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COMMISSION STAFF WORKING DOCUMENT

Supporting life-cycle approaches to decarbonise European buildings

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Executive Summary

The document serves to support authorities at EU, national and local level, as well as building professionals, in their efforts to decarbonise¹ buildings. It does so by aiming to provide an understanding of a topic which is broad and has wide-ranging implications: how to reduce the greenhouse gas emissions of buildings over their whole life cycle, from design and construction through their operational lifetime to eventual demolition. This so-called ‘whole life carbon’ approach to buildings is now present in EU legislation and other policy initiatives. The document highlights the potential of repurposing and **conversion of the existing building stock, including from vacant office buildings into social and affordable housing units**, as a way to improve supply and availability of housing.

The document explains what **building whole-life carbon** means in practice, and it describes how policy measures in the buildings sector that are based on a life-cycle approach, considering embodied carbon emissions next to operational ones, can support decarbonisation efforts whilst also contributing to Europe’s competitiveness and independence. Recent research on the role of whole-life carbon is presented, followed by an overview of the IPCC framework with the three levers of sufficiency, efficiency and renewables. Finally, **examples of national, city and market-level initiatives** are included to provide inspiration. EU legislation and non-legislative policy initiatives are presented in Annex IV.

When the entire building stock is considered as a whole, **operational carbon emissions** stemming from the use of buildings represent the **biggest source of carbon emissions** and, hence, efforts to improve the energy efficiency of buildings, driven by the implementation of the Energy Performance of Buildings Directive and the upcoming National Renovation Building Plans, have a vital role to play in decarbonising the stock. However, **embodied carbon emissions** which relate to the manufacturing of construction products and the construction of new buildings constitute the **second largest source of emissions** from the stock.

Given that a majority of embodied carbon emissions stem from new construction, which makes up about 1% of built space every year, a **life-cycle approach for new built represents an important potential to reduce building stock emissions** and to reach the EU climate objectives. Considering emissions over an individual energy-efficient building’s lifetime, the embodied carbon emissions can be higher than operational carbon emissions. The Energy Performance of Buildings Directive reflects life-cycle considerations and requires reporting of embodied carbon emissions for new buildings. Its implementation, together with initiatives under the Affordable Housing Package, are well positioned to further create the conditions to support lead markets based on circularity and low-carbon solutions, to foster industrial innovation and European competitiveness.

Introduction

In recent years, the European Union has created a comprehensive policy framework for Europe’s economy and society to become climate-neutral by 2050. The European Climate Law² has made this a

¹ Beyond what is presented in this Staff Working Document in relation to reducing operational and embodied carbon emissions, construction products can have an important potential for long-term carbon storage.

² [European Climate Law](#)

legally binding goal and it establishes the goal of climate neutrality for the European Union by 2050³. It sets the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990. The Draghi report highlighted that decarbonisation also contributes to Europe's competitiveness and independence, by reducing reliance on imported fossil fuels. Looking beyond 2030, the co-legislators have recently agreed on a 2040 climate target⁴ of 90% net reduction in greenhouse gas emissions compared to 1990 levels in order to put the EU on a firm path to climate neutrality by 2050. It points out how **circular business models can create significant reductions in greenhouse gas emissions in hard-to-abate sectors, such as the built environment**. This can be done, for example, by extending the functional lifetime of buildings, with renovations being preferred to new construction, substituting primary raw materials with less-carbon intensive secondary raw materials, or replacing fossil-based materials with sustainably sourced bio-based renewable materials. The Communication stresses the **importance of creating lead markets** for clean technologies and products in Europe.

In this context, numerous recent additions to the EU legislative *acquis* address the reduction of emissions from buildings at different stages of their life cycle (see Annex IV). Being able to tackle whole-life carbon emissions of buildings depends however on a variety of decisions along the life cycle, supported by policies working on both supply and demand. Depending on very different factors, like e.g. the available energy system and the structure of the existing building stock, cost-efficient solutions for decarbonisation can vary greatly and very often need to be combined to reduce emissions efficiently.

Decarbonisation of the building stock is a broad task and requires efforts on many different fronts. This covers **design, material supply, construction and operation of buildings** in a carbon-efficient manner, considering both **supply of and demand for material, energy and built space**.

An increasing number of studies shows that it is important to apply a broad range of complementing measures based on concepts linked to better use of existing buildings, energy and material efficiency and resource needs being met by renewable ones, to effectively reduce whole-life carbon emissions from the sector.

This document aims to set such different measures into context, and to give an overview of what kind of drivers could support a comprehensive life-cycle approach, at both building and stock level. Given that, in the EU, construction accounts for a major part of material consumption and generates the largest waste stream⁵, and considering that policy so far has made less use of demand side measures, this document **focuses on how measures impacting material demand can work alongside the existing policy framework to support further emission reduction**. It thereby complements initiatives concerned with aspects of resource use and emissions related to buildings.

³ [2050 long-term strategy](#)

⁴ [2040 climate target](#)

⁵ [Background data collection and life cycle assessment for construction and demolition waste \(CDW\) management](#)

This Staff Working Document⁶ sits at the **crossroads of the Clean Industrial Deal**⁷, published in 2025, and its roadmap for competitiveness and decarbonisation on the one hand, **and the European Affordable Housing Package**⁸ on the other. The latter includes the European Strategy on Housing Construction aimed at unlocking the full productivity potential of the construction ecosystem, with a view to boosting the supply of affordable, sustainable, resilient and quality housing. In addition, a Communication confirms the New European Bauhaus as a powerful enabler for the clean transition and innovation and bioeconomy. The NEB Academy re- and up-skills the construction ecosystem for sustainable and circular construction and supports innovation and research in the sector.⁹ These initiatives, together with the EU Mission on Climate Neutral and Smart Cities, are well positioned to consider embodied carbon emissions also with a demand side perspective when driving the decarbonisation agenda. Public procurement, funding, pilot projects and knowledge sharing and guidance will be important in supporting the transition.

What is “whole-life carbon” in the building stock?

The term **whole-life carbon** describes the greenhouse gases that are emitted over the entire life cycle of a building (see Figure 1). It is assessed by calculating life-cycle global warming potential (GWP), expressed in kilogram of CO₂ equivalent per square metre. The life cycle of a building can be separated into different stages and modules, each of which contributes to the building’s overall climate impact. During its operational lifetime, a building may emit greenhouse gases due to the energy consumed for its heating, cooling, lighting and powering of electrical household appliances. This is commonly termed operational carbon. In contrast, embodied carbon represents the emissions originating from other modules, primarily linked to the materials used in the construction and renovation activities, as well as from activities linked to construction, demolition and waste management. In addition to what is illustrated in Figure 1, buildings can also temporarily store carbon through the use of specific materials.

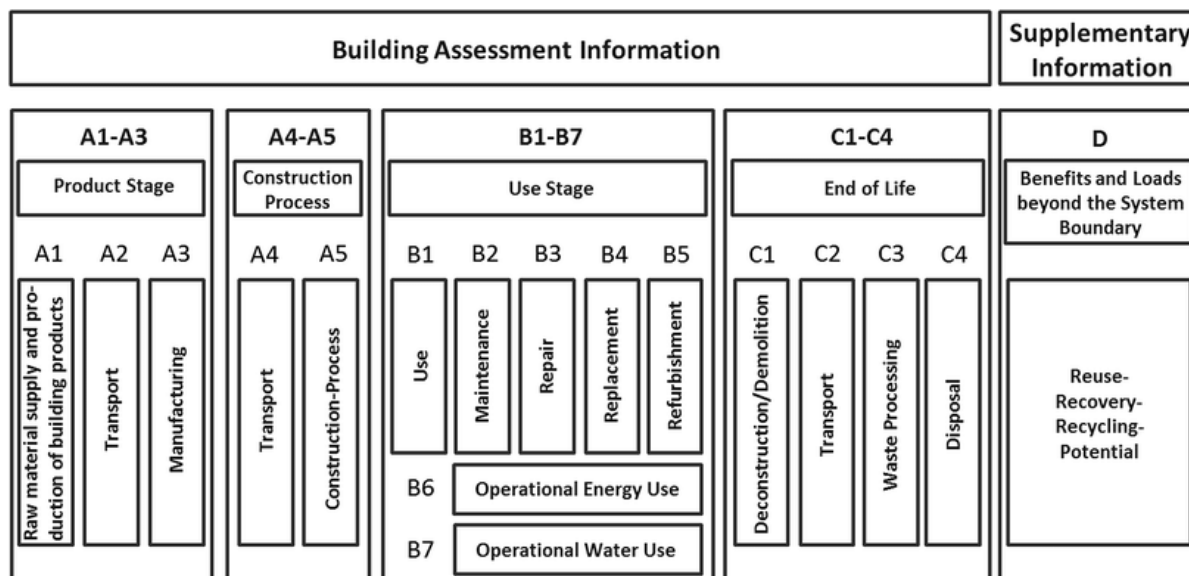
⁶ In 2020, the European Commission published the strategy “A [Renovation Wave](#) for Europe – Greening our buildings, creating jobs, improving lives”. One of its actions was to publish a 2050 roadmap to reduce whole life-cycle greenhouse gas emissions from buildings, which this document fulfills.

⁷ [Clean Industrial Deal](#)

⁸ [Affordable Housing Plan](#)

⁹ [New European Bauhaus - from vision to implementation](#) The Communication sets out that “the Commission will support the sustainability and efficiency of the built environment by providing evidence on the decarbonisation of buildings....”, which this document fulfills.

Figure 1. Modular information for the different stages of building assessment according to EN 15978



Recent additions to the EU policy framework target the reduction of both operational and embodied carbon in several ways (Annex IV). Operational carbon is targeted by policy and so are both supply of and demand for energy giving rise to the emissions. As for embodied carbon, policy principally acts on the supply of the materials which give rise to emissions, by incentivising the decarbonisation of material production. Importantly, in the **EU's greenhouse gas accounting**, embodied emissions are allocated to the industries producing the construction products (and not to the buildings in which those materials are used). In this document, however, embodied emissions from construction product manufacturing are allocated to the buildings in which the products are used¹⁰. This makes it possible to assess the impacts that measures influencing the consumption of building materials might have on whole-life carbon emissions of buildings.

How to support a life-cycle approach in the building sector

Existing EU instruments that drive the decarbonisation of material production, reduction of transport emissions, improvement of energy efficiency, strengthened role of renewable energy sources and decarbonisation of electricity generation are pivotal to meeting Europe's climate commitments. Instruments that support the demand for low-carbon construction products secure European industry competitiveness, encourage substantial research and investment to scale up emerging low-carbon technologies and solutions and create robust medium and longer-term professional expertise and businesses.

Supplementary to the existing regulatory framework (see Annex IV), initiatives that aim specifically at circularity of materials and a more efficient use of the existing stock, can significantly help to decarbonise the EU economy. Including such initiatives makes it possible to **expand the toolbox for decarbonisation**, and at the same time support the EU industry to become a front runner in the sustainability transformation. While some **measures can create immediate impact**, others can **provide the market with long-term signals and investment perspectives**.

¹⁰ This is in accordance with the CEN standard EN15978 Sustainability of Construction Works

Such an approach has the potential to:

- guide building and renovation strategies and policies towards decarbonisation of buildings, based on a life-cycle perspective;
- highlight the overall climate impact of a building project, including at key decision-making moments, such as planning, construction, renovation and end of life, thereby incentivising the sector to always work with resource efficiency and circularity in mind;
- highlight how renovation can contribute effectively to decarbonisation of the building stock;
- guide national and local authorities towards providing affordable housing with substantial decarbonisation benefits by making more efficient use of existing built space;
- stimulate the market to create innovative construction products and techniques.

Examples of what a whole-life carbon approach could entail are provided below:

Potential by considering circularity and more efficient use of building stock	Examples of measures
<p>Guide building and renovation strategies and policies towards decarbonisation of buildings, based on a life-cycle perspective</p>	<p>-Inclusion of life-cycle perspective in building legislation, in development, renovation and housing plans, and in public procurement</p> <p>-Harmonised and robust whole-life carbon assessment methodologies, based on consistent and reliable data available for construction products (in compliance with Construction Products Regulation¹¹), buildings, energy and transportation</p> <p>-Implementation of parallel building decarbonisation measures, technical as well as business models, which can deliver significant whole-life carbon reductions at different moments in time, depending on their respective nature, maturity and potential to be adopted at larger scale</p>
<p>Highlight the overall climate impact of a building project, including at key decision-making moments, such as planning, construction, renovation and end of life, thereby incentivising the sector to always work with resource efficiency and circularity in mind</p>	<p>-Sector awareness of how to assess the climate impact of alternative design and construction options at the building level, which in turn influences decision-making regarding e.g. material efficient design and relevant carbon-efficient material solutions for each purpose/function/element</p> <p>-Application of offsite construction, renovation and building extension where it can be expected to support increased resource efficiency and reduction of waste</p>

¹¹ [Construction Products Regulation](#)

	<ul style="list-style-type: none"> -Minimisation of construction waste, by avoiding over-ordering of materials -Reduction of emissions linked to transport and energy consumption at construction site -Inclusion of whole-life carbon in investor sustainability strategies, considering e.g. adapting asset and project valuation methods to prioritise longer-life assets, and developing green finance products to encourage renovation over new construction
<p>Highlight how renovation can contribute effectively to decarbonisation of the building stock</p>	<ul style="list-style-type: none"> -Simplified approval process for renovation and repurposing compared to new constructions -Major renovation projects to assess and disclose whole-life carbon emissions in a reasonable manner -Deep energy renovation focusing on building parts which typically have the potential to save operational energy, such as the envelope and the technical building systems -Renovation of buildings with a high capacity for adaptability, ensuring that embodied carbon investment at the time of renovation will pay off during a prolonged building lifetime with a continuous efficient use-intensity and at the same time provide energy efficient built space -Financial incentives and cost advantages for low-carbon serial renovations
<p>Guide national and local authorities towards providing affordable housing with substantial decarbonisation benefits by making more efficient use of already existing built space</p>	<ul style="list-style-type: none"> -Strategies for using existing buildings more efficiently as a way to provide affordable housing in a flexible manner and in parallel contribute to community regeneration, and align these strategies with climate plans -Implementation of zoning codes that allow for flexible land use and adaptable building configurations, permitting a mix of uses within a single development, making it easier to repurpose spaces without major regulatory hurdles¹²

¹² The Swedish Government has passed a 'planning stimulus' to this effect
<https://svenskfattningssamling.se/sites/default/files/sfs/2023-12/SFS2023-903.pdf>

	<ul style="list-style-type: none"> - Simplification of office-to-housing conversions by removing regulatory barriers across planning, technical, financial, and administrative dimensions, while improving procedures - such as accelerating permit processing and streamlining approvals -to increase the viability of sustainable and affordable housing -Prioritisation of the preservation of existing stock in public funding and taxation -Identification of vacant and underused buildings to be included in vacancy registers, and incentive the reintegration of vacant buildings into the market¹³
<p>Stimulate the market to create innovative construction products (primary and secondary materials), techniques and business models</p>	<ul style="list-style-type: none"> -Performance-based requirements at the building level, resulting in increased demand and subsequent upscaling of production of low-carbon materials (such as bio-based materials, low-carbon cement and steel), supporting the development of lead markets for such products -Digital platforms and product passports to track and trade secondary materials to enhance the use of recycled and reclaimed materials in new construction and renovation projects -Urban mining strategies and the re-use of components by supporting local component exchanges and storage areas¹⁴ -Application of digital pre-demolition audits -Development of environmental performance declarations for construction products -Building codes to acknowledge the carbon removal capacity of products

¹³E.g. grants for old buildings like the '[Jung kauft Alt](#)' programmes in 119 German municipalities, or the [Milan/Lombardy initiative](#) where abandoned houses receive a special status, allowing for extensions and reduced construction taxes to encourage their renovation.

¹⁴ A German [National Urban Mining Strategy](#).

Importance of whole-life carbon: EU building stock level

While a scoping study¹⁵ to this Staff Working Document provided initial insight, a large project funded by the European Parliament¹⁶ allowed substantial granular and detailed modelling and covering the latest policy developments more comprehensively (see summary in Annex I). It shows that the EU building stock is responsible for 808 million tonnes CO₂eq of whole-life carbon emissions per year¹⁷¹⁸. It is important to note that these cover operational and embodied carbon emitted in the course of a single year¹⁹, including construction, renovation, maintenance, demolition as well as heating, cooling and ventilation, but no other electricity uses such as lighting or appliances. **Annual whole-life carbon emissions from the EU building stock** consist of 73% operational emissions and 27% embodied emissions, as shown in Figure 2.

¹⁵ [Supporting the development of a roadmap for the reduction of whole life carbon of buildings](#)

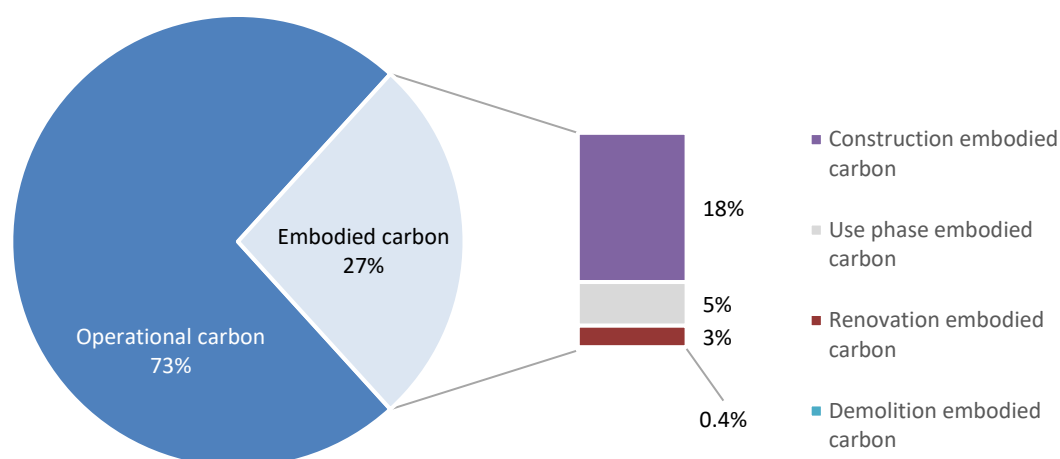
¹⁶ The Preparatory Action [“Analysis of life cycle greenhouse gas emissions of EU buildings and construction”](#) models different scenarios to investigate pathways for reducing whole-life carbon emissions from the EU building stock through to 2050. It employs advanced and granular modelling of archetypes, carbon reduction and removal strategies, as well as building stock upscaling and validation models. The assessment is realised through the definition of a whole set of new building archetypes representing the EU building stock using dedicated archetypes per Member State, building typology, energy performance and project type and the subsequent modelling of their emissions for different life-cycle stages. The modelling considers both life-cycle related greenhouse gas emissions (“whole-life carbon”) and carbon removals in line with EN 15978 and follow the latest EN15804+A2 methodology. The results from the building archetype data are scaled up to the entire EU building stock using an advanced building stock dynamics model and validated using established stock turnover models.

¹⁷ The operational carbon emissions refer to regulated energy use for heating, cooling and ventilation. It excludes emissions from lighting and non-regulated services, and energy uses such as electrical appliances or cooking, as these are not directly influenced by the building design. Embodied carbon emissions for construction products are allocated to buildings, and not the manufacturing installations where they were produced. The baseline corresponds to whole-life carbon released from the building stock in year 2020 and the analysis is built using generic life-cycle inventory data from Ecoinvent. To ensure geographical representativeness, the study consistently selected processes that reflect production practices that are representative for the European market.

¹⁸ This amount of emissions can be compared with EU and national total greenhouse gas emissions (which are production based) [EEA greenhouse gases — data viewer | Maps and charts | European Environment Agency \(EEA\)](#)

¹⁹ This provides only a snapshot of a baseline year, rather than a cumulative overview of the life-cycle emissions of all the buildings existing in that year.

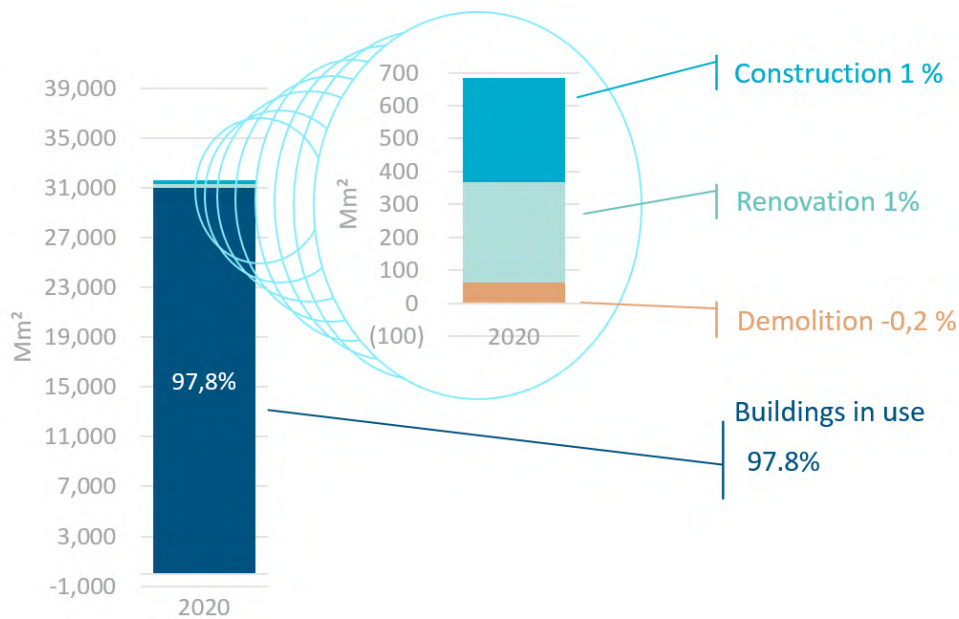
Figure 2. Greenhouse gas emission distribution by building stock activity, baseline year 2020



Most embodied emissions are associated with construction (of new buildings), accounting for 18% of the annual emissions from building stock, primarily driven by the production of materials used in construction. While deep renovation of energy-inefficient buildings is a key method of reducing operational carbon emissions (and overall whole-life carbon emissions), the renovation of existing buildings also contributes, mainly via the materials consumed, to 3% of the annual emissions from building stock. Likewise, maintenance and repair work on existing buildings account for a further 5%, illustrated as ‘use phase embodied carbon’. It should be noted that, while embodied carbon emissions for renovation are likely to be higher than for maintenance and repair *per building*, significantly more existing buildings are being repaired and maintained than are being renovated. This explains the higher embodied emissions from the use phase compared with renovation, at stock level.

New construction, renovation and demolition activities are undertaken on a very small proportion of the overall building stock every year, as illustrated in Figure 3. Only about 1% of the total floor area was newly constructed in 2020 (baseline year), yet the associated embodied emissions accounted for as much as 18% of the total whole-life carbon from the building stock (see Figure 2). About 1% of the total floor area underwent renovation, accounting for a smaller share of just 3% of the total whole-life carbon (see Figure 2). This is primarily because renovation typically requires less material than new built per square metre. Although **most emissions from the stock result from the operation of existing buildings**, in particular energy inefficient buildings, **embodied carbon from new construction is identified as another major source of greenhouse gas emissions** from the building sector. These new-construction-related emissions are also termed ‘upfront carbon’ emissions, as they occur before a building starts to be used.

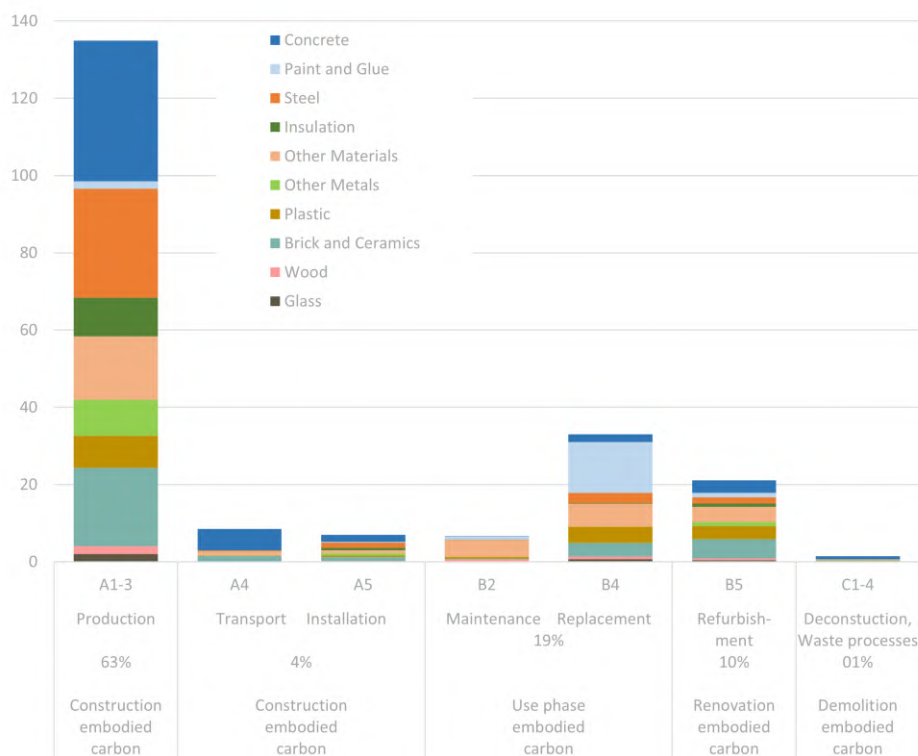
Figure 3. Building stock floor area distribution in million m2 in the baseline year 2020 for construction of new buildings, renovations and demolitions.



Heated floor area; Based on AMBIENCE/ HotMaps 2022 / BSO 2024

The study also identified concrete and steel as the categories of material that contribute the most to overall embodied carbon emissions from the EU building stock. At the same time, it revealed that several other materials, such as bricks and ceramics, paint and glue, and insulation also contribute significantly to these emissions. This is illustrated in Figure 4, with more details provided in Annex II.

Figure 4. Building stock embodied emissions (million tonnes CO₂eq) in 2020 by material and building life-cycle stages.

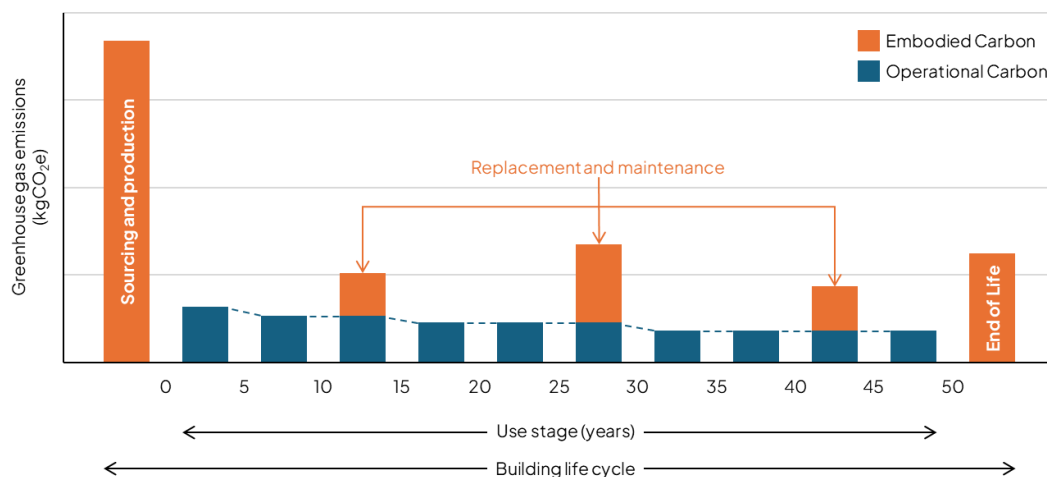


Importance of whole-life carbon: Building level

The above analysis of the sector's whole-life carbon emissions provides a snapshot of the EU building stock activities over the course of one year. The building stock consists of many different buildings at various stages of their individual life cycles: some are under construction, a vast majority are in their use phase, and others are at the end of their life. In order to understand what contributes to whole life-cycle greenhouse gas emissions from the entire building stock, it is useful to consider the matter at the level of an individual building, and to do so throughout its entire life cycle. In this way, different but very relevant pieces of information are obtained, which help to identify potential for decarbonisation. A **whole-life carbon analysis of an individual building looks at its embodied and operational emissions during its entire lifetime** (a life-cycle assessment typically considers 50 years), across all stages of its life cycle (see Figure 5).

It is important to note that embodied and operational emissions differ in terms of their time horizon. Operational emissions accrue over the service life of the building, whereas embodied emissions occur during shorter, specific activities: the manufacturing of construction products, construction, renovation, maintenance and demolition. **A baseline assessment for the whole building stock, as presented earlier, provides only a snapshot of a baseline year, rather than a cumulative overview of the life-cycle emissions of all the buildings existing in that year.** Hence, the respective shares of operational and embodied carbon emissions are very different to a new individual building.

Figure 5. Illustrative principle breakdown of embodied and operational carbon in an individual building. Source: Based on LETI Embodied Carbon Primer²⁰



Considering the time horizon of the next 25 years up to 2050, embodied emissions will make up a major part of new buildings' overall carbon footprint. This is because embodied emissions constitute most of whole life-cycle emissions in new energy-efficient buildings and a majority of these embodied emissions are released at the very beginning of a building's life cycle. **Minimising the near-term embodied carbon emissions, while still providing highly energy-efficient buildings,** by pursuing targeted material supply policies on the one hand *and* material demand policies that impact decisions already in the planning process on the other, is an effective way of contributing to the efforts to

²⁰Martin Röck based on [Röck et al. 2020](#) and [LETI Embodied carbon primer](#)

mitigate climate change²¹. This is particularly the case for new buildings, but also for buildings undergoing renovation.

The background study for this document²² revealed that **advanced building energy performance is on the whole beneficial from the point of view of whole-life carbon emissions**. The significant reduction of operational emissions greatly outweighs the smaller increase in embodied emissions often associated with high energy performance. This was found to be the case across all regions and building types that were modelled.

Further research²³ shows how life-cycle greenhouse gas emissions vary greatly across different building types. Considering values across all Member States, the analysis per building type shows that whole-life embodied carbon per m² and year tends to be lowest for apartment blocks (10.1 kgCO₂eq/m²/a on average), and highest for offices (14.9 kgCO₂eq/m²/a on average).

²¹ Carbon Leadership Forum (2017) [Time Value of Carbon](#)

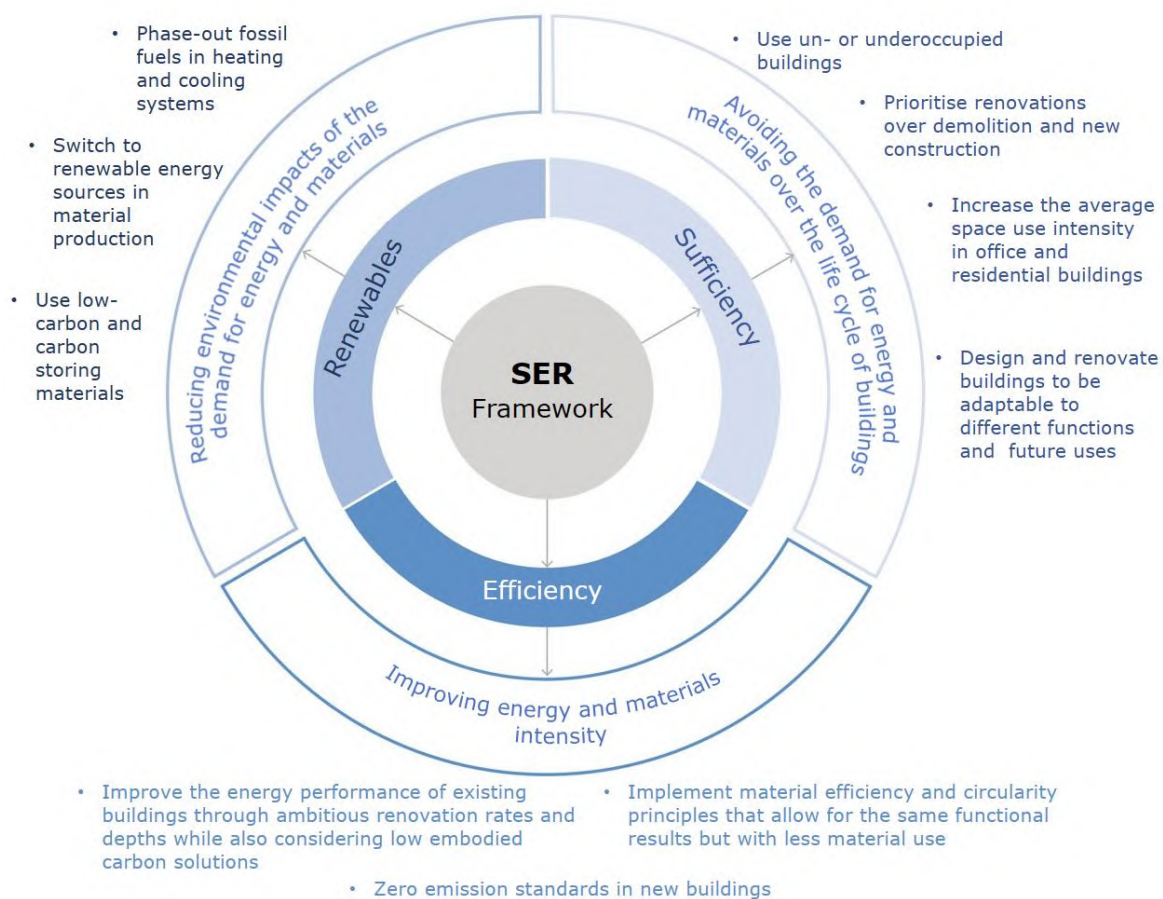
²² [Supporting the development of a roadmap for the reduction of whole life carbon of buildings](#)

²³ [“Analysis of life cycle greenhouse gas emissions of EU buildings and construction”](#) see Annex I for summary.

The concepts of Sufficiency – Efficiency - Renewables

The Intergovernmental Panel on Climate Change (IPCC) provides a useful overview of how buildings can be decarbonised, with three levers having been recognised in the so-called **Sufficiency, Efficiency, Renewables framework** (see Figure 6). The framework points to (i) sufficiency – better use of existing buildings, hence limiting demand for new built space; (ii) efficiency - improving energy and material intensity; and (iii) renewables - reducing the environmental impact of energy and material supply. The full framework with its concepts contributes to the general understanding of how to reduce whole-life carbon emissions from buildings, covering both supply and demand aspects related to material as well as energy.

Figure 6. The Sufficiency, Efficiency, Renewables framework as set out by the IPCC²⁴, with selected measures for buildings decarbonisation added.



Sufficiency – Better use of existing buildings

Within the context of buildings, this concept means **improving the existing stock to create attractive and affordable buildings** tailored to the occupants' needs regarding space, services and accessibility, all while taking ecological limits into account. Such measures can contribute to a comprehensive decarbonisation effort by reducing demand for both materials and operational energy. Systemic

²⁴ IPCC (2022). [Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change](#)

impacts go further, reducing waste from construction and, in particular, from demolition, as well as reducing land take and soil sealing²⁵.

The 6th IPCC Assessment Report describes this as:

- optimising the use of buildings;
- repurposing unused existing buildings;
- prioritising multi-family homes over single-family buildings;
- adjusting the size of buildings to the evolving needs of households; and
- downsizing dwellings.

Similarly, a Joint Research Centre study²⁶ sets out how this is achieved by:

- mobilising currently empty built space;
- prioritising renovations over demolition and new construction;
- increasing average space use intensity in office and residential buildings; and
- designing buildings to be used more intensively throughout the day/week or for future uses.

Housing represents a major portion of buildings in Europe, accounting for three quarters of built square metres²⁷. According to Eurostat²⁸, the share of the total population living in under-occupied dwellings in the EU (27) has been rather stable from 2016 to 2024, at 32-34%. In parallel, European office vacancy rates have risen steadily since the pandemic, climbing from 6% to about 9.7%.²⁹ Many major European cities continue to experience persistently high vacancy levels, even in central business districts.

Efficiency – Improving energy and material intensity

Efficiency in this framework covers measures to **reduce energy consumption as well as material used for any given building**. Energy efficiency measures include carrying out energy renovations and, when constructing new buildings, ensuring that they have a high energy performance. This cuts energy consumption related to the operation of the building, as well as the corresponding greenhouse gas emissions, per unit of built floor space.

Material efficiency measures in both new constructions and renovations rely on improving the building design in order to make the use of resource sustainable by reducing the need for materials while achieving comparable purposes and comfort levels. This includes making direct reuse of secondary materials in construction and renovation projects, recycling material in new production cycles and designing buildings in order to extend their lifetime, make them adaptable and ensure that they are suitable for deconstruction.

²⁵ [Gaspard et al. \(2023\) Introducing sufficiency in the building sector in net-zero scenarios for France](#)

²⁶ [Towards a green and digital future](#)

²⁷ While the dwelling sizes in the EU increased by 10% from 2000 to 2019, the household sizes decreased by 5%, see [Activity and efficiency trends for the residential sectors across countries](#)

²⁸ Source: Eurostat (online data code [ilc_lvh050a](#))

²⁹ Cushman&Wakefield (2025) [European Office Update – H1 2025](#) and AEW (2025) [Monthly research report – June 2025](#), Savills (2024) [European Office Development](#).

Renewables – Reducing the environmental impacts of energy and materials

The renewables component of the framework implies that **energy and material needs, after applying sufficiency and efficiency measures, are met by renewable resources whenever possible**. For the building sector, this includes heating and cooling with renewable energy, where onsite renewable energy generation provides the associated benefit of reducing the need for investment in energy supply. This part of the framework also includes the production of construction materials and components which cause low life-cycle embodied emissions, or which even have carbon-storing properties. Using sustainably sourced bio-based construction materials represents another important strategy, whereby renewable resources can help to reduce embodied emissions and support the storage of carbon during the lifetime of the construction products.

Practical implementation

A number of Member States and cities are working on **building policies and initiatives** based on life-cycle thinking to broaden their decarbonisation efforts. This has confirmed how the building sector itself is able to significantly impact its carbon performance, providing the policy framework is supportive. This is further proven by individual market initiatives.

National initiatives

Countries with the most ambitious requirements for operational energy and a low-carbon electricity mix also tend to be those seeking **to regulate embodied carbon emissions for further cost-efficient overall carbon reduction**. The Netherlands, Finland, Denmark, France and Sweden have adopted legislative measures to ensure systematic and consistent measurement and disclosure of the whole-life carbon of buildings³⁰. Some have introduced limit values to cap the whole-life carbon of new construction, while others are preparing to do so. Discussions have moreover started on how to tackle whole-life carbon in renovations³¹. Recognising the growing importance of embodied emissions and related untapped carbon savings potential, these countries have, with an eye to the specific conditions in which they find themselves, identified enhanced resource efficiency as a way of further reducing carbon emissions.

Other Member States are starting to prepare whole-life carbon measurement and benchmarking initiatives (Ireland, Spain, Czechia, Estonia)³². In many other countries, the measurement and mitigation of embodied carbon at the building level is voluntary and tend to be led by industry.

Denmark started early with the inclusion of life-cycle thinking in building legislation, and the description of this is provided as a national example below.

BOX 1. Denmark. Building regulation with climate requirements³³

Denmark enacted legally binding targets in 2019 that oblige the country to achieve a 70 % reduction in its greenhouse gas emissions by 2030 compared to 1990. Building on the Danish tradition of

³⁰ [Ramboll & KU Leuven 2022: Whole life carbon models for the EU27 to bring down embodied carbon emissions from new buildings. Review of existing national legislative measures](#)
[BPIE 2021: Whole Life Carbon. Challenges and Solutions for highly efficient and climate-neutral buildings.](#)

³¹ [Harmonised carbon limit values for buildings in Nordic countries](#)

³² <https://www.indicatedata.com/>

³³ <https://www.sbst.dk/byggeri/baeredygtigt-byggeri/national-strategi-for-baeredygtigt-byggeri/klimakrav-lca-i-bygningsreglementet>

public-private partnerships, fourteen climate partnerships were formed, including one for the construction and civil engineering sector. The partnership delivered its recommendations in 2020, of which one was to include a limit value of 12 kg CO₂/m²/year in the building regulations from 2021. The same year, the political agreement on a National Strategy for Sustainable Construction introduced this initial limit value for new construction as of 2023, taking into account most life-cycle modules (A1-A3, B4, B6, C3-C4 and D). It was agreed to gradually tighten the limit values up to 2030 to accelerate the green transition of the construction sector. An additional political agreement set in 2024 updated the limit values for 2025 and include separate limit values depending on the type of building and its size, it also included an updated preliminary decreasing of limit values for 2027 and 2029, respectively. For 2025, the average CO₂eq limit was set at 7.1 kg CO₂eq/m²/year, which means that approximately 85 per cent of the new constructions covered by the requirement must perform better compared to 2021. For 2029, the preliminary average limit value is set to 5.8 kg CO₂eq/m²/year. In 2025, it was agreed to include the construction process (modules A4 and A5) and, at the same time, the scope of new construction that is subject to the limit values was expanded. In parallel with the tightening of the limit values, background data is evaluated to assure representativeness of the Danish market. Reused products account for 0 CO₂/m²/year in the calculations as of an additional political agreement from 2023. A voluntary template for documenting LCA calculations is available to facilitate reporting and comparison.

In parallel, the Nordic countries, which are all in the process of regulating whole-life carbon for new construction, collaborate to accelerate the green, circular and digital transition. Under the Nordic Sustainable Construction³⁴, the countries learn from each other and together create new knowledge. Key lessons have been summarised in 8 steps: build up competences, secure stakeholder involvement, ensure access to generic data and standard values, improve availability and digitalization of environmental performance declarations for construction products, create a case basis and structure for limit values, determine the initial scope and method, establish a suggested limit value pathway and, finally, optimise the use of existing buildings.

Using existing buildings better has an important potential to save carbon. Doing so in a strategic manner requires knowledge about vacant space. France has a national strategy for this purpose, which is presented below.

BOX 2. France. National strategy on combatting vacant housing (sufficiency)³⁵

In 2021, the French government launched the “Plan national de lutte contre les logements vacants” (National plan to combat vacant housing), with a view to reintegrate long-term vacant properties into the housing market. The national strategy is designed to equip local stakeholders with detailed data and tools to accurately identify and address the issue within their jurisdiction, as well as to disseminate successful methods for reintegrating properties into the market. The main element is a platform containing a variety of building data, provided by the national ministry of housing. It enables local authorities to view each individual house within its jurisdiction with the owner's address, situation (vacant or occupied) and energy performance certificate.

On the national level, there are 1,1 million long-term vacancies (defined as “vacant for longer than 2 years”). This corresponds to 3,5 % of the building stock. It is estimated by the French government that mobilising long-term vacancies can contribute to 300.000 social housing units in tight real

³⁴ [Nordic Sustainable Construction](#)

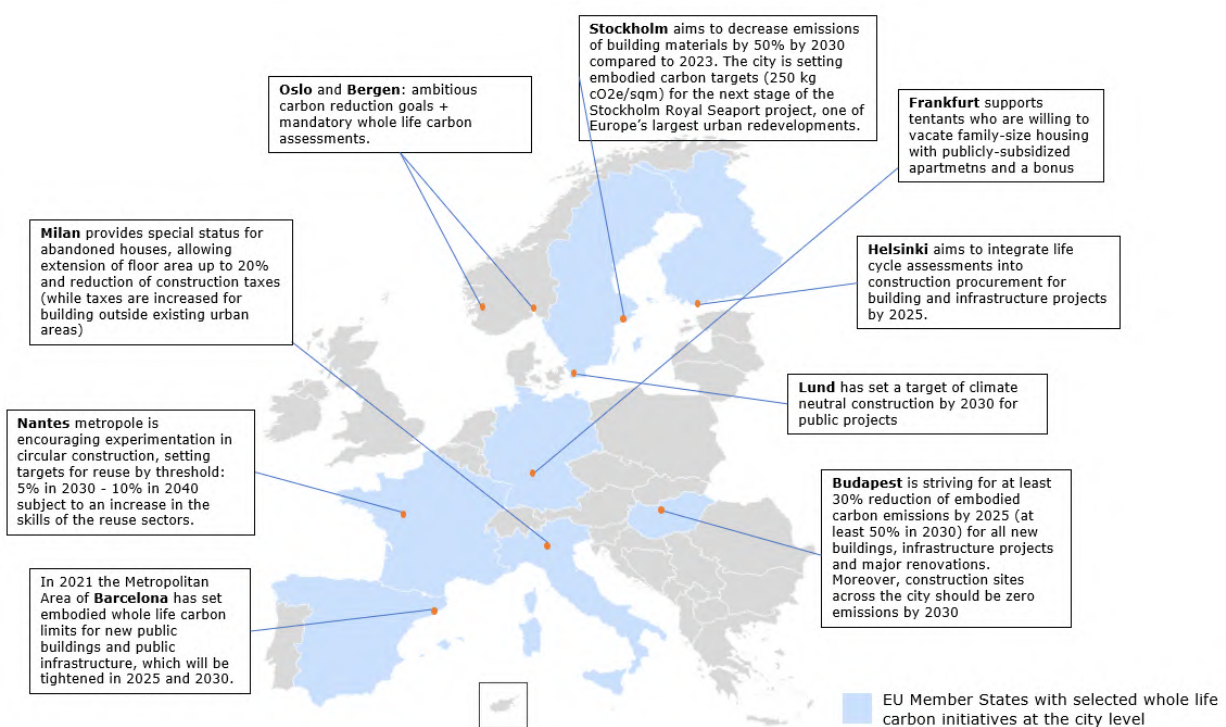
³⁵ [Sufficiency in the building sector](#)

estate markets. This can be compared with the 350.000 flats and houses built each year in France. Through the plan, 64% of all municipalities in mainland France are now addressing the issue of vacancies. Moreover, the municipalities get a better understanding of the complex factors contributing to vacancies and how to make better use of them.

City-level initiatives

Cities are uniquely placed to catalyse the transition to a sustainable building stock. This is as a result of their jurisdiction over land use, authority over housing programmes, role in implementing national policies and building codes, and role in coordinating with local utilities and stakeholders. They manage an extensive portfolio of buildings and, through green public procurement, are able to create market demand and incentives. They also approve building- and renovation permits and have urban planning competences. Policies and ambitious targets set by local governments establish crucial precedents, serving as guiding principles for integrated decarbonisation across various scales of infrastructure and buildings. Without attempting to be exhaustive, Figure 7 presents examples of city-level initiatives across Europe.

Figure 7. Overview of exemplary city-level initiatives in Europe illustrating the potential for policies at all governance levels to support emissions reductions from a whole-life carbon perspective³⁶. Examples from non-EU-Member States illustrate the range of initiatives.



³⁶ [Ramboll & KU Leuven 2022: Whole life Carbon models for the EU27 to bring down embodied carbon emissions from new buildings](#)
[Barcelona](#), [Milan](#), [Oslo](#), [Stockholm](#), [Frankfurt](#), [Helsinki](#), [Lund](#), [Budapest](#)

A number of initiatives organised by cities are presented in more detail below. They are typically driven by a combination of objectives, often linked to affordability and decarbonisation.

BOX 3. Göteborg, Sweden. City strategy on reducing whole-life carbon emissions of building stock

In Göteborg, the public housing company Framtiden has about 76 000 housing units, providing housing for about 25% of the city's inhabitants. The identified need for additional new housing units until 2035 is 80 000. While public housing companies are common in Sweden, their main objective is not to provide social housing but rather to provide good housing for everyone. They are not dependent on public funding but are expected to make their own business case.

A political decision was taken to significantly reduce the climate impact of buildings, as set out in the city's environment and climate programme 2021-2030. It includes the target of reducing overall carbon emissions by 90% up to 2030. This covers not only construction conducted by the city itself, but also private construction, for which the city is responsible for land allocation. This ambitious target is considered necessary in order to achieve the city's contribution to Sweden's overall target of climate neutrality by 2045. Gothenburg has developed a Climate City Contract committing to climate-neutrality by 2030, as part of the EU Climate Neutral and Smart Cities Mission.

Between 2020 and 2025, the aim was to reduce climate impact for each building project by 50%, working with existing technology, often based on circularity. While this aim was achieved, it also became clear that to reach the target of a 90% climate impact reduction by 2030, it would not be enough for each new project to massively improve its individual performance. The city would have to construct fewer new buildings, as the embodied carbon of new built development is high, even when great decarbonisation efforts are made. This is how combining circularity, on the one hand, and better use of existing buildings on the other, became a strategy for providing affordable, attractive and sustainable housing.

The new climate strategy in Gothenburg includes actively searching for buildings that can be converted to housing. There is a major focus on optimisation of space. It will be necessary to create a narrative about an attractive and modern city which people and organisations will want to be part of. There is considered to be significant potential for turning vacant and underused built space into housing, but this will require a different mindset and, most likely, changes to legislation.

Two examples of how circularity in new built structures can significantly reduce carbon emissions compared to conventional construction are the Omställningen and Återbruket apartment blocks. These are two pioneering projects which set the standards for future housing in the city. Both blocks are owned by the public housing company, providing apartments for rent. New housing projects starting in 2026 are all in keeping with the Omställningen apartment block.

The Omställningen apartment block

This project provides 70 apartments and was ready for occupancy in the spring of 2025. The embodied carbon emissions are about 60% lower than the city's baseline of 2020. The overall production cost is at the same level as for conventional construction projects, resulting in cost neutral rents. The main aspects contributing to the decarbonisation effort include a wooden building frame, a façade of reused slate and other products and materials with a low climate impact. Machinery and vehicles used on site and for transport were fossil free.

The Återbruket apartment block

This project, also with about 70 apartments, will be ready for occupancy by spring of 2026. The rental cost will be the same as for previous conventional building projects. The project has a very high level of reuse, in particular in the parts which normally result in high embodied carbon emissions. The frame has reused steel, a concrete system of joists salvaged from the demolition of

an IKEA store and glulam beams from a former ice rink. The façade also consists of reused material, e.g. roof sheets from the same ice rink. Other products and materials are either reused or have a low climate impact. Again, machinery and vehicles used on site and for transport were fossil free. Being a pioneer project, the potential extra cost of a few percentages which has been forecasted is considered a great success, and the solutions involved are estimated to become cheaper than conventional production when scaled up.

BOX 4. Conversion of vacant office into social housing in Dublin³⁷

Two long-vacant office blocks in Dublin were transformed into 86 social housing units to provide homes for over 200 people on Dublin City Council's housing waiting list. The project was facilitated by a developer, and purchased and managed by Tuath Housing, a non-profit organisation which has provided social housing in Ireland since 2000. Collaboration with Dublin City Council, which also contributed to the funding, was instrumental in the project's success. In 2018, the developer had secured planning permission for the conversion of the two blocks and, in 2020, Tuath Housing agreed to purchase and finance the project via funds from the Department of Housing and AIB's (Allied Irish Banks') Social Investment Fund.

The wider goal was to revitalise the area and adapt to the changing needs of businesses and consumers. Key features of the project included the conversion of vacant spaces into communal areas to encourage social interaction among residents. Tuath Housing, guided by the principles of 'community' and 'sustainability', aimed to create affordable yet high-quality social housing. To achieve this, the four-story buildings were expanded to five stories, with the addition of a penthouse floor and modern heating and ventilation systems powered by photovoltaic solar panels. Both social and environmental aspects are emphasised in the public communication, linked to the reclaiming of vacant space.

The resulting whole-life carbon emissions of the project were assessed, and three scenarios were compared: retrofitting, comparable new built development, and demolition and new built development. The results showed that 62% of emissions were saved in the case of retrofitting compared with a new building of a similar type, and that 73% were saved compared with a demolition and rebuild. These positive environmental considerations have been a main ingredient in the project's success. Tuath Housing's strategic plan for 2021-2025 underscores the importance of retrofitting homes not only in reducing carbon footprint over the long term but also in stimulating the economy in the short term.

BOX 5. Sufficiency case study Barcelona³⁸

In 2019, in the metropolitan area of Barcelona, two upper floors of a mixed-use building were converted from vacant office space into affordable and emergency housing, resulting in 34 housing units. The ground floor contains a supermarket and the first and second floors provide car parking. The specific category of emergency housing is designed for refugees, minors in crisis situations,

³⁷ [Sufficiency in the building sector](#)

³⁸ [Conversion of offices into affordable housing](#)

survivors of domestic violence and other vulnerable groups. Unlike social housing, which requires proof of income to demonstrate the ability to pay rent, emergency housing does not.

The project was initiated after the municipality of Sant Feliu de Llobregat approached the public development agency IMPSOL³⁹, which is a public business organisation affiliated with the Barcelona metropolitan authority and a well-known social housing promoter in the metropolitan area, inquiring about the possibility of conversion. After an initial feasibility assessment, IMPSOL launched an architectural competition, which both IMPSOL and the municipality followed closely. The conversion was about 20% cheaper than other new built social housing projects developed by the public developer IMPSOL around the same time, mainly because the façades and slabs were already in place, requiring only verification of the integrity of the structural elements and the replacement of windows. IMPSOL is a public enterprise and needs to be self-sufficient. It benefits from subsidies, which is important for making social housing provision economically viable. The funding source in this case was not specifically designed for conversions, but rather for targeting renovation and energy efficiency more generally. The subsidies covered 12% of the development costs. The conditions to obtain a building licence are the same as for a private entity, requiring finance from private or public banks.

The sustainability protocol for Barcelona metropolitan area⁴⁰ lays down life-cycle greenhouse gas requirements that apply to public projects conducted by IMPSOL. The protocol requires priority to be given to conversion over new construction and also sets specific limit values for carbon footprint for both new built and conversion projects. For new construction projects, the benchmark is a 40% reduction compared to the reference building while, for conversions, the required reduction is 68%. This project stands out in the way it applies an innovative natural ventilation system, involving atriums with operable skylights that open in summer to enable cross-ventilation and close in winter to create a thermal buffer zone. The building also features high-efficiency ventilation with heat recovery. As a result, the building exceeded the requirements of the sustainability protocol, achieving a 72% reduction in primary energy use compared to the current benchmark.

Market initiatives

In most parts of the EU, **efforts to report and manage whole-life carbon emissions in buildings have primarily been industry-driven**. Voluntary market initiatives take various forms, such as national and European standards to measure whole-life carbon emissions, green building certifications⁴¹, reporting and benchmarking tools⁴², net-zero-carbon pledges⁴³ and industry roadmaps⁴⁴. Although not yet a mainstream practice across the industry and still with room for improvement, these initiatives signal a **strong commitment from stakeholders in the construction and real estate sectors to adopt science-based targets and to track performance**. The initiatives play an important role in raising awareness, upskilling, unleashing the necessary innovation and capacity in the supply chain, filling persistent whole-life carbon data gaps, and at the same time pushing policy to incentivise the decarbonisation agenda.

³⁹ [Metropolitan Institute of Land Development and Property management \(Barcelona\)](#)

⁴⁰ AMB sustainability protocol: [Criteria for AMB and IMPSOL projects and works](#).

⁴¹ [DGNB](#) (Deutsche Gesellschaft für Nachhaltiges Bauen), [BREEAM](#) (Building Research Establishment Environmental Assessment Method), [HQE](#) (Haute Qualité Environnementale), etc.

⁴² [GRESB](#) (Global Real Estate Sustainability Benchmark), [SBTi](#) (Science Based Targets initiative), [CRREM](#) (Carbon Risk Real Estate Monitor), etc.

⁴³ [BBP](#) (Better Buildings Partnership), [ULI Greenprint](#) (Urban Land Institute), etc.

⁴⁴ [WBCSD](#) (World Business Council for Sustainable Development), [WGBC](#) (World Green Building Council), [IIGCC](#) (The Institutional Investors Group on Climate Change), [CEMBUREAU](#), etc.

ANNEX I: Analysis of life-cycle greenhouse gas emissions of EU buildings and construction

The general objective of this study⁴⁵ is to identify the most effective strategies and policy scenarios for supporting a decarbonised building sector by 2050, both at the aggregate EU level and at individual Member State level. It takes a previously published background study⁴⁶ as a starting point. While the basic concepts are similar, this recent study increases the level of detail of factors that could affect policies and instruments. The study modelled different pathways to reduce emissions across the entire building life cycle. For this, six strategies to minimise greenhouse gas emissions are applied, structured around a framework of three complementary general approaches: avoid, shift and improve. These in turn resemble the concepts of sufficiency, renewables and efficiency, respectively. The report goes on to examine emission reductions across predefined policy scenarios, each reflecting different levels of ambition and integration of the strategies.

The initial phase focused on collection and review of existing data related to buildings, construction practices and material use in Europe⁴⁷. This was complemented by a comprehensive mapping of a large number of carbon reduction and carbon removal (CRR) strategies applicable to the built environment⁴⁸, where a smaller number were used for the later modelling exercise.

In the next phase, scenario modelling was conducted to investigate different pathways for reducing whole-life carbon emissions from the EU building stock through to 2050⁴⁹. A new and more granular Member-State-based set of building archetypes representing the EU building stock was developed. For each of these archetypes, the study set out comprehensive life-cycle inventories and conducted an advanced life-cycle impact assessment, before upscaling to building stock level.

In particular, to support the modelling work and facilitate user engagement, an open scenario modelling tool was developed. This tool provides a publicly accessible interface that allows anyone to select, combine, and compare different scenario configurations, enabling dynamic analysis of decarbonisation options⁵⁰. This will be particularly interesting for policy makers, public authorities and researchers, also in relation to the requirement that Member States develop their own whole-life carbon reduction road maps as set out in the revised Energy Performance of Buildings Directive.

⁴⁵ [Analysis of life-cycle greenhouse gas emissions of EU buildings and construction: analysis of results and implications](#)

⁴⁶ [Supporting the development of a roadmap for the reduction of whole life carbon of buildings](#)

⁴⁷ See report D1.1: “Existing sources of data, gaps or shortcomings in data, and ways to collect or generate new data” (<https://ec.europa.eu/docsroom/documents/58194>)

⁴⁸ See report D1.2: “Mapping of the most promising carbon reduction and removal strategies, taking into account national context” (<https://ec.europa.eu/docsroom/documents/58195>)

⁴⁹ See report D2.1: “Report with quantitative baseline figures for whole life carbon and carbon removals”. The baseline analysis included the characterisation of building stocks and building archetypes at EU Member State level. Building-level LCA results were then upscaled to inform the macro-level analysis of the building stock, covering both the EU and national level.

⁵⁰ See D4.2: “Scenario Modelling Tool - Analysis of Life-cycle Greenhouse Gas Emissions and Removals of EU Buildings and Construction”.

In addition, the study includes a forward-looking assessment of the future availability and generation of building-related data to support ongoing monitoring and decision-making.

Reducing operational emissions was identified as a main target for impactful whole-life carbon reduction strategies across most Member States. However, its effectiveness varies significantly, with only a subset of countries achieving reductions above 70%, compared to total 2020 baseline emissions, using this strategy alone.

For some countries, embodied emissions have a higher relevance, as the share of operational emissions is lower. In Spain, Portugal, Bulgaria, Austria and Denmark, operational emissions make up only a bit more than half of all emissions. In Lithuania and Sweden, operational emissions make up even less. This explains why they achieve relatively smaller emission reductions through the operational emissions strategy. Other strategies are more relevant for these countries, including increased circularity and improved materials, and better use of existing buildings.

The analysis shows that embodied emission reduction strategies perform well when assessed in combination with operation emission reduction strategies. As an example, in several Member States, complementing the business-as-usual strategies with increased use intensity of buildings achieves a better result than complementing business as usual with strategies focusing on further reduction of operational carbon. These findings underscore the need to develop tailored national strategies that reflect country specific circumstances and potentials.

It is also important to consider the interdependency between strategies. In all Member States, the emission reductions achieved when implementing all strategies together are significantly higher than when applying any of the strategies individually. Hence, focusing on one or a couple of strategies only limits the overall impact of decarbonisation efforts and could be counterproductive.

Moreover, in a timeline perspective, strategies complement each other and must be considered as a whole, in relation to the timing and maturity of decarbonisation policies, as well as the potential inertia when it comes to implementing each one of them, as their effectiveness often depends on coordinated implementation over time.

ANNEX II: Results on building stock embodied carbon emissions from the study “Analysis of life-cycle greenhouse gas emissions of EU buildings and construction”, as presented in Annex I.

LCA Stage	Building stock embodied carbon emissions (MtCO ₂ e)																	
	Concrete	Steel	Paint and Glue	Other Metal	Other Materials	Insulation	Brick	Aluminium	Electronics	Plastic	Ceramics	Wood	Glass	Gypsum	Sand	Undefined	Copper	Total
A1-A3	52,664	31,864	7,687	17,283	8,138	13,100	16,084	11,095	11,353	4,789	6,018	3,258	2,122	776	675	72	59	187,038
A4	7,392	211	182	19	151	104	988	13	30	44	174	59	23	48	750	0	0	10,187
A5	3,137	1,608	403	866	431	756	874	556	638	333	313	183	108	44	156	4	3	10,412
B2	3	616	4,062	0	7,970	0	0	16	0	1,464	283	99	60	0	0	306	0	14,880
B4	15	197	12,922	0	1,080	0	0	866	0	3,531	2,587	4,159	354	1,518	0	2	0	27,232
B5	1,416	2,375	980	7,851	4,127	6,252	1,363	5,991	4,860	2,213	1,289	1,020	1,330	209	144	33	13	41,466
C1-4	467	13	21	0	17	34	71	1	0	95	9	74	0	4	17	0	0	824
Total	65,095	36,883	26,257	26,019	21,915	20,246	19,380	18,538	16,881	12,469	10,673	8,853	3,997	2,599	1,743	417	75	292,037

ANNEX III: Summary of sufficiency study for the roadmap

Recent research⁵¹ has unveiled the significance of new construction emerging as a second emission hotspot, alongside operational emissions. Adopting sufficiency policies in the building sector could effectively address the climate, environmental and housing crises all at once. By prioritising the use of the existing building stock before constructing new buildings, sufficiency emphasises the potential of purposefully leveraging and managing existing built spaces as a valuable resource, which has so far to a large extent remained untapped.

A growing body of literature demonstrates the potential systemic impact of sufficiency measures. Using the existing building stock effectively, such as by converting offices into residential homes, mobilising vacancies, adding storeys and converting single-family homes into two or more units, contributes not only to reducing material and energy demand, and hence emissions, but also to easing strain on land resources. Additionally, these measures help to achieve societal goals such as alleviating housing shortages, preventing isolation and loneliness, and reducing infrastructure costs for municipalities. Sufficiency represents an integrated approach to sustainability by acknowledging and balancing the interplay between decarbonisation and equity.

An analysis of five case studies exploring different regions, sufficiency measures, and governance levels demonstrates that sufficiency measures could save substantial amounts of floor space. Estimates based on upscaling case studies to comparable regions and cities reveal a considerable potential for utilising vacant and underused building space, with estimates ranging from 19 220m² in Belgium to 20 197,763m² in France and 23 526,633m² in Germany.

Using vacant buildings, especially those vacant for extended periods, typically results in higher operational carbon emissions compared to new buildings constructed according to the latest energy efficiency standards. The performance gap is likely more pronounced in older vacant buildings with low energy efficiency. This underscores the importance of energy efficiency renovations, which nonetheless, as shown in the Irish case study, are expected to result in whole-life carbon emissions that are 62% lower than those of a new building.

Several opportunities can be used to promote the adoption of sufficiency measures more widely:

- The diversity of approaches shows that incentivising the use of currently vacant building space can take many forms, which can be mutually reinforcing and combined.
- Sufficiency considerations can be included in other instruments and policy objectives. Using existing but vacant or underused spaces is often driven by social, economic, and aesthetic objectives, which create co-benefits for reducing greenhouse gas emissions. Compared to constructing new buildings, adaptation projects are often less costly and quicker to complete. This offers policymakers the opportunity to combine policy goals and narratives, such as supporting affordable housing, preserving vibrant town centres, and responding quickly to housing shortages.

⁵¹ [Supporting the development of a roadmap for the reduction of whole life carbon of buildings](#)

- Gaining a better understanding of the number of vacant buildings is possible with little extra investment and high potential benefits. So far, detailed understanding of vacancies and their location has been limited by low data availability. However, examples from France and Poland illustrate that pooling and systematically using existing data sources is a promising approach to overcoming this limitation.
- Sufficiency measures, particularly among private building owners, remain voluntary decisions in all the examples found across Europe. These initiatives and policies rely on the use of information and awareness building. Such information campaigns can be relatively easily adapted to local priorities and existing platforms, for instance, in existing and planned information tools at the regional or municipal level, such as one-stop-shops.

Using these opportunities also implies addressing remaining challenges:

- Implementing sufficiency principles in the building sector requires capacity within public administrations, i.e. dedicated teams which can develop and manage the projects, whether they involve databases, advisory services, information dissemination, or financial support programmes.
- Although economic factors may incentivise the more efficient use of un-used or underused space, there are also counter-incentives. Reviewing taxation regimes and tenancy regulations for unintended effects can make sufficiency thinking more attractive for property owners.
- While project costs are often lower than new construction, upfront costs pose another obstacle, especially for private building owners but also for public entities. These initial expenses can be a barrier and need to be considered and addressed.
- The application of sufficiency measures to individual buildings is very context dependent (owner type, size, location, etc.) and requires tailored approaches to be effective (generic tools combined with personalised advice).
- Finally, limitations regarding research, tools, and clear definitions hinder larger scale sufficiency efforts. Investing in research and demonstration projects will make it easier to implement effective sustainability policies.

Realising the potential of sufficiency initiatives in the building sector requires concerted efforts from all those involved: policymakers, researchers, industry players and the wider public.

ANNEX IV: Relevant existing policies and initiatives

In the past years the EU has adopted a wide range of legal and policy instruments to support the transition of the built environment and the construction sector towards low carbon and resource efficient solutions.

The European Commission published the “**The Clean Industrial Deal: A joint roadmap for competitiveness and decarbonisation**” in 2025⁵², which brings together climate action and competitiveness under one overarching growth strategy, with creating lead markets for low carbon products as a key element. As buildings are among the biggest consumers of many carbon-intensive products (including steel, cement, glass, aluminium, ceramics, mineral insulation wool), this will have a direct impact on the building sector.

The **European Affordable Housing Package**⁵³ aims to address the structural drivers of the housing crisis across the EU, by supporting and complementing the efforts at national, regional and local levels. One of its key objectives – delivered with a **European Strategy on Housing Construction** - is making the construction ecosystem more competitive and better equipped to meet the increasing demand for affordable housing, including through new construction but also through renovations and repurposing. It addresses bottlenecks on availability of materials as well as skilled labour. The package of initiatives will contribute to decarbonisation of the building stock, for example via measures to support the development of viable markets for secondary (re-used and recycled) materials, which will reduce the demand for primary materials, which in turn will substantially reduce the carbon emissions of new buildings and renovations. It will accelerate the development of harmonised standards under the Construction Products Regulation and specific standards for offsite construction and modular systems.

The revision of the **Energy Performance of Buildings Directive**⁵⁴ contributes to the objective of reducing emissions of at least 60% in the building sector by 2030 compared to 2015, and achieving a decarbonised zero-emission building stock by 2050. In particular, it introduces minimum energy performance standards to trigger renovation of worst performing non-residential buildings as well as targets to improve the average energy performance of residential buildings. Each Member State will develop its own national building renovation plan, setting out the national strategy to decarbonise its building stock. Those plans will be tailored to national circumstances and build upon the current long term renovation strategies.

The directive includes an enhanced standard for new buildings to be zero-emission. It sets out the obligation to calculate whole-life carbon emission of buildings, to be reported on the Energy Performance Certificate, by 2028 for new buildings over 1000m², and by 2030 for all new buildings. This will have to be calculated according to national methodologies, which have to respect the Union framework laid down in the delegated regulation (C/2025/8723). This Union framework ensures comparability of the calculation across Member States, together with harmonised data available at

⁵² [COM\(2025\) 85 final](#)

⁵³ [Affordable Housing Plan](#)

⁵⁴ [Energy Performance of Buildings Directive](#)

product level. Moreover, Member States are obliged by 2027, to publish and notify the Commission of national roadmaps detailing the introduction of limit values for life-cycle global warming potential.

The revised **Energy Efficiency Directive**⁵⁵ boosts energy savings targets, including reducing primary and final energy consumption by 2030. The directive requires Member States to almost double their annual energy savings obligations, in particular in the public sector. Member States will be obliged to annually renovate at least 3% of the total floor area owned by public bodies, to be transformed into at least nearly zero-energy buildings or zero-emission buildings. Public authorities are encouraged to disclose whole-life carbon of buildings, to use low carbon materials and work with circular materials flows in new buildings and renovation.

The EU's **Sustainable Finance framework**, with the EU Taxonomy for sustainable activities⁵⁶, has the potential to act as a catalyst for the EU to mobilise the financial sector to help fund the transition to a zero-carbon built environment. Since 2022, the so-called Climate Delegated Act requires new buildings larger than 5,000 m² that are aiming for Taxonomy compliance to disclose whole-life carbon. Since 2024, the Environment Delegated Act requires the same for all new buildings, in the context of a transition to a circular economy. This act also sets maximum values for the use of primary material for key building products and requires reporting on design for adaptability and deconstruction.

The **Construction Products Regulation**⁵⁷ governs the placing on the market of construction products. The revised regulation obliges manufacturers of construction products to declare environmental characteristics of products (such as global warming potential and other environmental indicators based on EN 15804). This facilitates the calculation of a building's whole-life carbon performance, based on reliable and verified data. The regulation also introduces the for Digital Construction Product Passport, which will make data available in machine-readable format, thereby improving the building design choices considering all the technical and environmental elements.

Some products that are installed in buildings, especially energy-consuming products such as boilers and solar PV panels, are regulated under the **Ecodesign Directive on Energy-related Products**⁵⁸, now replaced by **Ecodesign for Sustainable Products Regulation**⁵⁹, but still applicable for number of products under transition measures. Together with the EU Emissions Trading System and the Construction Products Regulation, this regulation is expected to lead to the creation of lead-markets for low-carbon materials and products. Introduced by the Ecodesign for Sustainable Products Regulation and the Construction Product Regulation, the **Digital Product Passport (DPP)** can include detailed information and tracking concerning origin, composition, components and the environmental footprint of materials used in products. It can increase transparency, and thus together with digital building logbook improve the sustainability of a building by optimizing the resources recovery, reducing waste and promoting circularity.

The Carbon Removals and Carbon Farming Regulation⁶⁰ and the forthcoming delegated act on long-term carbon storage in products will allow building owners to reliably demonstrate the biogenic carbon

⁵⁵ [Energy Efficiency Directive](#)

⁵⁶ [EU Taxonomy for Sustainable Activities](#)

⁵⁷ [Construction Products Regulation](#)

⁵⁸ [Ecodesign Directive on Energy-related Products](#)

⁵⁹ [Ecodesign for Sustainable Products Regulation](#)

⁶⁰ [Regulation on an EU Certification for Carbon Removals](#)

stored in wooden construction materials and bio-based insulation. This will create a framework for monetizing carbon storage in buildings.

The **Waste Framework Directive**⁶¹ is the principal European legislation addressing construction and demolition waste. It defines the waste hierarchy, promotes selective demolition and sorting systems, and sets waste prevention objectives as well as national targets for the recovery of construction and demolition waste. It also introduces the possibility of setting a long-term objective for having material fraction specific preparation for re-use and recycling. Moreover, under this directive, there is ongoing work to develop EU-wide end-of-waste criteria for construction and demolition waste.

The European Commission is currently working on a **Circular Economy Act**, aiming for a single market for waste, and supporting increased supply of, and demand for, quality secondary raw material. In the construction and demolition sector, the initiative seeks to make pre-demolition audits mandatory and digitalised, ensuring that valuable materials are identified in advance and that information on their availability can be easily accessed and exchanged. The Commission is moreover assessing the possibility to promote targeted public procurement criteria to increase the use of recycled and reused materials in public projects, thereby helping to create stable demand. In parallel, it will work to streamline end-of-waste procedures, reducing fragmentation across Member States and enabling secondary materials to move more freely within the Single Market. Finally, the Commission is considering simplified and more harmonised Extended Producer Responsibility approaches to support higher-quality sorting and recycling while reducing administrative burdens for operators.

In relation to waste, it is important to note that, for buildings undergoing demolition, the **F-Gas Regulation**⁶² and the **Ozone-depleting substances Regulation**⁶³ places an obligation on building owners and contractors to destroy the F-gases (hydrofluorocarbons) contained in foam insulation products and ozone, as both are “super greenhouse gases” with global warming potentials many several thousand times higher than CO₂. Globally, about 10 billion tonnes CO₂ eq are contained in such foams, almost three times the EU’s total annual emissions of greenhouse gases, thus constituting a huge potential for emission savings.

The **EU Emissions Trading System**⁶⁴ constitutes a “cap and trade” system for the power sector and energy-intensive industries. With its carbon price, emission cap and annual emission reduction rate, in combination with the **Carbon Border Adjustment Mechanism**⁶⁵, the EU Emissions Trading System will lead to strong decarbonisation of key production processes relevant for construction materials such as steel, aluminum, glass, mineral insulation, cement, bricks, tiles, and gypsum. In addition, a new emissions trading system (ETS II)⁶⁶ covering direct greenhouse gas emissions from buildings as well as road transport will be introduced by 2028. This will concern operational emissions in buildings by placing a carbon price on fossil fuel combustion. The **Social Climate Fund**⁶⁷ is being set up for the period 2026-2032, mobilising at least EUR 86.7 billion, to address any social impacts arising from this

⁶¹ [Waste Framework Directive](#)

⁶² [F-gas Regulation \(EU\) 2024/573](#)

⁶³ [Regulation \(EU\) 2024/590](#)

⁶⁴ [Emissions Trading System](#)

⁶⁵ [Carbon Border Adjustment Mechanism](#)

⁶⁶ [Directive - 2023/959](#)

⁶⁷ [Social Climate Fund](#)

new system by supporting vulnerable consumers. In parallel, the **Innovation Fund**⁶⁸, estimated at EUR 40 billion for 2020-2030 and sourced from revenues of the EU Emissions Trading System, supports innovative low carbon investments for energy intensive industries. Also, the Recover and Resilience Facility provides financial support to energy efficiency⁶⁹ and renewable energy⁷⁰.

Creating lead markets for European clean technologies and low-embodied carbon products is crucial to drive demand for such products and to make sustainable alternatives more accessible. The Commission is developing a **voluntary label on the carbon intensity of industrial products**, starting with steel, that is based on verified data reported under the EU Emission Trading System. Together with the mandatory declaration of global warming potential under the Construction Products Regulation, this will help Member States to implement the obligations regarding life-cycle global warming potential in the Energy Performance of Buildings Directive, and to include this dimension in public procurement.

The revised **Renewable Energy Directive (REDIII)**⁷¹ increases the ambition for renewable energy consumption. It sets a new Union-wide target of at least 42.5% (with an aspiration of 45%) of renewable energy sources (RES-share) in the gross final consumption of energy across all sectors. In addition, it includes several targets that aim to increase the renewable energy sources share in the buildings sector. The directive has a binding target for the heating and cooling sector as a whole, that requires an annual increase of 0.8 and 1.1 percentage points of the renewable energy sources share for the periods 2021-2025 and 2026-2030, respectively. It moreover has an indicative target for the district heating and cooling sector that requires an annual increase of 2.2 percentage points. Lastly, Member States are required to set an indicative target for the building sector that is in line with a union-wide share of 49% in 2030.

The **New European Bauhaus**⁷² initiative supports the transition of the construction eco-system towards low-carbon, circular and biobased solutions, enhancing the opportunities provided by the circular economy and the bioeconomy. Thereby it supports the whole-life carbon approach by integrating circular economy principles, promoting low-carbon materials, and encouraging life-cycle thinking in design, construction, and renovation. It aligns with EU policies like the Energy Performance of Buildings Directive and the Circular Economy Action Plan to reduce embodied and operational carbon. Through demonstration projects and funding, the New European Bauhaus fosters innovative, sustainable solutions, cross-sector collaboration and participatory processes. By emphasising beauty, sustainability, and inclusivity, it advances holistic strategies that minimise carbon impact across a building's entire life cycle, from material sourcing to demolition, supporting Europe's decarbonisation goals. While the New European Bauhaus supports an integrated approach to national housing strategies and local spatial planning decisions, it points to how better use of existing buildings through renovation, repurposing and social practices, should be considered prior to demolition and new construction, and how this can help delivering housing for all, fostering social cohesion and acceptance while protecting cultural heritage.

⁶⁸ [Innovation Fund](#)

⁶⁹ [Impact-RRF-energy-efficiency - Reform Support - European Commission](#)

⁷⁰ [Impact-RRF-clean-power - Reform Support - European Commission](#)

⁷¹ [Renewable Energy Directive](#)

⁷² [New European Bauhaus](#)

The **EU Mission for Climate Neutral and Smart Cities**⁷³ supports cities in accelerating the transition to climate neutrality through integrated Climate City Contracts, which provide a systemic roadmap covering all major emission sources, including the built environment. The Mission promotes life cycle thinking in buildings by helping cities plan and implement deep renovation, sustainable construction practices, circular use of materials, and the decarbonisation of heating and cooling systems. The Cities Mission Platform provides tailored technical and financial assistance to the Mission Cities, as well as knowledge, resources, tools and replicable solutions available to all cities to advance the transformation of Europe's building stock and support the wider uptake of life-cycle methods across the built environment.

The **Transition Pathway for Construction**⁷⁴ describes conditions and necessary actions for achieving a resilient, competitive, greener, and more digital construction ecosystem. It highlights how, for the construction ecosystem, addressing life-cycle emissions will help to stimulate innovation in products, processes, design and construction practices and tools. It also makes recommendations for action on whole-life carbon at EU level, national level and by industry. Many of these actions align with the measures discussed in this staff working document.

Level(s)⁷⁵ is the European framework that provides a common language for assessing and reporting on the sustainability performance of buildings, from early design to the demolition of buildings. It thus embraces a full circularity and life-cycle approach and the methodology to calculate whole-life carbon follows the relevant global and EU standards for sustainable construction (ISO 14040/44, EN 15978).

The Environmental Footprint methods, as in EC Recommendation 2279/2021^{76,77}, provide a standardised framework for companies to measure and communicate their environmental performance following a life cycle approach. The EF methods are applicable to any types of products or organisations and could also be applied to buildings and construction materials, even if adapted methods are currently in use. As mandated by the European Commission in 2016, the EN 15804 standard aligns with the EF methods with regard to various methodological requirements, particularly in areas such as impact assessment models, indicator units, and characterisation factors for different impact categories⁷⁸.

In the context of **Green Public Procurement**⁷⁹ policy, the European Commission has been supporting Member States, their contracting authorities and entities by developing recommendations in the form of clear, verifiable, justifiable and ambitious environmental criteria for products and services, based on a life-cycle approach and scientific evidence. One of the product groups for which criteria for voluntary application have been recommended is office buildings. These criteria provide contracting authorities and their procurers with the opportunity to set requirements that address the most

⁷³ [EU Mission on Climate-neutral and smart cities](#)

⁷⁴ [Transition Pathway for Construction](#)

⁷⁵ [Level\(s\)](#)

⁷⁶ [Recommendations on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations](#)

⁷⁷ [JRC Publications Repository - Suggestions for updating the Product Environmental Footprint \(PEF\) method](#)

⁷⁸ [European Platform on LCA | EPLCA](#)

⁷⁹ [Green Public Procurement](#)

significant opportunities for environmental improvements throughout the life cycle of office buildings. Published in 2016, the criteria are currently under revision.

The European Green Digital Coalition (EGDC) is an initiative which aims to harness the enabling emissions-reducing potential of digital solutions to all other sectors. The EGDC have developed a Net-Carbon Impact Assessment Methodology for ICT Solutions and is sector-agnostic, which delineates requirements for a comprehensive comparison of scenarios with and without ICT solutions in a given implementation context. The methodology enables the quantification of both the positive contribution (e.g., carbon reduction) and negative contributions (e.g., solution's direct footprint) of a given ICT solution in CO₂ equivalents (CO₂eq). To provide further guidance on applying the methodology, the EGDC have developed sector-specific methodologies, including for construction/buildings, for illustrating the practical application of each requirement within the context of the respective sectors, for example the environmental impacts related to materials and energy usage for the construction/building sector.

Digitalization can play a pivotal role in the optimisation of material, energy efficiency, and consumption patterns for buildings, if properly deployed and maintained. Deploying advanced digital technologies such as smart meters, coupled with Internet of Things (IoT) devices and Building Energy Management Systems, can provide granular real-time data. This data supports the facilitation for minimising energy wastage. The implementation of sophisticated monitoring systems underscores the capability of digital technologies to track the usage and utilisation of vital resources, including, but not limited to, materials for maintenance and water. This extent of monitoring enables the establishment of more effective, efficient and sustainable resource management protocols. Additionally, integrating and utilising sensor technologies, together with data analytics, contributes to efficient predictive maintenance. By foreseeing potential equipment failures and scheduling of maintenance activities proactively, the operational lifespan of the building systems can be prolonged, and the sustainability and resilience of the building infrastructure strengthened. The facilitation of digital tools requires careful planning and execution to ensure positive sustainable impact.

ANNEX V: Summary of public consultation on whole-life carbon

This specific public consultation on whole-life carbon was open from 17 July to 17 September 2023, and 250 responses were provided. A full analysis of the results with all details is available⁸⁰. A summary of this is presented below.

Stakeholders expressed high confidence in the potential and feasibility of currently available low-carbon measures when it comes to reducing whole-life carbon through a range of material selection, efficiency and sufficiency areas. Of the 18 reduction measures on which the consultation focused, 11 were rated as having very high/high whole-life carbon reduction potential by 80% or more of the respondents, while two more measures were rated as such by more than 60% of the respondents. Out of these 13 measures, eight were rated as having very high/high feasibility by 70% or more of the respondents, while two more measures were rated the same by more than 60% of the respondents. The five options considered having the biggest potential for reducing whole-life carbon emissions were: prioritising renovation, repair and maintenance over demolition and new construction; reduce greenhouse gas intensity of energy supply; promote energy efficient renovation to reduce the energy use of existing buildings; ensure that any new buildings are designed to be high energy performing; and, finally, reduce the carbon footprint of materials and construction products in their manufacturing processes.

Stakeholders felt that there was a need for robust whole-life carbon policies in addition to the policy framework in place at the time of the consultation (before revision of the EPBD and the CPR). All 12 policy instrument options were considered effective and feasible by most respondents.

Respondents overwhelmingly supported the introduction of mandatory maximum values for buildings (85%). There was with an almost equal split between those who prefer red immediate implementation and those who favoured a stepwise process, starting with a voluntary approach, becoming mandatory later on. 70% of the stakeholders saw a clear role for the EU to develop a harmonised methodology, instruments and guidance on maximum values to ensure consistency and comparability.

Based on harmonised assessment approach across the EU, a majority (67%) preferred any setting of targets to be done at the national level, with guidance from indicative EU values. 27% preferred EU values.

Of the 250 respondents, there was a rather even balance between the different sizes of organisation. Major EU economies were well represented in the survey, but the number received from eastern European Member States was low. The vast majority of respondents were used to taking whole-life carbon considerations into account in their work. The results thus reflect the perspective and expertise of stakeholders, authorities and members of the public who encounter whole-life carbon aspects in their day-to-day business and professional practices.

51% of the respondents believed that current EU policies relating to whole-life carbon of the building sector did not sufficiently ensure that the building stock would be aligned with a climate-neutral trajectory, and that additional policy would be needed to complement the existing framework (a view

⁸⁰ [Public consultation](#)

held in particular by architects, planners and engineers). 39% stated that a suitable EU framework was in place but needed to be strengthened (a view held in particular by material manufacturers and suppliers). Interestingly, a large proportion of small organisations took the view that additional policies were needed to complement the EU framework. The prevailing theme mentioned was the urgency to act upon whole-life carbon as a significant source of emissions in the EU. Across all stakeholders, there was a recognition of the need for incentives to increase the relevance of whole-life carbon emissions in discussions and decisions involving developers, architects and contractors.

The overwhelming majority of respondents (93%) believed it necessary to establish maximum values for whole-life carbon for some or all categories of individual buildings. Notably, 85% of respondents envisaged a situation where maximum values were mandatory. This included 44% of stakeholders, who advocated that this process be initiated on a voluntary basis, with a subsequent transition to mandatory limits (a view held in particular by material manufacturers and suppliers). Meanwhile, 41% called for an immediate implementation of mandatory limits (a view held in particular by architects, planners, and engineers). Respondents from countries with existing whole-life carbon methods supported the introduction of immediate mandatory maximum values more strongly than respondents from countries where this does not exist.

A significant portion of respondents (88%) believed that European-level governance would be most appropriate for addressing whole-life carbon emissions, but added that a mix of different governance levels (EU, national, regional and local) would be most effective. 70% of respondents believed that whole-life carbon of individual buildings should be measured in the same way across the EU, while determination of maximum values being considered to be most suitably done at national level, with guidance from suggested indicative EU values (two thirds of respondents).

A large majority of respondents (80%) believed that all new buildings, both residential and non-residential, should see maximum whole-life carbon values applied to them. Another 10% wanted to see limit values for a subset of new residential and non-residential buildings. A majority, albeit smaller, felt that maximum whole-life carbon values should be applied to all major renovation projects as well, in the case of residential buildings 56% and non-residential buildings 61% of respondents. Around another 20% wanted to see limit values for a subset of renovation of both residential and non-residential buildings, largely depending on the size of the renovation project.

The policies viewed as being more helpful in driving down whole-life carbon emissions, considering both their whole-life carbon reduction potential and the feasibility for policy to be enacted, were:

- include consideration of whole-life carbon in national construction, renovation and new housing plans and targets;
- make mandatory the declaration of the carbon footprint of construction products;
- link public funding to whole-life carbon performance.