

EU 2040 Climate Target: Contributions of the buildings sector

Part 5 of 7 studies on sectoral contributions to the 2040 target

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Abbreviations

CRF	Common Reporting Format
EC	European Commission
ECL	European Climate Law
EEA	European Environment Agency
EED	Energy Efficiency Directive
EP	European Parliament
EPBD	Energy Performance of Buildings Directive
ESABCC	European Scientific Advisory Board on Climate Change
ESR	Effort Sharing Regulation
ETD	Energy Taxation Directive
ETS	Emissions Trading Scheme
EU	European Union
GHG	Greenhouse gas
MSR	Market Stability Reserve
RED	Renewable Energies Directive
SCF	Social Climate Fund
WAM	With additional measures (projection)
WEM	With existing measures (projection)

Executive Summary

The 2040 climate target

The EU is legally obliged to achieve climate neutrality by 2050 and has an interim target for 2030 of reducing net GHG emissions by at least 55% compared to 1990. The European Climate Law also requires the EU to adopt an interim climate target for 2040.

In its communication of 6 February 2024, the European Commission proposed a net emission reduction of 90% by 2040 when compared to 1990. ESABCC (2024) recommends 90–95% reductions. The indicated target range means that all sectors will have to contribute significant emission reductions.

This paper explores the past contribution of the buildings sector to already achieved emission reductions as well as the contribution of the buildings sector to the upcoming 2040 climate target and what it takes for buildings to achieve the related emission reductions.

Emission trends in buildings

The buildings sector's greenhouse gas (GHG) emissions have continuously been reduced since 1990 from 735 Mt CO₂eq reaching 489 Mt CO₂eq in 2022. This has been achieved via a mix of energy efficiency gains, increasing use of renewable energies for heating purposes as well as an initial shift towards heat pumps and district heating in recent years. According to Member States' national projections from 2023, current policies and measures will reduce GHG emissions from buildings to a level 42% below 1990 levels by 2030 (EEA 2023). Until 2040, national projections estimate a 53% reduction with existing measures and a 62% reduction with additional measures compared to 1990 levels.

What does the 2040 target mean for the buildings sector?

The European Commission's recommended overall GHG target for 2040 is a reduction in GHG emissions of 90% with respect to 1990 levels. The buildings sector's contribution is slightly higher reaching a reduction in GHG emissions of 92%. This places the EC's recommendation right in the middle of the various target scenarios currently available for the buildings sector: these achieve GHG emissions reduction of between 88% and 99% in 2040. The GHG reductions are achieved mainly by a phase-out of fossil fuel-based technologies and increased efforts in energy efficiency through higher-than-present renovation rates.

Key challenges

The buildings sector faces significant challenges in meeting the EU's recommended 2040 climate target, primarily due to the need for substantial reductions in energy consumption and GHG emissions. One key challenge is the energy inefficiency of the existing building stock, much of which was constructed without modern energy-saving technologies. Retrofitting these buildings to meet stringent energy efficiency standards requires substantial financial investment, skilled labour, and time. Additionally, there is a need for widespread adoption of renewable energy sources to replace fossil fuel-based heating and cooling systems. The sector also faces regulatory hurdles such as the lack of uniform building codes (even within Member States). Furthermore, compliance needs to be ensured, both for retrofitting of existing buildings and for new buildings. The latter are obliged to meet net-zero energy standards by 2030. At the same time making sure all parts of the population have the possibility to take part in the energy

transition in the buildings sector is crucial for generating acceptance of policy measures. Sufficiency measures need to be actively promoted. Achieving the 2040 climate target demands coordinated efforts from policymakers, industry stakeholders, and consumers to overcome these challenges.

What is currently included in the existing EU legislation?

The buildings sector is addressed by a broad set of EU directives and regulations, comprising building energy standards for new and renovated buildings, targets for the share of renewable energies used for heating and cooling as well as for the overall GHG emissions from buildings. The most important directives are the Energy Performance of Buildings Directive (EPBD), the Energy Efficiency Directive (EED), the Renewable Energy Directive (RED) as well as the Effort Sharing Regulation (ESR). Moreover, the Emissions Trading System (ETS), the directives on ecodesign, corporate social responsibility, energy taxation or gas directly or indirectly affect the buildings sector. In the future the ETS 2 as well as the Social Climate Fund will play an important role for the buildings sector by setting up a cap-and-trade scheme for GHG emissions in the buildings sector (ETS 2) as well as cushioning its effects for low-income households by means of the Social Climate Fund (SCF).

Policies, measures and options to further reduce emissions in the buildings sector

The success of the 2040 decarbonisation target critically hinges on achieving the 2030 targets, which are already very ambitious. It is therefore crucial to fully implement the recently adopted 2030 framework. Member States must exert substantial effort, particularly in the buildings sector, to meet the goals set out in the various directives for 2030 and increase the level of ambition for the decade after 2030. The Commission should provide clear guidance in the process. Heat planning regulations and minimum energy performance standards (MEPS) must be enforced, MEPS for residential buildings need to be introduced. Renovating the worst-performing buildings is essential for reducing greenhouse gas emissions cost-effectively. Meeting renewable energy targets for heating and cooling by 2030 requires significant effort, as many Member States are lagging. Overachieving these targets is crucial to avoid intensified efforts post-2030. A clear biomass usage strategy is also necessary. Member States should support the phase-out of fossil fuels and need to aim for a zero-emission buildings stock by 2050. This entails strict provisions for new buildings as well as for retrofitting measures in existing buildings. The introduction of the ETS 2 requires careful assessment to mitigate the impact on households, with compensatory measures between and within Member States available through the SCF. Complementary measures, such as one-stop shops, information campaigns, and workforce development, must be consumer-focused and effectively implemented. A comprehensive action plan for the buildings sector should be established to ensure consistency in future regulatory revisions. The pathways for the buildings sector are ambitious and at the same time of key importance for decarbonising the EU-27, necessitating swift action and the inclusion of all possibilities, including sufficiency measures.

1 Introduction

The EU will adopt a climate target for 2040 in the coming years. This is a legal obligation set out in the European Climate Law (ECL). Article 4.4 of the ECL stipulates that “a Union-wide climate target for 2040 shall be set” – with a view to achieving the ECL’s climate neutrality objective. Once the target is adopted, the EU is also set to adopt a legislative package to implement this target. This package will reform relevant EU laws and policies.

This paper is part of a group of sectoral papers, published in the context of a project funded by the German Federal Ministry for Economic Affairs and Climate Action. In this project, Ecologic and Oeko-Institut analyse the ambition level of the 2040 target and examine the impacts of a new 2040 target on Member States, sectors, and instruments. For more information about this project see: EU 2040 Climate Target. Level of ambition and implications. Besides other outputs of this project, these sectoral papers explore contributions of respective sectors to the upcoming 2040 climate target and what it takes for these sectors to achieve the related emission reductions. Relying on various emission reduction scenarios, the papers discuss different measures and policies that could help achieve the necessary contributions.

The buildings sector as presented here is defined by the official Common Reporting Format (CRF) and includes emissions from fuel combustion in commercial and institutional buildings as well as in households:

1 A 4	Energy - Other sectors	
1 A 4 a	Commercial / Institutional	Emission from fuel combustion in commercial and institutional buildings
1 A 4 b	Residential	All emissions from fuel combustion in households

Emissions from the use of electricity and district heating are excluded since they are taken into account in the transformation sector.

This paper explores the past contribution of the buildings sector to already achieved GHG emission reductions as well as the contribution of the buildings sector to the upcoming 2040 climate target and what it takes for buildings to achieve the related GHG emission reductions.

2 Sectoral trends

2.1 Historic and projected emission trends

The EU buildings sector's GHG emissions have gradually been reduced since 1990 from more than 730 Mt CO₂eq to less than 500 Mt CO₂eq in 2022. According to Member States' national projections from 2023, current policies and measures will reduce GHG emissions from buildings to a level 42% lower than 1990 levels by 2030 (European Environment Agency (EEA) 2023a). With additional measures, GHG emissions are projected to reach a level 48% below 1990 levels. Compared to 2005 levels, national projections state a 37% reduction with existing measures and a 43% reduction with additional measures. Given these national projections and the national targets established in the ESR, the buildings sector puts additional pressure on the other ESR sectors in many Member States, both in smaller countries such as Malta, Cyprus and Estonia, but also in larger ones such as Italy, the Netherlands or Romania. Until 2040, national projections estimate an 53% reduction with existing measures and a 62% reduction with additional measures compared to 1990 levels. Figure 1 depicts the buildings sector's historic and projected GHG emissions based on with additional measures projections as submitted by the Member States in 2023.

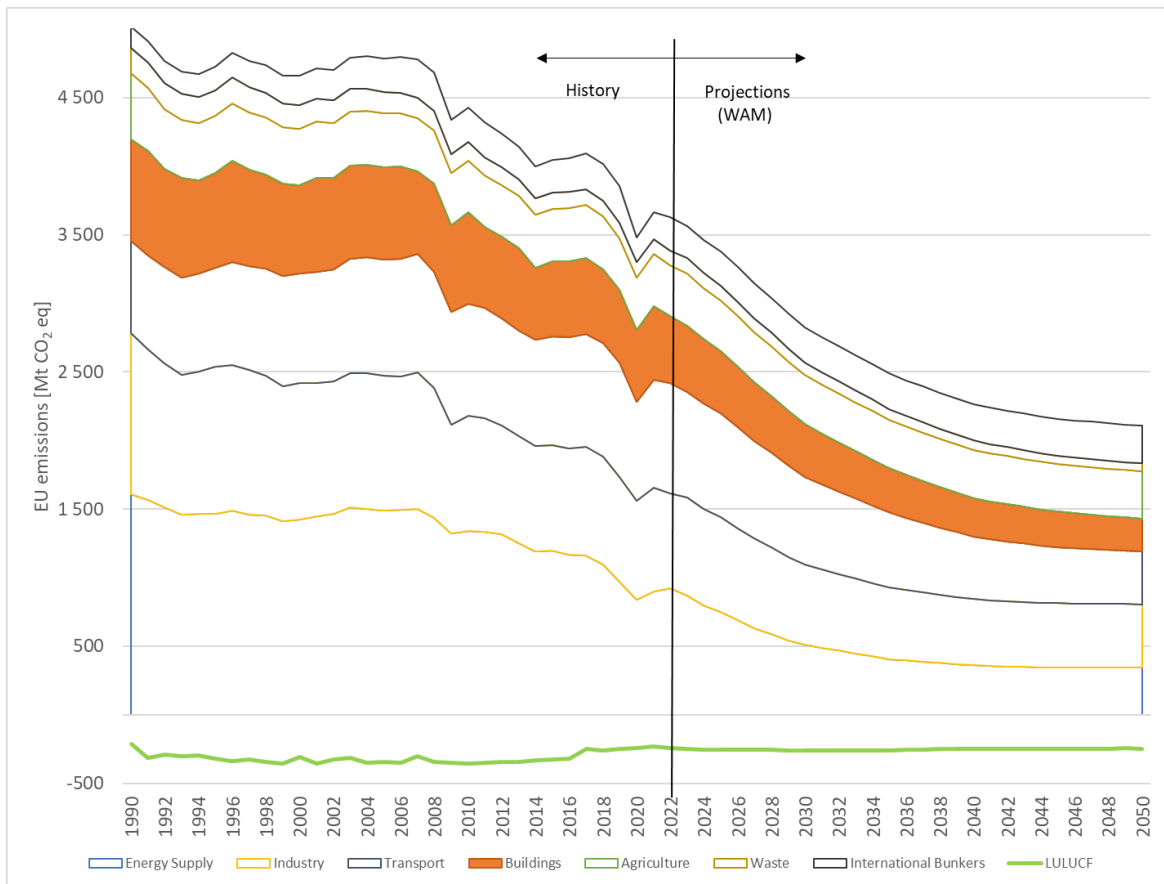


Figure 1: Historic and projected EU buildings GHG emissions (with additional measures projection, WAM) , based on European Environment Agency (EEA) (2023a)

2.2 Future trends in national projections

Until 2030, the buildings sector is covered by the ESR. Compared to 2005 levels, the ESR sectors are set to reduce their GHG emissions collectively by -40%. Hence, the contribution of the ESR sectors to the EU 2030 climate target is lower than of the ETS 1 sectors recognising that emission reductions are harder to achieve in transport, heating, agriculture, and the remaining ESR sectors (see Chapter 3.1.4). Member States' targets are differentiated according to Gross Domestic Product (GDP) per capita and reach from -10% in Bulgaria to -50% for Denmark, Finland, Germany, Luxembourg, and Sweden.

National projections show a large variation of the Member States' reductions of buildings sector GHG emissions for the ESR period 2005 to 2030. With additional measures projections indicate that emissions are likely to increase in four Member States, likely due to a mix of changes in the population size and economic growth. The highest increase in emissions is projected for Malta (+21%), followed by Estonia (+6%) and Romania (+3%). On the other hand, Denmark (-82%), Sweden (-81%), Slovenia (-76%), Finland (-69%) and Greece (-68%) are likely to reduce buildings sector emissions considerably. In 16 Member States, buildings sector emissions are projected to decrease more than the respective ESR target. In the eleven remaining Member States, the buildings sector puts additional pressure on the other ESR sectors to meet the respective Member State ESR target. Figure 2 shows the projected change of buildings sector GHG emissions for the period 2005 to 2030 according to the with additional measures (WAM) projections by Member States.



Figure 2: Projected change of buildings sector GHG emissions between 2005 and 2030 (with additional measures projection, WAM), based on European Environment Agency (EEA) (2023a)

Looking further to 2040 the overall picture changes somehow, but not drastically (cf. Figure 3). With Cyprus and Romania there are two Member States that do not reduce their buildings sector GHG emissions in 2040 with respect to 1990. All others achieve a reduction in GHG levels with ten Member States reaching reductions of more than 80%. Seven Member States end up reducing their emissions by 50% or less, leaving another eight to reduce by between 50 and 80%.

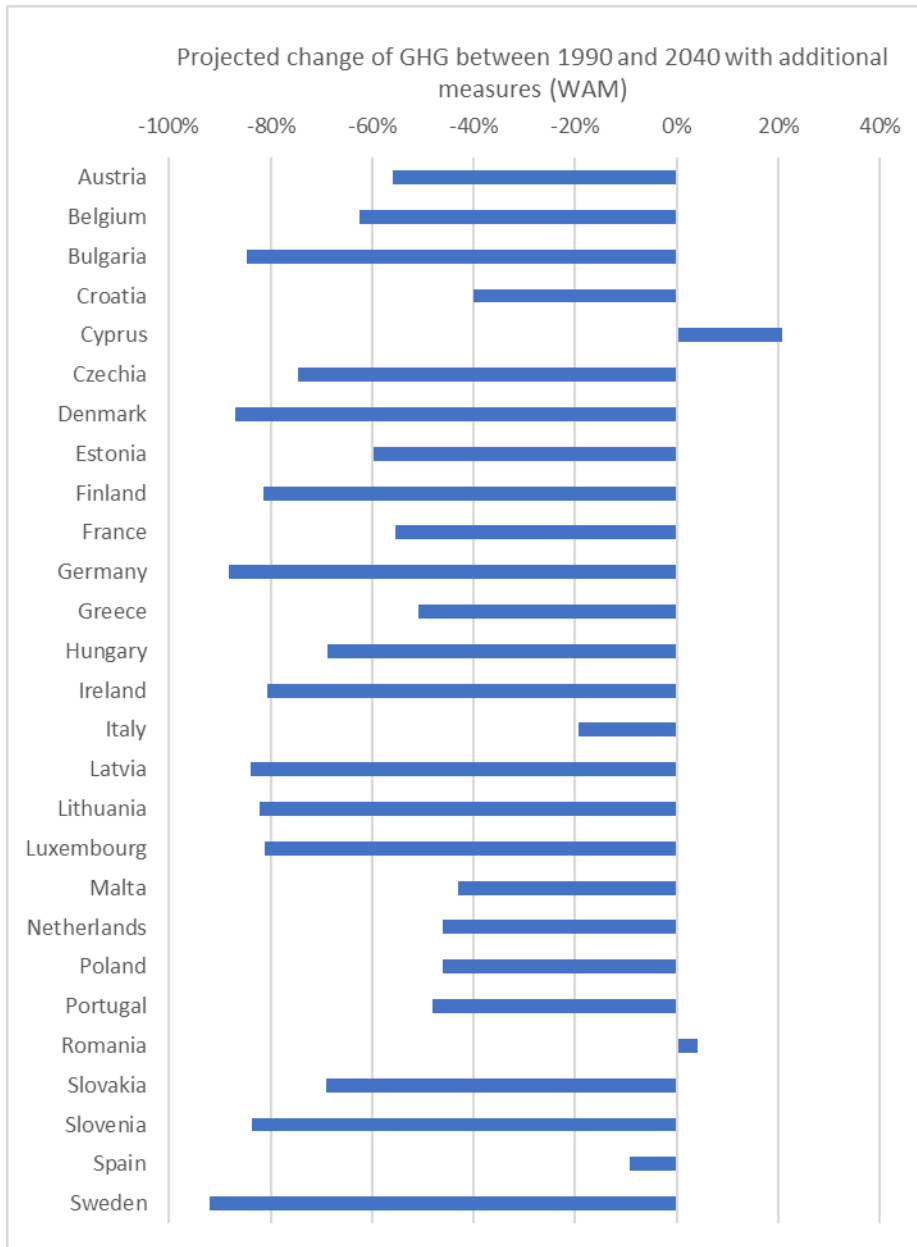


Figure 3: Projected change of buildings sector GHG emissions between 1990 and 2040 (with additional measures projection, WAM)

2.3 Interactions with other sectors

The buildings sector has relevant interaction and interdependencies with other sectors.

The energy sector stands out most, not only because of its historic interlinkages with the buildings sector via the supply of district heating and electricity, but also because of the increasing electrification of heating systems in the years to come. The buildings sector's dependence on the energy sector will therefore deepen further, as will its potential to act both as provider for flexibility in the future, more fluctuating electricity system and as producer of electricity via rooftop solar photovoltaics. Regarding GHG emissions this shift towards higher electrification rates will also shift the source of emissions to the energy sector. According to the impact assessment the share of the final energy demand for electricity in buildings (including for appliances) will grow from about one third in 2015 to 61-64% in 2040 (European Commission 2024). Should hydrogen eventually play a role in heating buildings, this would create another interlinkage to

the energy sector. The degree to which this is going to happen, is still unclear due to uncertainties in, e.g., supply, potential supply chains, production costs, end-consumer costs, or acceptance issues.

The transportation sector relates to the buildings sector in the following ways. First, via urban planning and infrastructure: The design and layout of buildings can influence transportation patterns, urban sprawl, and the demand for transportation infrastructure. Compact, mixed-use developments with access to public transportation can reduce the need for long-distance commuting. Second, via EV charging infrastructure: The integration of EV charging infrastructure into and next to buildings, supports the transition to electric mobility and can reduce emissions from transportation.

The industry sector is affected by the buildings sector's needs for construction materials: Sustainable practices in the production and use of construction materials, such as minimising carbon-intensive materials and promoting recycled or low-carbon alternatives, can reduce the environmental footprint of buildings. Building automation as well as industrial scale pre-fabrication of building elements facilitates an energy-efficient use of resources.

The need for construction materials also affects, and may put pressure on, the agriculture/forestry sector since wood-based construction solutions are a major source of reducing carbon emissions for newly constructed buildings as less or no process emissions from concrete are being generated. Increasing demand for biomethane from the buildings sector would also have an impact on the agricultural and waste sectors, potentially leading to more agricultural areas being used for biomethane production. Finally, the renewable energy carrier with the highest share in heating and cooling currently is solid biomass. From a climate perspective (cf. LULUCF paper), the amount of solid biomass used in the buildings sector for heating purposes may have to be reassessed (Braungardt et al. 2022).

2.4 Key challenges in this sector

The buildings sector faces significant challenges in meeting the EU's recommended 2040 climate target, primarily due to the need for substantial reductions in energy consumption and GHG emissions. One key challenge is the energy inefficiency of the existing building stock, much of which was constructed without modern energy-saving technologies. Retrofitting these buildings to meet stringent energy efficiency standards requires substantial financial investment, skilled labour, and time¹. Additionally, there is a need for widespread adoption of renewable energy sources to replace fossil fuel-based heating and cooling systems. A set of economic and financial barriers, however, hinder progress (cf. Kranzl et al. (2022)). These include high upfront costs both for retrofitting measures and renewable energy heating technologies when compared to fossil fuel-based heating systems. Operation costs for fossil fuels are still comparatively cheap, adding another barrier for transitioning to more sustainable solutions.

The sector also faces regulatory hurdles such as the lack of uniform building codes (even within Member States). For centralised district heating systems based on renewable energies, the regulations for the transition away from standard CHP plants are still incomplete: this includes rules for third party access to district heating grids, mandatory reporting on waste or excess heat availability, or insufficient consideration of spatial needs (e.g. for solar thermal collector fields).

Furthermore, compliance needs to be ensured, both for retrofitting of existing buildings and for new buildings. The latter are obliged to meet net-zero energy standards by 2030. At the same

¹ Often an adequate business case for retrofitting is missing due to long payback times.

time making sure all parts of the population have the possibility to take part in the energy transition in the buildings sector is crucial for generating acceptance for more stringent policy measures, which implicate higher energy costs for households.

The buildings sector is regulated by a whole set of different directives and regulations addressing the sector from different angles. Energy efficiency is addressed both by the EED and the EPBD. The Phasing out of fossil fuels is addressed in the RED, EED and EPBD. Planning issues are addressed in the EPBD and EED. Social aspects are addressed by the EED, EPBD and the SCF: they mostly concern provisions for alleviating energy poverty and protecting vulnerable households, thereby also trying to increase acceptance for the transition. Energy pricing and financing are addressed by the EU Taxonomy, the ETS 2, the EED and the EPBD. The number of different regulations, their interlinkages and practical consequences mean that the understanding of what is needed is complex. Consistency between regulations has so far mostly been achieved. However, the implementation of the ETS 2 with the complementary introduction of the SCF is a crucial point for coherence: the funding provided by the SCF needs to match the potentially high distortions introduced by the ETS 2 from the beginning.

Another aspect arises from the fact that the buildings sector is relatively speaking a slow-moving sector. That, in turn, means: all provisions set up today (and in the future) need to be compatible with the long-term climate targets. As shown above, the buildings sector's trends are far from being compatible with climate targets. Even though the latest cycle of recasting the main directives regulating the buildings sector is a step in the right direction, the next cycle of directive recasts needs to increase the level of ambition even further, especially for existing buildings.

GHG emissions in the buildings sector will be shifting away from buildings to the energy/transformation sector as consequence of the ongoing electrification and district heating expansion. Formally, this leads to less emissions in the buildings sector. In theory, therefore, the buildings sector could decarbonise completely by going "all-electric" and "all-district heating" without addressing energy efficiency at all. Provisions set in both the EPBD and the EED, however, ensure that energy efficiency is addressed – and for good reason: from a whole energy system perspective, disregarding energy efficiency leads to immense extra pressure on adding capacity for renewable energies, which in turn leads to high pressure on land consumption, grid extensions etc. Addressing energy efficiency therefore leads to higher degrees of freedom for the entire energy system.

3 Sector contributions to the 2040 climate target

3.1 What is already in current legislation?

The EU buildings sector is addressed by a whole set of different directives and regulations. While some are more important than others, the multitude of provisions shows the different angles from which buildings can be addressed. This chapter provides an overview of the different directives and regulations currently in place (or planned), Their main components and areas of regulation are summarised in Figure 4. While some provisions address a whole range of topics relevant to the buildings sector (e.g. the EED or the EPBD), others focus on particular fields only (e.g. the RED or the taxonomy).

Reducing energy demand for H&C	Phasing-out fossil fuels	Planning, data and information	Social aspects	Financing and energy pricing
<p>EED</p> <ul style="list-style-type: none"> Art. 4 Collective reduction of FEC by 11.7% by 2030. Art. 5 All public bodies combined must reduce their FEC by 1,9% annually compared to 2021. Art. 6 Renovate 3% of total floor area of heated & cooled public body buildings each year to NZEB or ZEB Art. 8 Cumulative end-use savings obligation annually 	<p>RED</p> <ul style="list-style-type: none"> Art. 15a Target and framework for mainstreaming RES in buildings Art. 23 Target for annual increase of RES-H&C share (0.8% until 2025 and 1.1.1% 2026-2030 Art. 23 'long-term decarbonisation strategies to increase RES in H&C' + 'MS to inform owners/tenants and SMEs on cost-effective measures, and financial instruments on RES in H&C' Art. 24 Target for renewables in district heating 	<p>EPBD</p> <ul style="list-style-type: none"> Art. 3 National building renovation plan (NBRP) Art. 12 Renovation passports Art. 15 Smart readiness of buildings Art. 16 Data exchange Art. 17 Financial incentives, skills and market barriers Art. 18 One-stop-shops for energy performance of buildings Art. 19-22 Requirements for Energy Performance Certificates Art. 23-24 Inspections Art. 25-26 Requirements for building professionals Art. 29 Information and awareness-raising campaigns 	<p>EPBD</p> <ul style="list-style-type: none"> Art. 9 (4) Financial support and social monitoring for MEPS Art. 12 Renovation passports Art. 17 (12) Financial incentives for vulnerable households Art. 18 (3) One-stop-shops with dedicated services for vulnerable hh Art. 29 Information for vulnerable hh 	<p>EU Taxonomy</p> <ul style="list-style-type: none"> Art. 9-15 Contribution to one of six environmental objectives Art. 17 DNSH-Criteria Art. 18 Minimum safeguard Annex: Criteria under which H&C related economic activities are labeled as sustainable are listed under items 4.15. to 4.25. Adjacent are further items of section 4 (Energy) and 7 (Construction and real estate activities)
<p>EPBD</p> <ul style="list-style-type: none"> Art. 5-8 Minimum requirements for new buildings and existing buildings that undergo major renovation Art. 9 Minimum energy performance standards and trajectories for progressive renovation Art. 13 Technical building system (efficiency requirements) 	<p>EED</p> <ul style="list-style-type: none"> Art. 26 Criteria for efficient district H&C 	<p>EED</p> <ul style="list-style-type: none"> Art. 3 Energy efficiency first principle Art. 13-20 Metering and billing Art. 22 Information and awareness raising Art. 25 Heating and cooling assessment and planning 	<p>SCF</p> <ul style="list-style-type: none"> Art. 1 Focus on households in energy poverty Art. 2(1) Legal definition of energy poverty Art. 6 Vulnerable households mapping in SCPs Art. 7 Financial support to reduce energy poverty Art. 9 Pass-on of benefits to households and micro-enterprises Art. 24 Monitoring MS performance in tackling energy poverty via SCP 	<p>ETS 2</p> <ul style="list-style-type: none"> ETS 2 for Buildings, Road Transport and additional Sectors Art. 30c: Declining union-wide quantity of allowances
	<p>EPBD</p> <ul style="list-style-type: none"> Art. 9b Definition of ZEB Art. 11 Technical building system (strive to replace stand-alone boilers powered by fossil fuels in existing buildings to be in line with the national phase-out plans) 		<p>EED</p> <ul style="list-style-type: none"> Art. 8(3) The proportion of cumulative end-use energy savings that benefits people in energy poverty shall at least be equal to the proportion of people that are affected by energy poverty. Art. 24 Empowering and protecting vulnerable customers and alleviating energy poverty 	<p>EED</p> <ul style="list-style-type: none"> Art. 7 Public procurement obligated to adhere to high energy efficiency.
				<p>EPBD</p> <ul style="list-style-type: none"> Art. 17 Financial incentives, skills and market barriers

Figure 4: Overview of the current EU legislation relevant to the buildings sector (adapted from Braungardt und Loschke (2024))

3.1.1 Energy Performance of Buildings Directive (EPBD)

EPBD contains key provisions addressing the energy efficiency of the building envelope as well as technical systems in buildings. The provisions addressing the components of the building envelope mainly address new buildings and buildings under major renovation (Art. 5-8, 9b), with minimum energy performance standards (MEPS) for existing buildings only addressing non-residential buildings (Art. 9). Additionally, the EPBD sets requirements for Member States to establish national building renovation plans (Art. 3), with one element of the plan being measures addressing the phase-out of fossil fuels in heating and cooling (Art. 11).

The need for planning, data and information focused on heating and cooling in buildings is also acknowledged in the EPBD: it establishes a support framework for building retrofit measures, including, among others, the provision of information on the energy performance of buildings (Energy Performance Certificates or EPCs, Art. 16-19), provisions to support building owners through one-stop shops (Art. 15a) as well as measures addressing the requirements for building professionals (Art. 22 & 23). Additionally, the EPBD requires consideration of vulnerable groups in renovation requirements and promotes access to funding for energy-efficiency refurbishments (Art. 14).

3.1.2 Energy Efficiency Directive (EED)

The Energy Efficiency Directive (EED) sets out requirements aimed at improving energy efficiency across various sectors, including buildings. The reduction of energy demand is a main priority of the EED, containing various provisions that directly and indirectly affect heating and cooling in buildings (Articles 4, 5, 6 and 8), which address the collective reduction in final energy consumption (FEC) (Art. 4), targets for public buildings (Art. 5 & 6) as well as an annual end-use savings obligation (art. 8). The EED contributes to the decarbonisation of district heating by formulating a definition of and requirements for efficient district heating (Art. 26). The need for planning, data and information focused on heating and cooling in buildings is acknowledged in Articles 3, 13-20, 22 and 25. The EED also acknowledges that focusing on the social aspects of transitioning buildings towards energy efficiency and decarbonisation is crucial for ensuring that the process is equitable and beneficial for all segments of society. Art. 24 mandates Member States to identify vulnerable consumers and prioritise them in energy efficiency programmes, directly addressing energy poverty by reducing energy expenditure for low-income households.

3.1.3 Renewable Energy Directive (RED)

An important element of the 2030 framework for the buildings sector is the target for increasing the share of renewable energies set in Article 23 of the RED, mandating an average increase of the renewable energy share of 0.8 percentage points per year for the years until 2025 and 1.1 percentage points per year for the years 2026-2030 (see Figure 5).

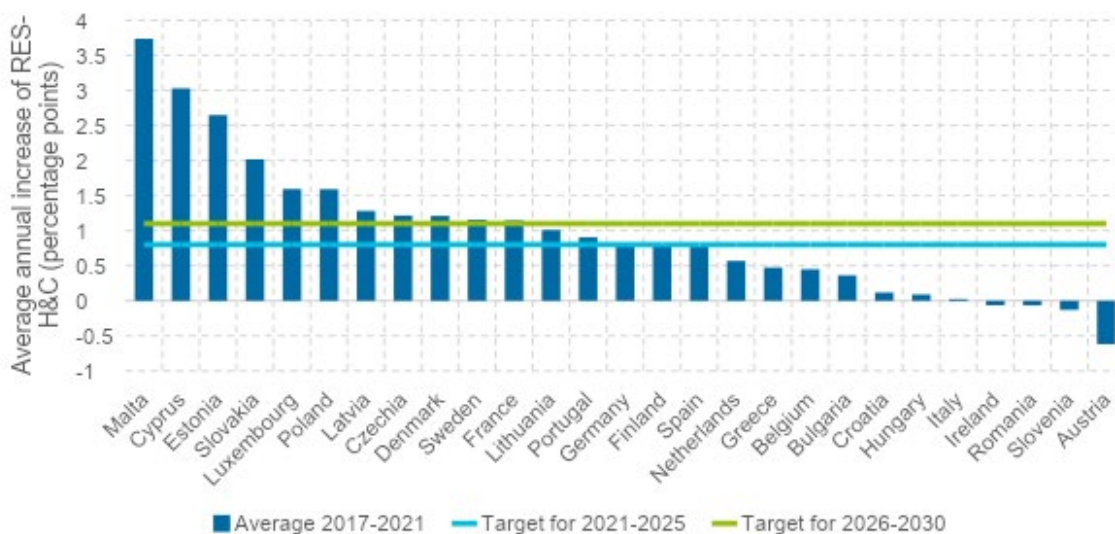


Figure 5: Average increase of the share of renewable energies for heating and cooling in the years between 2017-2021 and targets until 2030 in the RED (based on Braungardt und Loschke (2024))

The RED also addresses the phase-out of fossil fuels for heating in the overall target in Art. 23, in addition to several provisions addressing renewable energy sources in buildings and district heating (Art. 24). Additionally, the RED highlights the importance of providing training to building professionals to increase awareness and knowledge about renewable energy technologies (Art. 18). Unlike older versions of the RED, the current one acknowledges the principle of cascading the use of biomass, which leads to bioenergy usage coming in only at later stages of the biomass cascade (cf. Art. 3).

3.1.4 Effort Sharing Regulation (ESR)

The Effort Sharing Regulation (ESR) encompasses all greenhouse gas emissions beyond the ETS 1 framework, excluding the LULUCF sector, aviation, and international shipping. It establishes annual country-specific emission reduction targets until 2030 that reflect their financial capacity as well as historical emissions. Bulgaria, being the EU's lowest GDP per capita country, is mandated to reduce emissions by -10% compared to 2005 levels by the year 2030. Conversely, the wealthiest Member States are required to achieve a -50% reduction. Transport and heating in buildings constitute the largest sectors covered by the ESR, accounting for 35% and 25% respectively (European Environment Agency (EEA) 2023b). Agriculture ranks third with an 18% share. Energy installations, industrial processes, manufacturing, construction, and waste contribute the remaining ESR emissions.

The ESR provides Member States with a set of flexibilities. They can bank surpluses in years with lower emissions than emission allocations. They can also borrow a limited number of allocations from the following year if emissions are higher than emission targets. Moreover, Member States can buy and sell allocations from and to other Member States. Member States facing challenges in meeting their national targets may access a limited number of additional allocations through a safety reserve to offset their emissions. These extra allocations will be accessible only in 2032, during the final compliance check of emissions in the 2021 to 2030 decade and will serve as a last-resort mechanism under strict conditions, such as if the targets from 2013 to 2020 have been surpassed.

3.1.5 Emissions Trading System (ETS)

EU ETS 1

The EU Emissions Trading System (ETS 1) is a cornerstone of the European Union's policy to combat climate change and reduce GHG emissions. The ETS 1 covers emissions from stationary installations (energy and industry) as well as aviation and from the beginning of 2024 also maritime transport. The buildings sector is indirectly affected since heating plants (CHP and stand-alone) for big district heating networks are being regulated within the ETS-1 framework.

The EU ETS directive has undergone updates with the implementation of the Fit for 55 Package. This includes setting a more ambitious cap and strengthening the market stability reserve (MSR). Additionally, the European Funds for Modernisation and Innovation have been expanded.

EU Member States accrue substantial revenue through the ETS 1, which is frequently directed towards funding to support retrofitting projects, promote renewable energy installations, and improve the overall energy performance of buildings.

EU ETS 2

The forthcoming ETS 2 is a key element for levelling the playing field between fossil fuels and renewable heating technologies by pricing carbon emissions in the buildings sector (among others). It is scheduled to launch alongside the existing ETS 1 in 2027 focusing on buildings, road transport, and other sectors. Its cap, set at 1,040 million allowances, will be slightly lower than the ETS 1 cap of 1,125 million allowances for the same year. The EU ETS 2 cap is set in line with the new ESR emission reduction target. A 'frontloading' mechanism (increasing the total number of certificates by 30% in 2027) should enable a 'smoother' entry. From 2027 onwards, the number of emission allowances should decrease linearly by 5.10% of the reference quantity annually and from 2028 onwards by 5.38%. The total reduction in the buildings and transport sectors in 2030 should be at 43% compared to 2005, in the additional sectors at 42%.

In 2019, emissions stemming from fuel consumption for heating and cooking in buildings constituted one-third of the overall total of emissions regulated under ETS 2. Road transport accounted for 56% while the remaining 12% of emissions stem from the combustion of fossil fuels in small installations across both the energy and industry sectors. Germany accounts for nearly a quarter of all ETS 2 emissions, followed by France at 16% and Italy at 13%. These three nations, along with Poland and Spain, each contributing 8%, collectively represent 70% of the total ETS 2 emissions.

3.1.6 Social Climate Fund (SCF)

The Social Climate Fund (SCF) is a key provision addressing the challenge of energy poverty and complementing the directives above by providing financial assistance to lower-income households for energy efficiency renovations and renewable energy integration, aiming at alleviating energy bills and improving living conditions. It is set to be implemented to aid Member States in mitigating the extra financial strains on households due to the EU-wide introduction of carbon pricing on heating and transportation fuels under the ETS 2 (see above). Initial funds are to be provided from ETS 1 by auctioning 50 million allowances in 2025 so that the SCF can start providing support from its beginning in 2027. Once ETS 2 is running, however, funding for the SCF is supposed to come from ETS 2 generated revenues.

3.1.7 Other relevant directives or regulations

Ecodesign Directive

The Ecodesign Directive primarily focuses on setting minimum energy efficiency requirements for energy-related products rather than directly addressing buildings themselves. However, indirectly, the directive influences the energy efficiency of buildings by regulating the energy performance of products used within them. These products include, for instance boilers, heat pumps, insulation materials, windows, or lighting systems. The Ecodesign Directive ensures that products placed on the EU market meet certain energy efficiency standards, thereby reducing energy consumption in buildings. The Ecodesign Directive also has the potential to effectively phase-out stand-alone fossil boilers by setting efficiency requirements exceeding 100%.

Corporate Social Responsibility (CSR) Directive

The EU Corporate Social Responsibility (CSR) Directive aims to enhance transparency and accountability among companies regarding their environmental, social, and governance (ESG) practises. It requires companies to disclose non-financial information, including policies, risks, and outcomes related to environmental protection, social responsibility, and treatment of employees, among other factors. For the buildings sector, the CSR Directive has the following implications:

- **Environmental Impact Disclosure:** Companies involved in construction, real estate development, or property management are required to disclose information on their environmental impact, such as energy consumption, greenhouse gas emissions, and use of natural resources. This encourages greater awareness and accountability for the environmental footprint of buildings and construction activities.
- **Investor and Consumer Awareness:** Disclosure of non-financial information enables investors, consumers, and other stakeholders to make more informed decisions and assess the sustainability performance of companies in the buildings sector. This can influence investment decisions, procurement practices, and consumer preferences, driving demand for more sustainable buildings and construction practices.

EU Taxonomy

The EU taxonomy is a classification system that defines environmentally sustainable economic activities across various sectors, including the buildings sector. It aims to provide clarity and transparency on what can be considered environmentally sustainable, thereby facilitating sustainable investments, and promoting the transition to a low-carbon economy. For the buildings sector, the EU taxonomy sets criteria for determining whether activities related to construction, real estate development, and property management contribute to environmental objectives, such as climate change mitigation and adaptation. This includes criteria related to energy efficiency, greenhouse gas emissions, resource use, and circular economy principles.

The taxonomy is significant for the buildings sector because it helps investors, companies, and policymakers identify and assess sustainable investment opportunities and practices. By aligning with the taxonomy criteria, companies in the buildings sector can demonstrate their commitment to sustainability, attract investment, and access financing for sustainable projects. Furthermore, the taxonomy provides a common framework for measuring and reporting the environmental performance of buildings and construction activities, enhancing transparency and comparability. This supports informed decision-making by investors, consumers, and other stakeholders, driving demand for sustainable buildings and construction practices.

Energy Taxation Directive

The Energy Taxation Directive aims at aligning the taxation of energy products with EU energy and climate policies. Its revision is still ongoing.

Gas Directive

The EU Gas Directive aims to create a well-functioning, competitive, and integrated internal gas market within the European Union while safeguarding consumer interests, promoting energy security, and facilitating the transition to a low-carbon energy system. Since gas is still widely used in buildings, there are indirect effects for buildings. The main foci of the gas directive, however, are market structure, security of supply and gas infrastructure in more general terms.

3.2 Possible range of emissions 2040 – with a glimpse on 2050

Buildings account for approximately 40% of the EU's annual energy consumption and 36% of annual GHG emissions from the energy sector; this represents 15% of total EU-wide GHG emissions in 2021². Unlike the transportation sector, emissions from buildings in the EU have steadily decreased over time – i.e., in 2020, they were 27% below 1990 levels (European Environment Agency (EEA) 2023a).

Scenarios offer further insights into the expected GHG emissions from the buildings sector in 2040. These pathways indicate that GHG emissions in the buildings sector range from 7 Mt CO₂eq (reduction by 99% with respect to 1990, see Kalcher et al. (2023)) to 89 Mt CO₂eq (reduction by 88% with respect to 1990, impact assessment S1 scenario by European Commission (2024)).

Table 1 lists different scenarios for the buildings sector, starting with the recently published S1, S2, S3 and LIFE scenarios calculated for the impact assessment (European Commission 2024). All impact assessment scenarios assume a high electrification rate. The EC's

² European Environment Agency (2022)

recommended target for 2040 of an overall GHG reduction of 90% with respect to 1990 levels presents more or less the average of the S2 und S3 scenarios. Taking the S2-S3 average for the buildings sector only, the reduction recommendation amounts to 92%.

Table 1: Scenarios' assumptions for emissions from *buildings* in 2040.

	Estimated emissions in 2040 (Mt CO ₂ eq)	Estimated emissions in 2040 compared to 1990	Assumptions on measures and drivers	Data source
EU Commission, EU 2040 climate target, S1 scenario (2024)	89	-88%	<ul style="list-style-type: none"> Measures to improve energy efficiency (renovation) 	European Commission (2024)
EU Commission, EU 2040 climate target, S2 scenario (2024)	64	-91%	<ul style="list-style-type: none"> Large-scale electrification (heat pumps) Deep transformation of fuel mix (away from fossil energy carriers) 	
EU Commission, EU 2040 climate target, S3 scenario (2024)	48	-93%		
EU Commission, EU 2040 climate target, LIFE scenario (2024)	64	-91%	<ul style="list-style-type: none"> As in S1-S3 plus sufficiency measures (e.g. lower thermostat settings for heating temperatures) 	European Commission (2024)
Strategic Perspectives, -95% net scenario (2023)	7	-99%	<ul style="list-style-type: none"> The energy renovation rate of building stocks increases to 3% from 2030 to 2040. 	Kalcher et al. (2023)
Strategic Perspectives, -90% net scenario (2023)	9	-99%	<ul style="list-style-type: none"> Renovations focus on energy+ or zero-emissions buildings. 	
Strategic Perspectives, -85% net scenario (2023)	13	-98%	<ul style="list-style-type: none"> Renewable share for heating reaches 100% in 2040 through heat pumps and district heating. 	
CLEVER network, CLEVER scenario (2023)	50	-93%	<ul style="list-style-type: none"> Deep renovation with a renovation rate of at least 2% Strong reduction in fossil fuel usage Sufficiency as a no-regret option 	CLEVER network (2023)
Agora Energiewende, EU Gas Exit Pathway (2023)	12	-98%	<ul style="list-style-type: none"> Buildings are nearly fossil gas free by 2040 due to efficiency, heat pumps and decarbonised district heating improvements. Assumes a phase-out of coal and oil by 2035. 	Graf et al. (2023)
EU Commission, Renewable Space Heating under the Revised	38-46	-94 to -95%	<ul style="list-style-type: none"> Still fossil gas/oil usage in 2040 	Kranzl et al. (2022)

Renewable Energy Directive				<ul style="list-style-type: none"> Heat pumps, DH and solar thermal expanded Reduced biomass usage Deep renovations 	
Climate Analytics, 1.5°C compatible range (2022)	60	-90%		<ul style="list-style-type: none"> Heat pumps and district heating No hydrogen 	Climate Analytics (2022)
EU Commission, EU 2030 Climate Target Plan (2020)	32	-95%	n/a		European Commission (2020)

When looking at the combined national projections for 2040 the gap between what is needed according to the target scenarios and what would actually be achieved with existing or additional measures is still wide: the WEM projections for the buildings sector end up at a GHG reduction of 53% in 2040, whereas the WAM projections achieve a reduction of 62% in 2040 (European Environment Agency (EEA) 2023a). Reaching the recommended reduction of 92% in 2040 obviously needs an immense extra effort.

The main drivers to reach high GHG reductions in the scenarios are (cf. Table 1): higher and deeper renovation rates, roll-out of heat pumps on a large scale, adoption of district heating in urbanised areas, and a phase-out of fossil fuels. Sufficiency measures are part of the policy mix in some scenarios, but they do not feature too prominently. The target scenarios differ in their fossil fuel phase-out trajectories: the impact assessment scenarios (S1, S2, S3, LIFE) show the most ambitious gas phase-out trajectory up until 2030 compared to most other scenarios. In the 2030ies, however, all impact assessment scenarios show only moderate additional reductions in gas-usage in buildings leading to them being the least ambitious target scenarios for the reduction in fossil gas by 2040.

The role of hydrogen in the buildings sector varies between scenarios. In some scenarios hydrogen is completely left out of the buildings sector (e.g. CLEVER network (2023)), others include hydrogen in district heat generation only (e.g. Kranzl et al. (2022)), some have small amounts of hydrogen in the final energy mix in 2040 (e.g. European Commission (2024)). Since there are many uncertainties regarding the price of hydrogen generation, the potential amounts of hydrogen being generated within the EU-27 or the possible hydrogen imports etc. there is currently no conclusive picture regarding hydrogen in buildings. It is obvious that hydrogen will be part of the future energy mix of the entire energy system. Its role in buildings, however, may be limited, since other sectors (industry, energy) lack suitable decarbonisation alternatives.

Biomass usage in the different scenarios is mostly reduced for space heating in buildings compared to current usage levels, but not entirely (e.g. European Commission (2024), CLEVER network (2023), Kranzl et al. (2022)). As yet there is no conclusive framework for the future use of biomass. What is clear though, is that scaling up its usage on a continent-wide scale would cause many target conflicts, especially regarding space availability with regard to agricultural and LULUCF restrictions.

4 How to achieve the necessary contribution: Discussion of possible policies and measures and options

The framework for 2040 depends critically on the achievements until the year 2030. A first and crucial goal to pave the way towards full decarbonisation, is that the framework for 2030 is fully implemented by Member States. Furthermore, policy inconsistencies such as fossil fuel subsidies need to be removed in order not to undermine the needed efforts.

Achieving the targets outlined in Article 4 of the EED demands considerable additional efforts from Member States, particularly in the buildings sector. Nevertheless, with the EPBD adopting a "trajectory approach" towards residential buildings, the responsibility of delineating and executing specific policy instruments to align with this trajectory falls upon Member States. The Commission ought to formulate robust and clear guidance for Member States regarding ambitious implementation, ensuring the availability of the corresponding financial support.

Heat planning regulations as set out in the recast EED present an important tool for establishing a comprehensive approach to the buildings sector transformation on a district and municipal level. Again, it is important that Member States fully implement the provisions as specified in Art. 25 of the EED.

Minimum energy performance standards (MEPS) have been included in the recast EPBD, but for non-residential buildings only. Most scenarios show that for achieving climate targets in the buildings sector it is essential to also establish MEPS (and the corresponding renovation obligations) for residential buildings. Addressing and renovating so-called worst-performing buildings (WPD) first, not only has the highest potential in reducing GHG emissions, but also presents the most economical way for doing so.

For increasing the share of renewable energies in the buildings sector, Figure 5 in section 3.1.3 illustrates that even meeting the (somewhat) unambitious current targets set out in the RED for increasing renewable heating and cooling in buildings until 2030 requires significant additional efforts in numerous Member States. Currently, close to half of all Member States are falling short of meeting the targets established for the years 2021-2025. Nearly 60% are missing the targets set for 2026-2030, among them Member States with the highest absolute energy demands for heating and cooling, such as Germany or Italy. When considering the path towards full decarbonisation of heating and cooling in buildings until 2050 the RED targets specified until 2030 provide an insufficient contribution. In the decade after 2030 the level of ambition would have to rise threefold from the annual target amount of 1.1% in 2026 to 2030 to an annual increase of 3.4% for the 2030 to 2050 period. Therefore, Member States would ideally aim at overachieving the 2030 targets.

Given the potential conflicts arising from the use of biomass, it would be important to establish a clear framework and hierarchy in its usage. Currently, biomass is fully recognised for achieving the RED targets in the buildings sector but given the ambitious GHG targets set out for 2040 and 2050 it would be important to formulate a comprehensive strategy for biomass usage taking into account all sectors concerned.

In addition to the target for increasing the share of renewable energies in buildings, the responsibility for designing the framework to support the phase-out of fossil fuels for heating up to 2030 rests mainly with Member States. Phasing-out fossil fuels by 2040 is stated as a non-binding objective in the EPBD, and Member States are to provide details on the "transformation

of existing buildings into zero-emission buildings by 2050” in their national building renovation plans. These plans need to be consistent with the objective of full decarbonisation by 2050. Making phase-out plans binding in the next EPBD revision cycle would be an option to further strengthen the ambition level with regard to the 2040 targets.

The introduction of the ETS 2 and its distributional impacts on households need to be closely assessed on a Member State level and, if necessary, cushioned for end consumers. Accompanying compensatory measures provided by the SCF need to be available with the Start of the ETS 2 at the beginning of 2027. All additional revenues of the ETS 2 should be used by the member states to support the transformation of the building and road transport sectors.

Complementary measures need to be fully implemented and further strengthened: these include one-stop shops (as set out in the EPBD in Art. 15a), national and EU-wide information campaigns (cf. EPBD Art. 29) and initiatives (such as the Heat Pump Action Plan), and a plan to build up a workforce fit for making the transformation in the buildings sector happen (cf. EPBD Art. 17 & Art. 26). One-stop shops as well as information campaigns need to be consumer-centric and aligned with the actual questions asked and hurdles encountered by those willing to invest in the transformation. Focussing on the benefits of renovating buildings could encourage more activity.

The pathways for the building sector are very ambitious and at the same time of key importance for decarbonising the EU. It is therefore important to include all possible options, including measures in sufficiency such as reductions in per capita floor area. These may be hard to sell though, especially in Member States that traditionally already have low per capita floor areas. Nonetheless, all options need to be on the table in order to have a chance in reaching the buildings sector targets. Since the buildings sector is addressed by a whole suite of different directives and regulations, it would be helpful to first establish a comprehensive action plan for the buildings sector before going into the next revision process for the various directives and regulations. This would make sure there is a consistent plan, which can then be incorporated into the legislative process.

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