also Schwarzwälder, H. (2023), Die digitale Bauwirtschaft – Wege aus der Branchenlogik. Status Quo und Chancen der digitalen Transformation.
[89] Agora Energiewende, ifok, BPIE (2024), Serielle Sanierung. Effektiver Klimaschutz in Gebäuden und neue Potenziale für die Bauwirtschaft.
[90] See Schwarzwälder, H. (2023), Die digitale Bauwirtschaft – Wege aus der Branchenlogik. Status Quo und Chancen der digitalen Transformation.

In Spain, the main barrier identified was that the **initial investment costs** for digital tools and equipment cannot be passed on to the end customer. Any additional investment on digital equipment or services needs to be recovered in the few months of the renovation project execution. A similar argument was stated by German experts. There, the regulation that governs how architects and engineers are compensated for their services (Honorarordnung für Architekten und Ingenieure - HOAI), sets standardised fee calculations based on project complexity, scope and construction costs and does not include digital planning and/or mandatory BIM models for the detailed design stage.

Also, construction companies in Germany claim that there is little demand for digital solutions in tendering and their use has even been declining since 2021[91]– coinciding with the general downturn in construction activities because of multiple crises.

Like in Germany, French stakeholders claim that while the use of BIM has grown significantly, digital models created by architects are often not used by companies carrying out the renovation at the construction site due to a lack of skills. However, the French open data policy (see box) paved the way for many digital innovations. Most concerns relate to the reliability of digital innovation, especially the reliability of data and simulations, which is seen as a barrier to their widespread uptake.

EXAMPLES OF HOW BARRIERS ARE BEING ADDRESSED TO SUPPORT DIGITALISATION

In 2023, Spain approved its **BIM plan** to include BIM requirements in public procurement. The plan instructs contracting authorities on the incorporation of BIM into information management for public sector construction-related contracts, according to a progressive roadmap for BIM implementation.[92]

The French **open data policy** – requiring open data by default and proactive provision of data from all government authorities[93] – and the public availability of data about the building stock and its energy performance have driven the development of new apps and tools to improve the renovation process. For example, some apps support homeowners in assessing buildings by drawing on national building databases. This makes it easier to decide in favour of or against renovation measures.

In France, the introduction of an **obligation to renovate residential buildings** rated G by 1 January 2025 (the "Climate and Resilience law")[94] has led to a significant increase in digital innovations to help homeowners identify necessary renovation work and estimate the impact of renovation measures.

[91] PWC (2025), The construction industry is still in transition: the skills shortage and bureaucracy are hampering progress.
[92] Ministerio de Transportes, Movilidad y Agenda Urbana (2023), Plan BIM en la contratación pública.
[93] Ministère de l'Aménagement du territoire/Ministère de la Transition écologique (2022), Loi climat et résilience.
[94] Loi n° 2021-1104 du 22 août 2021 portant lutte contre le dérèglement climatique et renforcement de la résilience face à ses effets.

BARRIERS TO INNOVATIONS IN TECHNOLOGY

> **The main barriers to unlocking the full potential of renovation activities are related to the renovation process, decision-making and other non-technological aspects.[95] The areas of process and social as well as digitalisation innovation seem most important for tackling these challenges.**

The **lack of skilled workers** was mentioned as a main barrier to applying innovative technologies in renovation.

In France, for example, even "regular" heat pumps are being deployed slowly due to a **lack of skills**, and insufficient feedback on the quality and actual energy performance of the heat pump installations.[96] Other innovative solutions, like thermoacoustic heat pumps, face the same problem. Skilled workers familiar with new technology usually represent **high labour costs**, as mentioned by both French and Spanish experts.

A consequence of the lack of a skilled workforce is a significant loss of performance when technological innovations are poorly installed. This leads to frustrations among building owners and occupants and hampers large-scale deployment.

In addition, some of the interviewed experts in France raised the **reluctance of insurance companies to adopt and financially cover these innovations over traditional solutions** as an important barrier.

Technological innovations like infrared-heating windows and thermally activated building systems require extensive testing processes, which are expensive and require skilled professionals to carry them out. Only then can technological innovations be certified and enter the market. The **delays and costs associated with the authorisation process** were also mentioned as a hurdle by German experts.

In Spain, the **lack of awareness or information** of the final customer – especially in the residential sector – is also considered an important barrier to the adoption of new technologies. Emerging heating technologies (e.g. heat pumps) and other technologies such as smart monitoring systems also encounter challenges due to limitations on space or aesthetic and historical heritage preservation requirements.

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[95] Prieto, A., Armijos-Moya ,T. and Konstantinou, T. (2024), Renovation process challenges and barriers: addressing the communication and coordination bottlenecks in the zero-energy building renovation workflow in European residential buildings.
[96] Pouget Consultants (2022), Etude sur les freins et leviers à la diffusion de la pompe à chaleur en logement collectif DGALN/DHUP/QC4.

For innovative heating systems, the energy performance of the buildings is very often a barrier. While previous innovative solutions such as distributed heat pumps are already at a high state of technological readiness, one of the largest obstacles to progress remains the lack of insulation and air sealing in the buildings they could serve, which reduces efficiency and effectiveness.[97] The readiness of buildings therefore becomes crucial for the uptake of certain innovations in technology.

EXAMPLES OF HOW BARRIERS ARE BEING ADDRESSED TO SUPPORT RENEWABLES AND HEATING TECHNOLOGIES

In Spain, as part of the Recovery, Transformation and Resilience Plan, financial support is dedicated to innovative renewable energy solutions, including heat pumps, and renewable installations for self-consumption in communities and multi-family buildings (which are home to around 70% of the population), with a special focus on vulnerable groups.

France has linked public financing with training achievements: the RGE label (Reconnu Garant de l'Environnement) is a French certification system for companies specialised in energy renovation and renewable energy. For example, public funding is only granted if the customer hires a company with RGE certification to install the heat pump. In 2023, 1.2 million heat pumps were sold, of which 910,000 were air-to-air heat pumps.[98] This market growth in recent years has gone hand in hand with an increase in skilled worker training and company certifications. Also, as part of the 2024 heat pump action plan, one of the eight measures involves assessing the needs of companies and public institutions to enable the required skills development.[99]

With the Market Incentive Programme (MAP), the German government promoted the use of heat from renewable energies – for example solar thermal systems, wood pellet heating systems and efficient heat pumps. The MAP was launched back in 1993 and enshrined in law when the Renewable Energy Heat Act (EEWärmeG) came into force on 1 January 2009. The programme was a central energy policy funding instrument, mainly aimed at existing buildings. In 2021, the MAP was merged with other individual energy efficiency programmes to form the Federal Subsidy for Energy-Efficient Buildings (BEG).

[97] European Commission (2024), Addressing European research and innovation challenges for system transitions in energy and mobility.
[98] Ministère de la Transition écologique (2024), Pompes à chaleur.
[99] Ministère de l'Économie des Finances et de la Souveraineté industrielle et numérique, Plan Action pompes à chaleur (French Action Plan Heat Pumps); ANR, Call for Expressions of Interest under the Heat Pump Action Plan.

BARRIERS TO MATERIALS INNOVATIONS

Regulatory and **cultural** barriers were identified as the most important in relation to the use of innovative materials such as bio-based solutions.

In Spain, experts mentioned regulatory barriers for innovative materials. There, CE (Conformité Européenne) markings guarantee the performance of construction materials and are a guarantee for buyers. For new and innovative materials it is often necessary to apply for a DIT (Technical Suitability Document) or an ETA (European Technical Assessment) to conduct a **technical assessment issued by an accredited body**.[100] However, these two instruments have no administrative effect, nor do they represent authorisation for use or guarantee of new innovative materials, further administrative processes are required for those two purposes.

The deep-rooted **conventional mentality**, the importance of **aesthetics and tradition, resistance to change and innovation** and the **lack of clear related standards and regulations** can also be obstacles hindering the adoption of sustainable materials in Spain. Experts also indicated that enterprises producing innovative materials encounter **challenges in promoting and advertising their solutions** since they do not know who they should address – the final user (building occupant/owner) or their direct customer (project contractor).

In Germany, **a lack of resources to provide certificates and environmental product declarations (EPDs)** was mentioned as a challenge for innovative, sustainable materials and products.

Experts in France indicated that, while innovative materials provide many advantages from a health and sustainability perspective, their low market volumes and therefore lack of experience make integration into renovation difficult, leading to a feeling of **added complexity**. Some public contracting authorities lack knowledge in technology and material innovations. This cultural gap may hinder the widespread adoption of these innovations. In addition, bio-based products are not always easily accessible because the supply and marketing processes are often less organised than those for conventional materials.[101] Apart from regulatory challenges, it was mentioned that new construction materials can also **complicate insurance processes**, as they may be unfamiliar to insurers or lack long-term performance data. Moreover, stakeholders and decision-makers involved with project funding typically focus on initial costs and budget control rather than long-term implications and operational savings on maintenance, energy and water.[102]

[100] Plataforma Tecnológica Española de Construcción (2024), Hoja de ruta de innovación para la sostenibilidad del sector construcción en España.
[101] Odeys (2023), Retour sur la rencontre bas carbone: frein et leviers à la prescription des isolants biosourcés.
[102] Lombard, R. (2017), It's not easy being green: Difficulties in sourcing sustainable building materials.

EXAMPLES OF HOW BARRIERS ARE BEING ADDRESSED TO SUPPORT INNOVATIVE MATERIALS

Several German federal states (Berlin, Hamburg, Baden-Wurttemberg) have adopted **procurement guidelines that encourage or require the use of secondary raw materials**, such as recycled concrete, asphalt or insulation, in construction and renovation works.

These criteria are often embedded in sustainability strategies or public building guidelines and support circular construction goals.

The **"Gebäudetyp E"**, implemented in several German federal states, can help to use more innovative materials (see under "Process and social innovations" above).

Italy introduced **mandatory green public procurement (GPP) minimum environmental criteria** for all public building contracts, covering new construction and renovation projects. This significantly incentivises the market to improve the quality of products, increase traceability of recycled content, adopt certifications for recycled products, and raise awareness among producers and users. Even though implementation was slow (around 18% on average for big towns in 2020), the market quickly adapted by increasing supply of GPP–compliant construction products.[103]

BARRIERS FOR INNOVATION IN CIRCULARITY

The main barriers for the use of circular economy innovative solutions are related to **perceived complexity and regulatory elements**.

Experts in France and Spain indicated that renovation is already complex, and adding circularity principles may add excessive layers of complexity (for now). In Spain, there is even a regulation for circularity including elements such as higher recycling rates (up to 70%) and extended producer responsibilities for management of waste produced by building products and materials, but SMEs experience an extra burden on translating the requirements into practical actions. In Germany it was mentioned that logistics for recycling of plaster or mineral wool hardly exists. On a more general level, it was stressed that landfilling is currently far too inexpensive, making it an overly convenient disposal option and that a viable business model for secondary materials can only emerge once market pressure increases and larger quantities of secondary materials are recovered.

Experts claimed that additional renovation criteria for circularity could further slowdown renovation activities since the renovation value chain is still dealing with previous challenges and embedding circularity within the process is perceived as another layer of complexity.

Circular economy approaches also **require the development of new business models** that demand changes in the supply chain, and which encounter their own barriers.[104,105] The fragmentation of the renovation process into smaller contracts – often as a result of the common tendering practices – prevent a lifecycle view on the building.

[103] Interreg Europe (2024), Sustainable and circular, A Policy Brief from the Policy Learning Platform for a greener Europe.
[104] BAM/ARUP, Circular business models for the built environment.
[105] Circular Berlin (2023), Study "Business models for circular construction and renovation".

EXAMPLES OF HOW BARRIERS ARE BEING ADDRESSED TO SUPPORT CIRCULARITY

Germany set a goal in the last legislative period to become a leading market in circular solutions in the construction sector.[106] The National Circular Economy Strategy emphasises the importance of conserving primary raw materials by increasing the use of secondary raw materials, the conversion and continued use of buildings, circular and low-waste planning of buildings, reuse of building components, and recycling measures to utilise the material properties of resources. While there are increasing guidelines and initiatives for circular construction in new buildings, renovation projects using reused materials or building components are still scarce. The introduction of a resource passport is planned, which will provide information on the materials used in a building.

France has implemented an **extended producer responsibility (EPR) scheme for construction and demolition waste** since 2022.[107] Under this scheme, producers and importers of construction products are responsible for the end-of-life management of their materials, including collection, sorting and recycling. The scheme covers a wide range of materials, including insulation, flooring, windows and fittings, and is managed by approved eco-organisations (producer responsibility organisations). It has helped to scale up recycling infrastructure and to create markets for secondary materials.[108]

OTHER BARRIERS

Experts in the focus group generally highlighted the importance of the **cost of the innovations** as a barrier across innovation areas, often due to low market volume. They also indicated that while regulation is well received, the requirements of building codes and norms are often based on **outdated assumptions and over-dimensioned**, exceeding practical needs. Resistance to adopting innovative solutions in renovation often comes from the fact that many professionals and companies are transitioning from new construction to renovation. Because working with existing buildings involves different challenges and skills, **many in the industry are still in a learning phase**. As a result, they tend to focus first on understanding the basics of renovation, and view innovation as something to consider later, once they have mastered the fundamentals. Stakeholders interviewed agreed that binding legal requirements are the most powerful tool to bring innovation for renovation into the

[106] Allianz für Transformation (2024), Eine starke Kreislaufwirtschaft für Wertschöpfung, Souveränität und Nachhaltigkeit.
[107] Government of France (2024), Produits et matériaux de construction du secteur du bâtiment.
[108] BPIE (2024), Extended Producer Responsibility in the construction sector.

A STRATEGIC APPROACH FOR ADDRESSING THE IDENTIFIED BARRIERS

The research and interviews identified a variety of barriers. To create a clear connection between the barriers and how they can be tackled strategically in an integrated manner, rather than with individual measures, we propose to cluster them under three strategic approaches[109] (Figure 3):

MARKET BARRIERS
Including barriers related to demand as well as regulation and policy.

VALUE CHAIN
Considering barriers related to the actors, workforce, knowledge and skills, data and information, culture and behaviour.

FINANCE
Related to costs, revenues, risks and business models.

A strategic approach, targeting all three categories, is needed to overcome barriers and support the uptake of innovations in renovation: different levers and enablers need to be established to enhance markets, the value chain needs to be transformed to contribute to the market, while different financial mechanisms on the demand and supply sides act across market creation and transformation of the value chain. This addresses multiple barriers to innovation through broader top-down instruments that can be attached to high-level regulations such as the EPBD (see next chapter), national renovation programmes, or other initiatives to increase and accelerate the renovation of the EU building stock.

[109] During the first stage of the research and discussions with experts, the identified barriers were categorised in six groups: regulatory and policy, financial, cultural and behavioural, technological, knowledge and skill gaps, and data and information.

	PROCESS AND SOCIAL INNOVATIONS	INNOVATION IN DIGITALISATION	INNOVATION IN TECHNOLOGY	MATERIALS INNOVATIONS	CIRCULAR ECONOMY INNOVATIONS
MARKET BARRIERS	(R&P) **Compliance requirements of construction standards frequently favor traditional construction**		(D&I) **Lack of information on the benefits**	(R&P) **Not clear standards. When available, often they have outdated requirements** (R&P) **Complex certification processes**	(R&P) **Complex regulation creates extra burden on a process that is already complex**
	(C&B, R&P) **Lack of binding targets/regulation to push the market**				
VALUE CHAIN BARRIERS	(C&B) **Aversion to change existing procedures** (K&S, C&B) **Difficulties to coordinate differently among actors, while involving new tools, which require investment, and may have a risk on profitability** (R&P) **Unfavorable procurement rules and practice**	(C&B) **Little affinity for digitalisation in workforce** (T) **Limited interoperability and standardization** (R&P) **Unfavorable procurement rules and practice**	(K&S) **Lack of awareness of the final customer** (K&S) **Limited specialized workforce**	(K&S) **Added complexity** (C&B) **Multiple customers need to be addressed throughout the supply chain for the usage of certain materials**	(C&B) **Aversion to change existing procedures** (R&P) **Procurement/tendering not in favour of whole lifecycle view** (C&B) **Requires new business models with adjustments in the value chain**
	(K&S) **Industry and workforce shifting from new construction to renovation, priority is to learn how to handle existing buildings, delaying the adoption of available innovation in renovation**				
FINANCE BARRIERS	(F) **Investment is required for new organisation of collaboration approaches and supportive tools** (R&P, C&B, D&I) **Lack of project aggregation**	(F) **Existing business models limit the chances to take higher risks and investments on emerging innovations**	(F) **High cost from limited specialized workforce**	(F) **Project funding focuses on upfront costs and budget control, rather than long-term environmental impacts or potential savings from reduced maintenance, energy, and water use**	
	(F) **High cost due to low market volume; (R&P) Lack of clear market signal**				

Figure 4. Barriers to innovations in renovation

(R&P): **Regulatory and policy**; (D&I): **Data and information**; (C&B): **Cultural and behavioural**; (T): **Technological**; (K&S): **Knowledge and skill gap**; (F): **Financial**

4 KEY POLICY OPPORTUNITIES FOR SCALING UP INNOVATION FOR RENOVATION

Member States should develop a strategic agenda for innovation in renovation, based on three pillars: create markets, transform the value chain and provide effective financing solutions. The transposition of recent EU policy files presents an opportunity to apply this approach, accelerate deep renovation and contribute to the sustainability of the industry.

A strategic approach to innovation in renovation will increase the productivity of the whole sector, raise the quality of the renovation work and bring costs down.

Policies to support this should be based on the following three pillars.

CREATE MARKETS THROUGH TARGETED REQUIREMENTS

There are several routes for governments to create markets for innovative solutions for renovation:

- Requiring market actors to meet certain standards
  - at a certain point in the life cycle of the building
  - by a fixed date
- Financial support (see sub-section Effective financing solutions below)
- Public procurement for renovation works see section 4.2 Policy opportunities beyond the EPBD).

TRANSFORM THE VALUE CHAIN

There are different routes to transform the value chain to facilitate and leverage the adoption of innovations in renovation:

- Changes in procurement strategies integrating the renovation process from planning through implementation to end-of life (see section 4.2 Opportunities beyond the EPBD)
- Standardising data formats and definitions and refining existing building codes
- Requiring and supporting digital tools throughout the renovation value chain.

EFFECTIVE FINANCING SOLUTIONS FOR INNOVATION IN RENOVATION

Routes to increase investments for innovation in renovation include:

- Enhancing access to capital/credit for more user groups (increase demand)
- Creating new markets through standards/requirements and/or market-based mechanisms (see section on market creation)
- De-risking investments in innovation.

The following sections discuss how different EU directives and regulatory files bring opportunities to enable these elements. Specific recommendations are summarised in the final chapter.

TRANSPOSITION OF THE EPBD AS A LEVER TO BOOST INNOVATION IN RENOVATION

European Member States must transpose the new EPBD into national legislation by the end of May 2026. This presents an opportunity to strategically strengthen support for innovation in renovation and design policies that transform and enhance the way renovation is conducted in the EU.

CREATING MARKETS THROUGH TARGETED REQUIREMENTS FOR ENERGY EFFICIENCY

The EPBD provides several opportunities to create markets for innovative renovation solutions. The new provisions create a general market for renovation, directing construction activity towards the existing building stock. In this way, they represent baseline requirements for renovation to accelerate, creating demand for solutions that can deliver faster than current practices.

Particularly relevant for innovation in renovation is the implementation of EPBD Article 9.[110] The obligation to reach a certain level of energy performance by a specific date according to minimum energy performance standards (MEPS) for non-residential buildings (Article 9(1)) will accelerate renovation in the targeted buildings. By selecting specific building segments, setting an appropriate ambition level and timeline and defining eligible renovation actions, the obligation can be structured to include elements that actively support and incentivise innovation in the renovation process. A similar approach can be extended to the residential sector.

For the renovation of residential buildings, Article 9(2) on the trajectory for the progressive renovation of the residential building stock provides more flexibility for Member States to design the policy mix. MEPS are one option, but other tailored policy instruments may target worst-performing buildings and achieve the sub-targets defined by the provisions for this building segment (at least 55% of the reduction of the average primary energy use of the residential building stock must be achieved through the renovation of the 43% worst-performing buildings).

Experience from the UK and the Netherlands has demonstrated that MEPS stimulate the market beyond the targeted segment. In France, too, MEPS stimulated the renovation market notably. Article 9 can thus be a powerful instrument to stimulate the market for renovation in general, and an opportunity to increase the volume of innovative solutions.

[110] Provisions from other articles such as solar energy in buildings (Art. 10), technical building systems (Art. 13), one-stop shops (Art. 18), and recommendations to be included in EPCs (Art. 19) and renovation passports (Art. 12) can also bring multiple opportunities to create market for innovations in renovations, if they are implemented with higher levels of ambition or their scope extended to renovating building segments not yet covered. Other articles are expected to encourage innovation more indirectly: EPBD Article 11 on zero-emission buildings is one example. The requirement to establish new zero-emission standards marks a general rise in ambition of the energy performance of buildings. This provides greater market certainty and indirectly encourages innovation. Similarly, the introduction of limit values for the life-cycle GWP as required by Article 7 for new buildings will initiate changes in construction demand. Over the longer term, it might have an impact for innovative materials or circularity approaches for the renovation market as well, since companies often work in both market segments. However, evidence of those spill-over effects is still unclear, and we recommend a targeted approach to incentivise innovation in renovation.

TRANSFORMING THE VALUE CHAIN

Process and social innovation and innovation in digitalisation as well as circular economy principles have a transformative effect on the renovation value chain. They require strong links between planning and implementation, so coordination of all supply chain actors is needed at an early stage. This creates opportunities to optimise and streamline processes, including improving renovation site logistics, accelerating individual renovation processes and more effective interaction with the building owner, occupants and other key actors.

The EPBD requires Member States to collect better and more comprehensive data about the building stock. Article 22 requires Member States to systematically compile a database on the energy performance of buildings, including data from energy performance certificates (EPCs), inspection reports, renovation passports, digital building logbooks, smart readiness indicator, energy suppliers, life-cycle GWP and material passports. It calls for better digital data management and clearly defined access rights, data formats and use cases. This is a precondition for a renovation industry that relies on digital processes.

National building renovation plans (NBRPs, EPBD Article 3) offer a framework to strategically collect and use the data to better understand the effects of innovation in renovation and help prioritise investments.

This transformation also requires increasing awareness about the benefits of innovations and specialised skills among renovation companies and workers. Creating strategies to facilitate and increase the training of the renovation workforce to use innovative solutions is essential. Also, in relation to the workforce, the **EPBD brings a significant focus on vulnerable groups throughout the different provisions**. There is potential to engage and train vulnerable groups to carry out renovation activities, creating jobs and addressing skills gaps within the restoration value chain.

EFFECTIVE FINANCING SOLUTIONS FOR INNOVATION

Investments are needed to mainstream innovative solutions for energy renovation on both the demand and supply sides. On the demand side, building owners must have the financial capacity to invest in these solutions. On the supply side, innovators need sufficient resources to develop and scale up the production of their solutions. Small and medium-sized enterprises, which carry out the renovation work, must be enabled to use innovative solutions. This can be facilitated by digital solutions that e.g. simplify the submission of offers via a centralised offer platform. However, financial support to adopt and invest in tools is also considered important for this target group.

EPBD Article 17 requires Member States to provide appropriate financing for renovation, remove (non-economic) barriers and especially target vulnerable households. It mentions a range of financing mechanisms that Member States should consider. Article 17 should also be seen as an opportunity for Member States to accelerate the uptake of innovative solutions through securing investments.

Apart from Article 17, the **EPBD has introduced the specific requirements for Member States to set up one-stop shops for the energy performance of buildings** (Article 18). In practice, there are many one-stop-shop concepts, mostly focusing on informing building owners comprehensively about renovation options for their buildings. However, one-stop shops can also be an important vehicle to push for innovative solutions and create value locally. To spur innovative renovation solutions, they should help the customer in financing and planning the whole renovation journey.

POLICY OPPORTUNITIES BEYOND THE EPBD

CREATING MARKETS THROUGH PUBLIC PROCUREMENT

Given that public procurement accounts for nearly 15% of the EU's GDP, it plays a key role in driving innovation in the renovation sector.[111] Currently, more than half of public contracts in the EU are awarded without any environmental criteria.[112] So far, green public procurement criteria serve as voluntary guidelines only.[113] The role of public procurement will increase in view of renovation targets provided by Article 6 of the Energy Efficiency Directive (EU) 2023/1791. Each Member State must ensure that at least 3% of the total floor area of heated and/or cooled buildings that are owned by public bodies is renovated each year to be transformed into at least nearly zero-energy buildings or zero-emission buildings.

The EED also introduces **sector-specific requirements for public procurement practices for buildings and renovation works (Article 7, Annex IV).** Contracting authorities must apply the 'energy efficiency first' principle. In addition to the energy efficiency requirements for procurement, the EED also notes the possibility for Member States to require contracting authorities to consider broader aspects of sustainability – including social, environmental and circularity criteria – in their procurement practices, and to consider the so-far still voluntary EU GPP criteria or equivalent national criteria, where available. Making GPP criteria mandatory could help ensure that more innovations with a positive impact on sustainability are taken into account in procurement decisions. This discussion is currently ongoing at the EU level.

The EED further highlights that Member States should support contracting authorities and contracting entities in the uptake of energy efficiency requirements, including at regional and local level, by providing clear rules and guidelines. These include methodologies on the assessment of life-cycle costs and environmental impacts and costs; setting up competence support centres; encouraging cooperation among contracting authorities, including across borders; and using aggregated procurement and digital procurement where possible.

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[110] European Commission, Public Procurement of Innovation.
[112] ECOS (2024), Buy better to build better: Driving public purchase towards green construction products.
[113] The European Commission has launched an evaluation of the EU Public Procurement Directives to assess their effectiveness. A call for evidence and a public consultation was launched in December 2024; the impact assessment is ongoing and a proposal for a revision planned for autumn 2025. ECOS (2024) recommends implementing GPP for key construction materials such as cement and steel.

For innovative products and services that are not yet on the market but still in the research stage, the Public Procurement Directive (2014/24/EU, Article 31) provides for the use of **innovation partnerships**. These apply when a contracting authority identifies a need that cannot be met by existing solutions on the market. Innovation partnerships could also be leveraged to promote the development of innovative renovation products, services or works. However, as this report has shown, many effective solutions exist already – the biggest challenge is often related to scaling them up.

TRANSFORMING THE VALUE CHAIN THROUGH DIGITALISATION

Many innovative renovation processes and solutions, such as industrial prefabrication, rely on digital planning and streamlined processes along the value chain. The EU Public Procurement Directive, while allowing flexibility, emphasises transparency, competition and non-discrimination with the specific aim to protect SMEs. **National procurement authorities often interpret this conservatively, which leads to risk-averse and highly fragmented practices.** Legal uncertainty often discourages the use of more flexible procedures, such as functional tenders or innovation partnerships. Public authorities by default tender individual services/trades separately, such as design, construction, façade elements and technical building systems. This prevents the commissioning of integrated, turnkey solutions. Furthermore, public procurement practices often set a precedent, shaping a broader culture of project tendering across the sector, creating a 'culture of fragmentation', where breaking down projects into small lots becomes the default approach. There is a lack of experience and legal guidance to confidently use more integrated approaches.

The EED, when highlighting the special role of public bodies (Article 6), also **mandates setting up an inventory of heated and/or cooled buildings owned or occupied by public bodies**[114] that Member States must update at least every two years. This inventory should be linked to the database required in the EPBD (Article 22) to align these efforts.

A circular economy, as outlined in the EU Green Deal and Circular Economy Action Plan, will require the transformation of value chains. **The EU is advancing a comprehensive regulatory framework to accelerate the transition to a circular economy**, with key initiatives such as the Ecodesign for Sustainable Products Regulation, the revised Construction Products Regulation (CPR) and the planned Circular Economy Act. One central instrument is the digital product pass, which aims to promote sustainability, circularity and legal compliance by providing a detailed digital record of a product's life cycle, enhancing information and coordination along the supply chain.

[114] Buildings that have a total useful floor area of more than 250m^2.

5 RECOMMENDATIONS FOR MEMBER STATES TO BOOST INNOVATION IN RENOVATION

Member States should use the implementation of recent EU policies as an opportunity and apply a strategic approach to boost innovation in the renovation sector. This will support the competitiveness and sustainability of the construction sector.

The key policy opportunities identified in the previous chapter to boost innovation in renovation can be summarised as follows:

STRATEGIC APPROACH	POLICY OPPORTUNITY
 **Create markets through regulatory requirements**	**Design MEPS for non-residential buildings and a policy mix to renovate worst-performing buildings** • EPBD Article 9 (1,2)
	Introduce sector-specific requirements for procurement • EED Article 6 / 7
 **Transform the value chain**	**Push for better data and invest in digital infrastructure** • Database on the energy performance of buildings – EPBD Article 22 • Inventory of heated and cooled buildings – EED Article 6 • National building renovation plans – EPBD Article 3 • Prepare for upcoming digital product passports – CPR Article 75, 76
	Revise public procurement laws to mainstream innovative solutions – ongoing revision of the EU Public Procurement Directive
	Support the value chain in the uptake of circular solutions with additional policies • Circular Economy Act (upcoming)
	Upskill the workforce • EPBD Article 17
	Distinguish between new construction and renovation when collecting data
 **Effective finance solutions for innovation**	**Support start-ups by de-risking investments**
	Design specific support programmes for smaller renovation companies to deploy innovative tools
	Unlock finance through one-stop shops for energy renovation

CREATE MARKETS FOR INNOVATION IN RENOVATION

DESIGN MINIMUM ENERGY PERFORMANCE STANDARDS FOR NON-RESIDENTIAL BUILDINGS

For the implementation of Article 9(1) for MEPS for non-residential buildings, the following design options should be considered to boost innovation in renovation:

- **Set separate thresholds for different building categories and choose final energy as the indicator:** This approach helps estimate the renovation market size per segment – reducing uncertainty about how many buildings (e.g. hospitals, hotels, offices) must be renovated to meet the obligations. It also supports the design of targeted measures for segments with high innovation potential and enables bundling of similar buildings for streamlined, scalable 'plug-and-play' renovation solutions.
- **Provide additional incentives for innovative action:** Additional incentives can encourage innovative renovation practices – for example, offering a bonus within financial support schemes or extending compliance deadlines when innovative approaches are used. Financial rewards could also target solutions that are easily replicable across one or more building segments, helping to generate higher market uptake.
- **Create a market for MEPS certificates:** This could be an option to incentivise innovative financing solutions to generate additional energy savings beyond the minimum standards, creating a market for innovations that can accelerate renovation processes and increase the depth of the renovation.

DESIGN A POLICY MIX TO RENOVATE WORST-PERFORMING RESIDENTIAL BUILDINGS

To trigger innovative practices and accelerate renovation in residential buildings, the following are crucial:

- **Define a responsible actor to deliver energy savings:** In MEPS schemes, this is typically the building owner. However, the responsibility to deliver energy savings may also lie with municipalities under their local heating and cooling plans, with a regional one-stop shop, or with the facility manager of larger apartment buildings or real estate stocks. Assigning clear responsibility for delivering renovation volumes or energy savings can help design targeted strategies to integrate innovation into renovation activities.
- **Scale solutions by providing incentives for pooling renovation:** Identifying building segments or regions (neighbourhoods, districts) with buildings sharing similar characteristics can enable replicability of innovative solutions. Incentives could be granted for plug-and-play solutions that can be implemented in many buildings, for instance in entire neighbourhoods.

Support the deployment of innovative renovation solutions in hard-to-reach segments: The implementation of the EPBD calls for special attention to vulnerable groups, linking closely to the sub-target of achieving at least 55% of energy improvement through the renovation of worst-performing buildings – often home to socioeconomically vulnerable households. Meeting this target requires focused efforts to boost renovation rates in this segment. Innovative, cost-reducing solutions will be essential to enable upgrades in hard-to-reach buildings. Support programmes could include a portion of projects that trial and showcase scalable innovations.

INTRODUCE REQUIREMENTS IN PUBLIC PROCUREMENT

The implementation of the EED and GPP criteria represents a strategic opportunity for EU Member States to stimulate early innovation and test new approaches in renovation.

Member States should go beyond minimum compliance with EED requirements and mandate the use of GPP criteria for building renovation in national procurement frameworks: this way governments can send strong market signals that reward forward-thinking renovation solutions. Member States could promote the use of innovative solutions by:

- Requiring life-cycle assessments and environmental product declarations for public renovation projects and ensuring that data collection systems align with EU-level digital infrastructure
- Encouraging or requiring use of BIM and digital twins
- Incentivising the use of circular materials (e.g. requirements such as minimum thresholds for recycled content, reuse and recyclability of materials, or design for disassembly).

TRANSFORM THE VALUE CHAIN

PUSH FOR BETTER DATA THROUGH IMPLEMENTATION OF EUROPEAN LEGISLATION AND INVEST IN DIGITAL INFRASTRUCTURE

Digital tools can help transform the construction value chain for both new builds and renovations. A precondition for this is that the tools used by different actors at different stages of the life cycle can function seamlessly, without interruptions due to differences in data format or definitions. A construction data space[115] would unleash the enormous potential of data-driven innovation, enabling collection, interoperability and sharing of data in the construction ecosystem, which is an important priority.[116] Two main policy angles can support this: establishing common formats, standards and definitions; and establishing and strengthening policy instruments that implicitly or explicitly require better coordination of actors across the value chain.

[115] A data space is a framework to support data sharing providing a clear structure for participants to share, trade, and collaborate.
[116] European Commission (2023), Transition pathway for construction.

- **Create a strong database:** Member States should use the requirements to set up a database (EPBD Article 22 and EED Article 6) to establish an open data policy and make the data widely available, in compliance with data protection requirements. A well-designed database can enable innovative business models, especially if linked to digital building logbooks.

- **Push for better data collection and monitoring through national building renovation plans** (EPBD Article 3): Member States should use this instrument to support a comprehensive strategy to support innovation in renovation.

- **Prepare for the upcoming introduction of digital product passports** in the CPR, which will provide essential information on product durability, reparability and material content. Developing national pilot schemes for digital product passports in renovation projects, and investing in digital infrastructure to enable product traceability, will be key steps to ensure smooth uptake and mainstream circular economy innovation in renovation.

REVISE PUBLIC PROCUREMENT LAWS TO MAINSTREAM INNOVATIVE SOLUTIONS

To incentivise innovation in renovation and transform the value chain:

- Member States should **revise their procurement laws to enable the digitalisation and simplification of procedures**, including the use of e-procurement platforms and outcome-based specifications, the latter defining the desired societal or service outcome and leaving more room for innovation for the supplier.

- **Procurement rules should treat performance-based specifications and lot-based tendering procedures as equally legitimate approaches**. These reforms would create opportunities for providers of innovative and holistic solutions, such as serial renovation models, to see greater uptake of their offerings. The implementation of functional tenders that specify the performance or result rather than to prescribe the detailed renovation steps allows for innovation partnerships and collaborative procurement models.

- Procurement authorities should provide **guidance and capacity-building on how to use functional or performance-based procurement**, or develop model tenders or frameworks for integrated, digitalised renovation approaches.

SUPPORT THE VALUE CHAIN IN THE UPTAKE OF CIRCULAR SOLUTIONS WITH ADDITIONAL POLICIES

In light of the EU Circularity Act and the need to boost circular innovation in renovation, Member States should develop additional policies.

- This includes **facilitating regional platforms and 'material banks'** that enable construction components to be reused and ensuring that secondary materials can be certified and competitively marketed.

- Member States can also set up **extended producer responsibility schemes**,[117] which will support the creation of markets for secondary materials and also influences product design. Additionally, increasing landfill tax for construction and demolition waste contributes to the creation of secondary material solutions.

UPSKILL THE WORKFORCE

Renovation solution suppliers across the value chain need to be enabled to adopt innovative solutions. There is potential to address the lack of workforce capacity in the renovation value chain by engaging with vulnerable groups and training them to carry out renovations of their buildings and neighbourhoods, but also beyond. This can address part of the problem of limited workforce capacity and provide vulnerable groups with opportunities for inclusion and enhancement of jobs and income.

- **In particular, small- and medium-sized companies should be enabled to adopt innovative digital renovation solutions.** Training should enable them to use open data standards, facilitating seamless renovation processes. Digital tools, in turn, can ease the familiarisation with new processes, e.g. simplify the submission of tenders via digital platforms.

- **Reallocate part of the resources frequently used for short-term aid (e.g. subsides) to incentivise construction companies to train the potential workforce.** This should be accompanied by efforts to create more stable working conditions (instead of temporary jobs) and faster training processes (through innovative digital tools, for instance).

- **Provide practical guidance and training to public procurement agencies:** Governments should equip public procurement agencies with practical guidance and training to apply life-cycle costing and innovation-friendly criteria effectively. The EU GPP criteria for construction (currently non-binding guidance) should be transformed into formal procurement templates.

DISTINGUISH BETWEEN NEW CONSTRUCTION AND RENOVATION WHEN COLLECTING DATA

- When collecting data on the adoption of and market for innovative solutions, it is essential to **make the distinction between new constructions and renovation**. The renovation industry plays a key role in current and future decarbonisation efforts. Clear understanding of the status quo and emerging developments is essential to support innovation in the renovation value chain.

- Public projects using innovative solutions in any of the renovation stages should **collect data on the performance, benefits, costs and other aspects of the solutions and showcase them** to relevant actors.

[115] BPIE (2024), Extended Producer Responsibility in the construction sector.

General renovation **projects receiving financial support for innovative solutions should be encouraged to collect data** on the performance, benefits, costs and other aspects.

As the renovation value chain transforms and becomes more integrated, **data should be made available through one-stop shops, funding platforms, industry associations and other key channels**. This ensures that the available evidence about the performance, benefits, costs and other aspects of the innovative solutions reaches the relevant actors, while promoting transparency and quality of the evidence.

DEVELOP EFFECTIVE FINANCING SOLUTIONS FOR INNOVATION IN RENOVATION

Financial support remains an important ingredient for scaling innovations. The implementation of the EPBD presents an excellent opportunity to review existing financial support schemes and adapt them to incentivise the uptake of innovative solutions. Other important areas that currently receive limited government support are de-risking mechanisms to promote investment in innovation development and deployment, and enabling smaller enterprises to adopt innovative renovation solutions.

SUPPORT START-UPS BY DE-RISKING INVESTMENTS

Venture capital or angel investing often provide early funding for start-ups developing innovative solutions to develop, test and enter the market. Similarly, public innovation grants typically support SME clusters or pilots to adopt and scale digital tools such as BIM, digital twins or material tracking platforms, often covering training and implementation costs – but mostly for large infrastructure projects and new construction but not renovation.

Member States should create instruments to de-risk investments in mass production of innovative renovation solutions, e.g. through advanced market commitments.

Especially helpful are de-risking tools that provide the innovation provider with sufficient security to invest in mass production also in renovation. One example is revenue-based financing, which can provide flexible funding for businesses with recurring revenue models – such as subscription-based energy audit software or renovation planning tools. Rather than paying back the capital in fixed instalments (as with traditional loans), the company pays a percentage of its future turnover back to the investor on a flexible basis.

Another promising scheme to be explored for renovation is advanced market commitments. Governments or large buyers commit in advance to buy a certain amount of new technology – such as an intelligent heating or ventilation system – if it meets agreed standards. This helps companies invest in developing and testing new solutions because they know there is guaranteed demand.

SUPPORT SMEs TO ADOPT INNOVATIVE TOOLS IN THEIR RENOVATION PRACTICES

An additional financing need is to support companies to adopt digital tools or reorganise their processes in response to product innovations (business-to-business). Financial support and de-risking strategies at this intermediate step in the value chain are often overlooked. Financial support programmes for SMEs to adopt innovative tools to accelerate and optimise the renovation process could help overcome this bottleneck.

Member States should specifically support SMEs to take up innovative tools that help them to renovate faster.

A strategic financing sequence could start with public grants or tax incentives, which would reduce the initial risk for SMEs adopting new practices or construction technologies. This can then be followed by loans backed by guarantees or revenue-based financing to support scaling up, ensuring that early adoption is both viable and sustainable.

> **The time is right to use the transposition of recent EU policy files as an opportunity to strategically boost innovation in renovation – for the productivity and sustainability of the sector and to advance climate targets.**

UNLOCK FINANCE THROUGH ONE-STOP SHOPS FOR ENERGY RENOVATION

Member States should integrate third party-finance in one-stop shop services to support innovation in renovation.

One-stop shops should offer tailored financial advice and access to multiple funding options, such as grants, green loans or energy performance contracting. One-stop shops should collaborate with financial institutions to offer pre-approved financing packages aligned with renovation scenarios.

Financing can be directly embedded into the one-stop shop platform, or it can facilitate access to standardised energy performance contract in which a third-party financier (e.g. an energy service company) covers upfront renovation costs. Repayments are made over time from verified energy savings, reducing or eliminating the initial cost burden for the homeowner. One-stop shops can also increase investor confidence by offering performance guarantees through partnerships with energy services companies.

In this role, one-stop shops can act as a trusted intermediary. They can also aggregate individual renovation projects into investment-ready portfolios, conducting risk assessments, standardising documentation and ensuring due diligence. This makes it easier for third-party financiers to fund multiple small-scale renovations efficiently.

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