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IMPACT ASSESSMENT REPORT

Accompanying the

Proposal for a Directive of the European Parliament and of the Council

on the energy performance of buildings (recast)

{COM(2021) 802 final} - {SEC(2021) 430 final} - {SWD(2021) 454 final}

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Glossary

Term or acronym	*Meaning or definition*
AFID	Alternative Fuels Infrastructure Directive
AFIR	Alternative Fuels Infrastructure Regulation
BACS	Building Automation and Control System
BSO	Building Stock Observatory
BRP	Building renovation passport
CPR	Construction Products Regulation
CTP	Climate Target Plan
DHW	Domestic hot water
EEAG	Energy and Environmental State Aid Guidelines
EED	Energy Efficiency Directive
EGD	European Green Deal
EPBD	Energy Performance of Building Directive
EPC	Energy performance certificate
ESR	Effort Sharing Regulation
ETD	Energy Taxation Directive
ETS	Emissions Trading System
EU SILC	European Union Statistics on Income and Living Conditions
EV	Electric vehicle
GBER	General Block Exemption Regulation
GHG	Greenhouse gases
HVAC	Heating, ventilation and air conditioning systems
LMFH	Large multi-family house
LTRS	Long-term renovation strategies
MEPS	Minimum energy performance standards
MSs	EU Member States
Mtoe	Million tonnes of oil equivalent
NECP	National Energy and Climate Plans
NZEB	Nearly zero-energy building
RED	Renewable Energy Directive
RRF	Recovery and Resilience Facility
RRPs	National Recovery and Resilience Plans

SCF	Social Climate Fund
SFH	Single family house
SRI	Smart readiness indicator
ZEB	Zero emission building

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

1.1 From the European Green Deal to the Fit for 55 package

1.1.1 Introduction

In December 2019, the Commission presented the European Green Deal[1]. The Green Deal sets out a strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. The European Climate Law[2], as agreed with the co-legislators, makes the EU's climate neutrality target legally binding, and raises the 2030 ambition by setting a target of at least 55% net emission reductions by 2030 compared to 1990.

The building sector has a crucial role in achieving this goal. Buildings are the largest energy consumer in the EU, where they are responsible for approximately 40% of energy use and 36% of energy-related greenhouse gas emissions[3]. The renovation of buildings has also a significant relevant economic dimension, as the construction industry ecosystem (buildings and infrastructure) generates about 9.6% of EU value added and employs almost 25 million people in 5.3 million firms[4].

Based on the European Green Deal strategy and a comprehensive impact assessment, the Commission's Communication of September 2020 on Stepping up Europe's 2030 climate ambition (the '2030 Climate Target Plan')[5] proposed to raise the EU's ambition and put forward a comprehensive plan to increase the EU's binding target for 2030 towards at least a 55% net emission reduction, to be met in a responsible way.

Raising the 2030 ambition now helps give certainty to policymakers and investors, so that decisions made in the coming years do not lock in emission levels inconsistent with the EU's objective to be climate-neutral by 2050. The 2030 target is in line with the Paris Agreement objective to keep the global temperature increase to well below 2°C and pursue efforts to keep it to 1.5°C. The Climate Target Plan (CTP) 2030 identifies buildings as a major area where common EU decarbonisation efforts can be strongly increased. The analysis underpinning the CTP concluded that a mix of instruments from climate, energy and transport policies is needed. Moreover, the EPBD's regulatory tools need to be strengthened to address the non-economic barriers that leave the renovation rate at a level which is too low and incompatible with achieving the enhanced climate

[1] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[2] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law') (OJ L 243, 9.7.2021, p. 1).

3 Including direct emissions from buildings and indirect emissions stemming from electricity and heat consumed in buildings.

[4] SWD(2021) 351 final.

[5] *Stepping up Europe's 2030 climate ambition Communication* COM (2020) 562 final.

and energy goals. Building renovation and improvement of their energy performance reduces energy needs and energy bills: better insulated buildings are therefore a safeguard against the volatility of energy prices and their increase, especially for more vulnerable consumers, and contribute to the goal of security of supply. In addition, the EPBD is expected to contribute to the reduction of emissions in the transport sector, specifically by enabling the charging of e-vehicles in private buildings and supporting sustainable mobility.

The ‘Fit for 55 package’ was therefore conceived by the Commission as a comprehensive policy package to enable action to meet this increased ambition; the revision of the Energy Performance of Buildings Directive (EPBD) is part of the intended policy tools. The revision of the EPBD was in fact included in the 2021 Commission work programme listing all legislative acts to be reviewed under the heading ‘Fit for 55’.

The analysis from the CTP was repeated in preparation of the ‘Fit for 55 package’ and the above findings and policy conclusions of the CTP were confirmed. Without a revision of the EPBD driving higher energy renovations, the net 55% greenhouse gas emissions reduction target for 2030 will not be achieved. In particular, without the policy drivers from a revised and strengthened EPBD, we will be facing a gap representing 49% of the efforts to decarbonise the building sector. This impact assessment fulfils the role of developing and assessing policy options to strengthen existing measures and tools to make them ‘Fit for 55’, and align them with climate neutrality in the long term, based on the policy conclusions of the Climate Target Plan and focusing on the areas identified in the Renovation Wave strategy.

This initiative is part of a policy mix with strong interlinkages among instruments, similar to the assessment made when preparing legislative proposals for the revised Energy Efficiency Directive (EED), Emissions Trading System (ETS), the recast Renewable Energy Directive (RED II), Effort Sharing Regulation (ESR) and Alternative Fuels Infrastructure Regulation (AFIR). As such, the initiative takes into account the interplay with the other proposals, in order to maximise its complementary role.

Significantly scaling up efforts in reducing emissions and increasing energy performance and renewable deployment in the building sector is imperative to achieve the EU decarbonisation goal. Nevertheless, the efforts to be made come with substantial challenges, which accompany the green transition. Lack of skilled workforce in the construction sector across its value chain, potential materials shortages and product supply-chain bottlenecks can hamper the upscaling of renovations across Europe and call for a wider policy response. In addition, with new buildings being constructed and existing buildings renovated, greenhouse gases are emitted during the extraction and manufacturing of construction materials, and during transport and construction. To address those challenges, it is essential that this initiative is accompanied by appropriate measures supporting the green transition. The Renovation Wave strategy has identified a series of measures which are being implemented, and buildings and construction activities also feature in the other strategies following the Green Deal, including the Pact for Skills, the Industrial Ecosystem Strategy, the Zero Pollution Action Plan, the Circular Economy Action Plan, the Biodiversity Strategy and the Climate Adaptation Strategy.

Buildings also have a strong societal dimension and their use reflects behavioural trends and dynamics in society. The COVID-19 pandemic has had an impact on building use patterns, such as working more from home, which are likely to last beyond the recovery period and require adaptations of the building stock, both for residential and non-residential buildings. The revision of the EPBD is timely as it can contribute to ensuring improved building performance in this dynamic phase and is thus an important measure alongside the Recovery and Resilience Facility.

1.1.2 Alignment with the 2030 Climate Target Plan policy conclusions

The Climate Target Plan (CTP) 2030 states that EU buildings by 2030 should reduce their overall greenhouse gas emissions by around 60%[6], their final energy consumption by 14% and energy consumption for heating and cooling by 18%[7] in comparison to 2015. The analysis in the CTP also found that greenhouse gas emissions can only be lowered cost-effectively to a level compatible with achieving the goal of -55% by duplicating the floor area renovated every year to improve its energy performance, decarbonising heating and considerably increasing the energy savings achieved through renovations.

The impact assessment of the 2030 Climate Target Plan provided an indication of what effects a combined policy mix could have on reaching the new climate target and subsequent climate neutrality by 2050. However, the impact assessment required further clarifications and additional analysis to reach the level of details needed to support the individual sectoral legislative proposals. As regards the EPBD revision, which focuses on sectoral building policy, the MIX scenario in the CTP impact assessment representing the most cost-effective mix of policies between regulatory and carbon pricing mechanisms, made revising the EPBD the driver of increased energy renovation through standards and strengthened regulations. Without the policy driver of the EPBD revision assumed in the MIX scenario, the renovations rate will not increase sufficiently. This would result in the target for reducing GHG emissions being missed by around 49% and the 2030 target for reducing final energy consumption attributed to the buildings sector in the Climate Target Plan being missed by 40% (see Section 6.2).

The CTP analysis also confirmed the finding from other assessments that energy efficiency is an essential component of action towards increased climate ambition across sectors including in buildings, and also via systematic application of the 'energy

[6] In this impact assessment, in line with the approach of the Climate Target Plan for the building sector, when referring to GHG emissions, reference is made to operational emissions from energy use. When emissions refer to the embodied carbon content of buildings, this is clearly indicated.
[7] SWD(2020) 176 final.

efficiency first' principle. Reducing first the energy needs of buildings is a more sustainable and cost-effective way to reduce emissions than investing in additional clean energy generation to compensate buildings' low energy performance[8]. Even in an increasingly and progressively decarbonised energy sector, improving the energy performance of existing buildings is necessary to avoid unnecessary investments in energy infrastructure and to improve the living conditions of the EU public[9]. For buildings, a combination of the 'energy efficiency first' principle and expansion of renewable energy is needed because renewables are not available indefinitely and can only contribute a limited amount of the greenhouse gas emission reductions in the buildings sector[10]. Combining the green and digital transitions, smart buildings can enable efficient production and use of renewables at building, district and city level, help decarbonise the transport sector and promote the circular economy.

The CTP identified specific measures to ensure the appropriate pace at which to improve the building stock. These include the potential introduction of mandatory standards for the worst-performing buildings and the gradual tightening of the minimum energy performance requirements[11]. Additionally the CTP flagged up long-term renovation strategies within the context of the EPBD as a key policy vehicle. Their aim would be to introduce additional measures to remove barriers to building renovation and strengthen pull factors for faster and deeper energy renovation.

1.1.3 Coherence within the 'Fit for 55' package and the role of the EPBD revision

To follow the pathway proposed in the European Climate Law and deliver this increased level of ambition for 2030, the Commission has reviewed the climate and energy legislation currently in place. These are expected to only reduce greenhouse gas emissions by 40% by 2030 and by 60% by 2050. The 'Fit for 55' legislative package, as announced in the 2030 Climate Target Plan, is the most comprehensive building block in the efforts to implement the ambitious new 2030 climate target, and all economic sectors and policies will need to make their contribution. The majority of the proposals in the 'Fit for 55' legislative package were adopted by the Commission on 14 July 2021, while the revision of the EPBD is scheduled for a slightly later date to take into account the analysis and steer coming from the Renovation Wave strategy adopted in October 2020.

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[8] Net Zero by 2050 Scenario - Data product - IEA

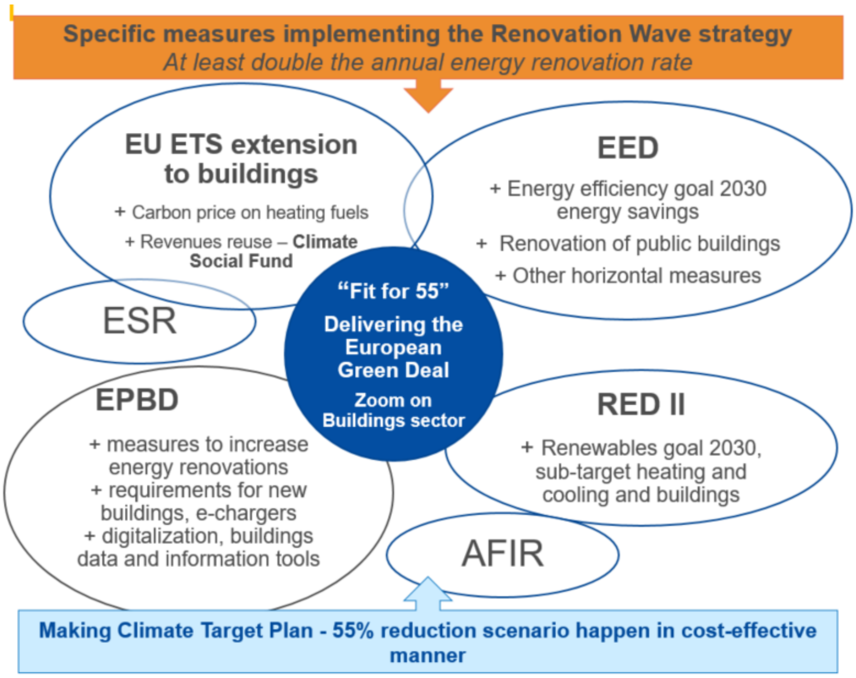
[9] Building codes with specific regulation on thermal insulation of the building envelope started appearing after the 1970s in Europe. This means that a large share of today's EU building stock was built without any energy performance requirement: one third (35%) of the EU building stock is over 50 years old, while more than 40% of the building stock was built before 1960. Almost 75% of it is energy inefficient according to current building standards. Source: JRC report *Achieving the cost-effective energy transformation of Europe's buildings*.

[10] ENEFIRST, 2021 http://enefirst.eu

[11] See also Annex J: 2030 Climate Target Plan Policy Conclusions.

The 'Fit for 55' legislative package is a set of a comprehensive and interconnected proposals which will enable an acceleration of greenhouse gas emission reductions in the next decade. They combine the following initiatives: (i) application of emissions trading to new sectors and a tightening of the existing EU Emissions Trading System; (ii) increased use of renewable energy; (iii) greater energy efficiency; (iv) faster roll-out of low emission transport modes and the infrastructure and fuels to support them; (v) alignment of taxation policies with the European Green Deal objectives; (vi) measures to prevent carbon leakage; and (vii) tools to preserve and grow our natural carbon sinks. The proposals were accompanied by a '*Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality*[12] Communication, which explain the logic of the policy mix chosen to deliver on the target of -55%, which is a careful balance between pricing, targets, standards and support measures in a whole-of-the-economy approach. The Communication clearly highlights the revision of the EPBD as parts of the efforts to deliver the EU's 2030 Climate Target.

Figure 1.1: EPBD Interactions with other key legislation affecting the energy performance of buildings



The proposals adopted in July 2021 include measures targeting the buildings sector; the EPBD revision is consistent with and ensures complementarity with these. Without a strengthening of the EPBD, the -55% goal will not be achieved, making it necessary to strengthen other measures or to move to a higher carbon price.

[12] COM(2021) 550 final.

The above figure illustrates the main measures addressing buildings in the 'Fit for 55' package. See Chapter 7 for more details on these and the interactions with the revision of the EPBD.

1.1.4 The scope of greenhouse gas emissions covered in the EPBD revision and coherence with other initiatives addressing whole-life cycle carbon emissions

In line with the CTP, the scope of this initiative is to improve energy performance and reduce GHG emissions during the use phase of buildings. The emissions covered are direct emissions from energy use in buildings[13] (e.g. from a gas boiler in the building used for space heating) and indirect emissions from the use of electricity and heating and cooling supplied to the building (e.g. through electric heating or a district heating network)[14].

For clarity, all GHG emissions mentioned in this document refer to operational GHG emissions, unless otherwise stated.

In addition to emissions during the use phase, there are emissions that occur during other parts of the building life cycle. These include the extraction and processing of the raw materials, manufacturing of materials and equipment, transport to the site, the construction process of the building, the installations of equipment as well as the end-of life (e.g. deconstruction or demolition) process and transport and reuse, recycling or disposal of waste[15,16,17]. The revision of the EPBD contributes to the policy efforts at EU level to address these emissions with a specific measure, which is the mandatory calculation and display of life-cycle emissions for new buildings (see Annex H, Section 3). Addressing the whole-life carbon impact issue was widely underlined by stakeholders during the open consultation, who suggested including measures in the EPBD to account for carbon emissions over the entire life cycle of buildings (68%).

The measure proposed in the EPBD revision can complement other EU policies aimed at reducing lifecycle emissions in buildings. In particular, there will be no overlap between the measure in the EPBD revision and the Construction Product Regulation (CPR). The CPR provides a common technical language to assess the performance of construction products. The CPR ensures that reliable information is available to professionals, public authorities, and consumers, so they can compare the performance of products from different manufacturers in different countries.

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[13] The energy use regulated through the EPBD is heating, cooling, ventilation, domestic hot water, built-in lighting and other technical building systems. See EPBD Annex 1.

[14] This corresponds to the emissions in the residential and service sector and part of the emissions in the power sector and heating and cooling sector in the CTP.

[15] Röck, M. et al. (2020) *Embodied GHG emissions of buildings – The hidden challenge for effective climate change mitigation*.

[16] LCA applied to buildings aims to assess the potential environmental of buildings over the complete life cycle, from materials production to the end-of-life and management of waste disposal.

[17] https://www.bpie.eu/wp-content/uploads/2021/05/BPIE_WLC_Summary-report_final.pdf

The calculation of life-cycle emissions on building level in one of the proposed measures under the EPBD[18] will be made using the European Level(s) framework or equivalent (as also referenced in the EU Sustainable Finance Taxonomy). In the Level(s) framework, the life cycle analysis of buildings uses product data calculated on the basis of existing assessment methods under European standards or under the CPR when available.

The EPBD is also in line with initiatives such as the forthcoming Communication on restoring sustainable carbon cycles[19] and the proposal for a regulatory framework for carbon removal certification[20] and the findings of the study on Circular Economy Principles for Buildings' Design[21]. The study analysed case studies of circular economy policies in construction at national and regional level across the EU and other OECD countries, and suggested policy options at EU level. It found possible opportunities in the Construction Products Regulation, the Energy Performance of Buildings Directive, in green public procurement, and in guidance for local and regional planning authorities. The proposed measure in the EPBD complements well the provisions in these policies.

1.2 The revision of the EPBD in the Renovation Wave strategy

In line with the Green Deal, on 14 October 2020 the Commission adopted the strategic Communication *A Renovation Wave for Europe – greening our buildings, creating jobs, improving lives*. The Renovation Wave communication integrates climate, energy and environmental objectives, industrial strategy and circularity objectives, as well as skills, consumer welfare and fair and social transition goals. It contains an action plan with concrete regulatory, financing and enabling measures for the years to come and pursues the aim to at least double the annual energy renovation rate of buildings by 2030 and to foster deep renovations. It is expected that mobilising forces at all levels towards the objectives of the Renovation Wave will result in at least 35 million building units renovated by 2030.

The Renovation Wave links with ongoing work on green finance and sustainable investments and includes targeted actions at EU, national and local level. It focuses especially on tackling energy poverty and the worst-performing buildings, on renovating public buildings and social infrastructure and on decarbonising heating and cooling. It also flags that research must spur innovation in the construction industry ecosystem for this transformation, in line with the twin green and digital transitions. Energy renovation of the existing building stock can open up numerous possibilities and generate far-reaching social, environmental and economic benefits. With the same intervention, buildings can be made healthier, greener, interconnected within a neighbourhood district, more accessible, resilient to extreme natural events, and equipped with interoperable,

[18] See Chapter 5.2, in particular the description of ZEBs on life-cycle reporting. See also Annex H.
[19] Planned for adoption in December 2021.
[20] Planned for late 2022.
[21] *Study on circular economy principles for buildings' design*, Publications Office of the EU (europa.eu).

standardised smart charging points for e-mobility and bike parking. The construction industry ecosystem is expected to play a key role in the implementation of the Renovation Wave and in transforming buildings in line with climate objectives, in particular with integrated design and execution, enhanced quality controls and compliance checks, high resource efficiency in line with circularity principles, and uptake of skills in construction in line with the twin green and digital transitions.

The 23 implementation action points identified in the strategy include regulatory measures, with a strengthening of the EU legislative framework of the Energy Efficiency Directive (EED), the Renewable Energies Directive (RED), the Ecodesign Directive and the EPBD[22]. They also include the possible extension of emissions trading to the buildings and the road transport sectors, which would introduce a carbon price for fossil fuel use in those sectors. The strategy was also accompanied by the establishment of the New European Bauhaus[23]. The extensive preparatory work and stakeholder consultation on the key aspects to be addressed in the Renovation Wave strategy[24] identified key measures and instruments, either to be strengthened or newly designed in the EPBD revision. These include the introduction of mandatory minimum energy performance standards for all types of buildings, the revision of the energy performance certificates framework, and building renovation passports. The current EPBD revision addresses 3 of the 23 key Commission actions to implement the Renovation Wave and some of its main regulatory measures.

1.3 The Energy Performance of Buildings Directive

1.3.1 The current EPBD framework

Over the last years, due to a well-established regulatory framework for the energy performance of buildings and higher standards for equipment and appliances, the EU building stock has become more efficient. This is particularly the case for new buildings. The market diffusion and lowering of price of renewables has increased their uptake by buildings owners.

The EPBD Directive (2010/31) is the main legislative instrument for promoting energy performance improvements in buildings in the EU. The EPBD is the cornerstone of EU legislation on energy efficiency for buildings. It was first adopted in 2002 by means of Directive 2002/91/EC. This Directive was then replaced and also substantially reinforced

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[22] See Annex K for an overview of the EPBD revision in the context of the Renovation Wave action plan.

[23] Established to ideate, incubate, accelerate and realise innovative projects demonstrating the right balance of sustainability (comprising circularity), quality of life (comprising aesthetic) and inclusion (comprising accessibility and affordability), the New European Bauhaus is called to support the objectives of the Renovation Wave while going beyond buildings. Form will follow planet, making the necessary beautiful too in a more sustainable and just built environment.

[24] Stakeholder consultation on the Renovation Wave initiative, https://ec.europa.eu/energy/sites/ener/files/stakeholder_consultation_on_the_renovation_wave_initiative.pdf

in 2010 by Directive 2010/31/EU. That was a recast Directive, which was amended in 2018 by Directive (EU) 2018/844 as part of the Clean Energy Package for All Europeans. The objective was to modernise the building stock in the light of the latest technological developments by promoting an optional smart readiness indicator scheme, facilitating the deployment of infrastructure for electro-mobility in buildings, and the better integration of automation systems and renewable solutions[25]. The amending Directive entered into force in July 2018 and Member States had to transpose it into national law by 10 March 2020.

The EPBD (2010/31/EU), as revised by Directive (EU) 2018/844), aims to transform the EU building stock into a highly energy efficient and decarbonised building stock by 2050, moving towards nearly zero-energy building standards. The Directive works through two complementary mechanisms: (i) minimum performance requirements for new and existing buildings (raising the depth of any upgrades and the standards for new-builds); and (ii) information for the public and companies through energy performance certificates for buildings to enable them to choose the efficiency level that is right for them. The Directive sets specific energy performance requirements for new and renovated buildings and on technical building systems (which include renewable energy and heating and cooling systems). The cost-optimal methodology helps Member States set their ambition levels right and keep them under review. Taken together, these mechanisms contribute to setting the right energy performance standards for different buildings, and facilitate information on more energy-efficient housing.

The most important measures in the current EPBD are:

- long-term renovation strategies aiming to decarbonise national building stocks by 2050, with indicative milestones for 2030, 2040 and 2050;
- cost-optimal minimum energy performance requirements for new buildings, for existing buildings undergoing major renovation, and for the replacement or renovation of building elements like heating and cooling systems, roofs and walls[26];

[25] In the area of building automation and control systems, the EPBD introduced in 2018 a definition for such systems and a requirement for all non-residential buildings over 290 kW to have Building Automation and Control Systems (BACS) installed. In addition, there were provisions to support the installation of devices to enhance monitoring and control functionalities in residential buildings. New provisions were introduced to Article 8 of the EPBD with regard to technical building systems, in particular concerning the installation of thermal regulating devices in each room and the recording of information related to the energy performance of systems upon completion of works.

[26] Article 4(1) (EPBD) requires Member States to take the necessary measures to ensure that minimum energy performance requirements for buildings or building units are set with a view to achieving cost-optimal levels. Article 5 of the EPBD requires Member States to calculate cost-optimal levels of minimum energy performance requirements for buildings and building elements using a comparative methodology framework to be established by the Commission.

- requiring, since 31 December 2020, all new buildings to be nearly zero-energy buildings (NZEBs); new public buildings already had to be NZEBs since 31 December 2018;
- energy performance certificates (EPCs) to be issued when a building is sold or rented and requiring their rating to be visible in the advertising media;
- inspection schemes for heating and air conditioning systems;
- electro-mobility is supported by minimum requirements for charging points and ducting infrastructure car parks over a certain size;
- an optional European scheme for rating the 'smart readiness' of buildings (SRI);
- the promotion of smart technologies, including through requirements on the installation of building automation and control systems (BACS), and on devices that regulate temperature at room level;
- addressing the health and well-being of building users, for instance by considering the air quality and ventilation that Member states should take into account when defining energy needs.

The EPBD requires Member States to establish a long-term renovation strategy to support the renovation of their national building stock, so that by 2050 the building stock is highly energy-efficient and decarbonised. The long-term renovation strategies must include: (i) an overview of the national building stock policies and actions to stimulate cost-effective deep renovation of buildings, (ii) policies and actions to target the worst-performing buildings, split-incentive dilemmas, market failures, energy poverty and public buildings; and (iii) an overview of national initiatives to promote smart technologies and skills and education in the construction and energy efficiency sectors. The strategies must also include a roadmap with measures and measurable progress indicators indicative milestones for 2030, 2040 and 2050, an estimate of the expected energy savings and wider benefits, and the contribution of the renovation of buildings to the EU's energy efficiency target. The 2020 long-term renovation strategies[27] (LTRS) adopted by Member States have been assessed by the Commission[28]. These strategies fed into the preparation and assessment of national resilience and recovery plans and this impact assessment.

In addition, the Directive is accompanied by secondary legislation. The Commission published in October 2020 two regulations (an implementing act[29] and a delegated act) on

[27] https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/long-term-renovation-strategies_en

[28] Commission staff working document on Preliminary analysis of the long-term renovation strategies of 13 Member States, SWD(2021) 69 final. An update of the assessment covering the remaining LTRS will be published in December 2021.

[29] Implementing Regulation detailing the technical modalities for the effective implementation of an optional common Union scheme for rating the smart readiness of buildings, C(2020) 6929 final, https://ec.europa.eu/energy/sites/ener/files/smart_readiness_buildings_implementing_act_c2020_6929.pdf

establishing an optional common EU scheme for rating the smart readiness (SRI) of buildings, accompanied by associated annexes (based on the empowerment given by Article 8 EPBD, introduced by Directive (EU) 2018/844). The delegated act on cost-optimality (Delegated Regulation No 244/2012)[30] and the accompanying guidelines[31] support Member States in calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements, using the comparative methodology framework established by the Commission.

The Commission has also published a series of recommendations on building renovation ((EU)2019/786) and building modernisation ((EU)2019/1019) aspects. These are linked to the new rules introduced in 2018 in the EPBD.

1.3.2 The progress achieved

While the evaluation of the EPBD in 2016 revealed some weaknesses, notably inefficiencies in national implementation, the EPBD is overall a successful regulatory instrument that has led to significant energy savings in the buildings sector (about 49 Mtoe of energy savings from 2007 to 2013[32]) and has grown over time in ambition and scope. It has spurred significant changes in the national buildings codes and standards for minimum energy performance requirements, in relation to major renovations of existing buildings and in relation to new buildings, and has introduced the energy performance certificate, an information tool which is present and used in each country and by the financial sector. The nearly zero-energy building requirements for new buildings provided the necessary longer-term predictability for investors, offered stakeholders a common vision for the sector, and mobilised industry to deliver business models and technologies.

One of the main reasons why the current EPBD does not yet deliver on the required push for building renovation is that it does not contain any obligations directly triggering building renovation.

[30] Commission Delegated Regulation (EU) No 244/2012 of January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements.

[31] Guidelines accompanying Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU.

[32] This is equivalent to the gross inland consumption of both Austria (34.7 Mtoe) and Ireland (14.96 Mtoe) together in 2019 (49.66 Mtoe). Over 2007-2013, direct GHG emissions were reduced by 63 Mt CO_2 (i.e. 8% of the 1990 emissions of the household and service sector).

2. PROBLEM DEFINITION

2.1 Introduction

This section provides first an overview of the barriers preventing higher levels of renovations, which are complex and multi-layered. Not all are addressed by the revision of the Energy Performance of Buildings Directive (EPBD). Annex N provides key information related to the characteristics of the building stock and the ownership structure of buildings, which are relevant to understand the origin of the problems addressed. Such an overview helps identify key drivers of the problems addressed in this initiative and also assess the interplay of the EPBD revision with other measures of the 'Fit for 55' package, in particular carbon pricing. This section finishes by outlining the two key problems addressed by the EPBD revision and their drivers, concluding with their expected evolution.

2.2 Barriers to energy renovations

The strategic Communication on the Renovation Wave addressed the need to significantly increase energy renovations in the EU by setting the objective to at least double the annual energy renovation rate of residential and non-residential buildings by 2030.

While preparing both the Renovation Wave Communication and the impact assessment, a number of stakeholder consultations, in-depth literature reviews and targeted studies were undertaken to identify the different sets of barriers to energy efficiency renovation in buildings in EU countries. Some of these barriers are more or less relevant depending on the Member States, and sometimes on regions within them. However, albeit with a different weight across Europe, all of these barriers taken together account for the insufficient annual renovation rates in the EU and the existing gap towards the 2030 decarbonisation target for the building sector.

The barriers to energy renovations can be divided in six main categories:

(1) <u>Economic and financial barriers</u> associated with building renovations – from the high upfront costs and affordability of renovation, access to finance, the issue of split incentives (which are also and organisational barrier), to the relevant opportunity and transaction costs and high discount rates;

(2) <u>Behavioural barriers</u> related to consumer support for the uptake of energy renovations – from the lack of knowledge and conflicting information on the energy performance of buildings and multiple benefits of energy renovations, to a general lack of acceptance of the need to step up decarbonisation efforts, including in buildings, the inertia (bounded rationality), the perceived hassle of renovations, and the aversion to indebtedness and financial risk;

(3) Information barriers associated with the lack of accessible, transparent and comparable information across the board and in EU countries on the decarbonisation trajectory for buildings, lack of comparable and standardised information tools on the energy performance of buildings across the EU, as well as the lack of information on available funding for energy renovation investments and on the potential lower credit risk associated with energy efficiency investments[33];

(4) Administrative barriers related to both insufficient technical expertise and capacities among local and regional authorities to support building renovation programmes, lengthy administrative processes and permit procedures;

(5) Technical barriers related to the possible shortage of skilled workforce for energy renovation, lack of standardised practices and industrialised solutions in the building renovation market, as well as the lack of skills and accessible advisory and quality assurance support for non-professional building owners;

(6) Organisational barriers associated with the complexity of building ownership and use, where co-ownership and collective decisions are often the norm, and where the commercial lease of buildings and building units add to the complexity and split incentives.

On top of these six categories of stable barriers, some temporary and periodic barriers might arise that affect energy renovations across EU countries. These are often of a macro-economic nature and related to market cycles, market interventions and market adjustments. In the last 2 years, a number of consequences that stem from the COVID-19 pandemic have affected the market of energy renovations. The interruption of global shipping routes has had a cascade effect on the availability of construction materials. At the same time, the high number of public subsidies in EU countries for energy renovation released on the market, in particular by the Recovery and Resilience Facility, has generated a temporary shortage of skilled workforce for energy renovations and made renovations more expensive. While the demand for energy renovations in buildings is expected to grow in the next year, these initial shocks are expected to recede and the market is expected to adjust.

The following table outlines the barriers to building renovations, with Annex E (Intervention logic and common barriers to building renovations) explaining them in more detail.

[33] Based on initial evidence from the EEFIG SR8 working group. A special report on this and other assets and activities related to environmental objectives, including energy efficiency and building renovations investments, is expected from the European Banking Authority in 2023 https://ec.europa.eu/eefig/eefig-working-group-risk-assessment_en

Table 2.1: Barriers to building renovations

Type of barrier	Barrier
Financial barriers	Upfront costs and affordability of energy renovations
	Weak economic signal
	Split incentives
	Lack of access to public and private financial support for affordable renovations
	Limited public funds, public financial support not sufficiently targeted towards deep renovations
	Lack of clear property value differential
	Transaction costs, high discount rates
Behavioural/consumer barriers	Lack of knowledge, conflicting or lack of information on energy performance of buildings and multiple benefits of energy renovations
	Time and hassle factor, inertia and bounded rationality
	Perceived risk, attachment to incumbent technologies
	Lack of acceptance of need to step up decarbonisation efforts, including in buildings
	Aversion to financial risk and indebtedness for energy efficiency investments
Information barriers	Lack of well-communicated decarbonisation trajectory
	Lack of standardised information tools on energy performance
	Lack of information on available funding opportunities (public and private) for energy renovations on buildings, and on the potential lower credit risks of energy efficiency investments
Administrative barriers	Regulatory & planning (e.g. limitation in façade intervention, approval process for renewable installation and renovation permits)
	Lack of technical expertise and capacities in regional and local administration for energy efficiency renovation programmes
	Burdensome administrative processes (multiple permit procedures, no single entry point)
Technical barriers	Lack of skilled workforce for energy efficiency renovations, lack of low-carbon renovation skills
	Lack of standardised practices and industrialised fast-track solutions for energy renovations in buildings
	Lack of quality assurance for complex renovation
Organisational/building complexity barriers	Collective decision problems for co-owned properties
	Commercial lease barriers

The barriers identified in the above table are largely common across EU countries, although their weight in the overall decision-making process to embark on energy renovations can be different depending on specific national circumstances. Two of the most common barriers are the issue of split incentives and access to finance to bridge the upfront cost and affordability of energy renovations. In their long-term renovation strategies[34], 16 Member States clearly underline the issue of split incentives as one of the most relevant barriers to energy renovations. Although the issue of split incentives is common across Europe, some of its most striking features are affected by national differences[35]. While the issue of split-incentive is included into 'economic and financial barriers' as it relates to the mismatch of economic incentives, it cannot be alleviated by economic incentives alone, and it combines with organisational barriers. As outlined in Annex N, the owner-tenant ratio presents some differences across Member States, with the number of people living in rented accommodation much higher in Germany (49%), Austria (45%), Denmark (39%), and France (36%), compared to an EU average of 30%. The owner-tenant ratio has a direct impact on the relevance of the split incentive issues in designing policy for energy renovations of national building stock. In southern Europe, south-east and north-east Europe, people own rather than rent housing, with countries in south-east Europe having a high ownership ratio. Similarly, the possibility to increase rents following energy renovations is regulated differently across EU countries, with northern and western European countries having more regulatory social safeguards. The difficulties in finding appropriate measures that properly address the issue of split incentives was also highlighted, especially by non-governmental organisations (NGOs), in the consultation on the inception impact assessment. While tenant associations largely favoured the need for measures that introduce obligations for building owners, the renovation hassle and risks of 'renovictions' was also mentioned as a possible negative consequence of renovations.

Access to finance to bridge the upfront costs of energy renovations is also a very common barrier across all EU countries. This was underlined by multiple stakeholders during the targeted EPBD revision and Renovation Wave consultations (Annex B). Moreover, private financing products for energy efficiency renovations are not sufficiently developed and marketed across EU countries, which reduces access to favourable financial offers. Moreover, insufficient cost-effective use of EU and national financing to leverage additional private investments and the lack of appropriate information tools to better target financing towards deep renovation and the worst

[34] Long-term renovation strategies 2020, https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/long-term-renovation-strategies_en#national-long-term-renovation-strategies-2020
[35] Castellazzi (2017); Overcoming the split incentive barrier in the building sector.

performing buildings is often underlined across the board as part of public resources spending[36].

Across the EU, technical barriers experience similar trends to administrative and information barriers. Overall, they are more relevant in Member States where the uptake of energy renovations appears to be less strong. In addition, a number of Member States identify a close link between the administrative burden barriers of renovation, the behavioural barriers related to the hassle of renovations, and organisational barriers linked to building ownership status and the collective decision-making of co-owned immovable goods.

2.3 What are the key problems?

While the previous sections focus on the overall barriers to renovating buildings, this section focuses on the barriers that can be addressed by the revision of the EPBD.

2.3.1 ***The first key problem:*** *The EPBD framework is insufficient to achieve the 2030 climate objectives. No specific measure is in place to address non-economic barriers that limit the energy renovation of buildings.*

As previously indicated, the main aspect currently hampering the progressive decarbonisation of the building stock in the EU is the low renovation rates across EU countries. The EPBD framework is incapable of overcoming this problem because it does not contain measures to trigger building renovations. The EPBD defines the energy performance levels that have to be reached when a new building is built or when an existing building undergoes a major renovation, but it does not trigger additional renovations. Stakeholders also recognised that the EPBD framework was inadequate. In the consultation on the inception impact assessment, several stakeholders across all categories indicated the need for the EPBD to include additional measures to (radically) increase the rate of renovations in order to help achieve the decarbonisation objectives.

The energy performance trend in buildings depends on the combination of the quantity of building renovations (renovation rates) in EU countries and the quality of the energy efficiency improvements achieved by single renovations (renovation depth)[37].

Based on the latest available data, 11% of the existing building stock in the EU undergoes some level of renovation each year[38]. This means that in terms of floor area affected, the annual renovation rate appears to be at a satisfactory level. However,

[36] This was identified in particular across many Member States by an European Court of Auditors' special 2020 report on 'Energy efficiency in buildings: greater focus on cost-effectiveness still needed' in relation to an audit on cohesion policy spending on energy efficiency renovations in buildings, https://www.eca.europa.eu/Lists/ECADocuments/SR20_11/SR_Energy_efficiency_in_buildings_EN.pdf

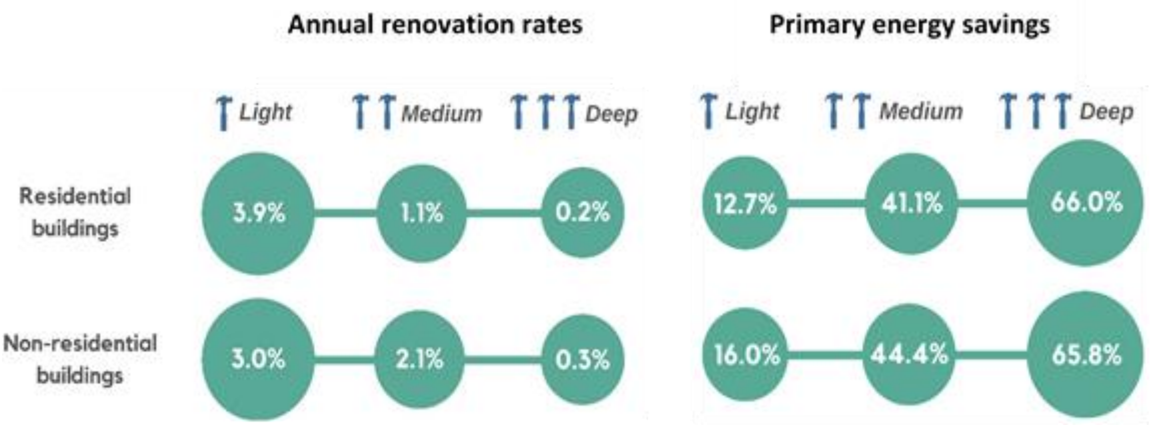
[37] Energy efficiency improvements during renovation can be realised either in the building envelope (walls, roof, windows, etc.) or in the technical building systems (hot water production, space heating/cooling, etc.).

[38] https://ec.europa.eu/energy/sites/ener/files/documents/2.annex_to_final_report.pdf

renovation works seldom address the energy performance of buildings, and the weighted annual energy renovation rate[39] at EU level is only around 1%. This applies to residential and non-residential buildings, including public buildings, with only marginal differences. This rate, if maintained, is not compatible with the achievement of the 2030 energy and climate goals, as illustrated in the Climate Target Plan analysis[40].

Figure 2.1 illustrates that the current level of annual renovation rates tends to favour building renovation with small primary energy-saving impacts overall (light renovations), while a wide range of technologies that would allow for much deeper renovations are available. Only a residual share of building interventions therefore target medium and deep energy renovations, which are able to achieve more than 40% and 60% primary energy savings respectively.

Figure 2.1: Annual energy renovation rates and corresponding average primary energy savings per intervention in the EU (2012-2016 average)[41]



For households, renovation is ultimately a private decision that is driven by several considerations. These often do not relate primarily to energy efficiency improvements but rather to the comfort, functionality, aesthetic and structural resilience of a building. For professional operators, the decisions can be based on more commercial considerations. Without appropriate regulations and increased awareness of the numerous benefits of energy renovations (indoor comfort, reduced energy needs, higher property value), several opportunities to greatly improve buildings will be missed. Similarly, financial institutions often express difficulties with navigating the technical aspects of

[39] The term 'weighted annual energy renovation rate' refers to the annual reduction of primary energy consumption in the total building stock achieved through the sum of energy renovations at all depths (light, medium and deep).

[40] The low renovation rate was a significant concern highlighted during the consultation on the inception impact assessment. In 62 responses, stakeholders called for an increased renovation rate of at least 2% or 3%. Most of this feedback came from business associations/companies, followed by NGOs.

[41] Esser, Anne; Dunne, Allison; Meeusen, Tim; Quaschning, Simon; Wegge, Denis; Hermelink, Andreas et al. (2019b): Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU. Final report - Infographics. Research report prepared for European Commission, DG Energy. (Ipsos); (Navigant).

renovations and their financial benefits. As a result, there is a lack of understanding, which would be necessary to offer targeted instruments such as favourable loans to building owners that plan to undertake renovations that also cover energy improvements.

Across the building stock in the EU, the worst performing buildings, i.e. buildings in the lower energy performance classes, are responsible for a large share of energy consumption and GHG emissions. However, despite this relatively high impact, the number of renovations among the worst performing buildings is lower than the average. There are several reasons for this: on the one hand, the lack of upfront capital and targeted funding and technical assistance tailored to buildings that require a more complex package of renovation measures, while investments in building renovations tend to prioritise single measures with relative short payback. On the other, worst performing buildings, both in the residential and service sector, are often rented out, meaning that the barrier of split incentives between owners and tenants to renovate buildings applies[42].

2.3.2 The drivers of the first key-problem.

Based on the general analysis of barriers to energy renovation in buildings in Section 2.2, the EPBD can address several but not all barriers to energy renovation. The problem drivers related to the first key problem that the EPBD revision will address are as follows (also detailed in Annex E):

- Split incentives
- Lack of information on the energy performance of buildings and multiple benefits of energy renovations
- Lack of standardised information tools on energy performance
- Lack of well-communicated decarbonisation trajectory
- Public financial support not sufficiently targeted towards deep renovations
- Behavioural barriers.

The issue of split incentives, or 'owner-tenant dilemma', is a very well-known barrier to the uptake of energy renovations in buildings. On the one hand, this affects the financial case for the energy renovation of rented buildings and the possibility to stimulate enough interest in energy renovations of such buildings by splitting its two main economic benefits: increase in property values and reduction of energy costs. Building owners would be required to pay for efficiency investments, while building occupants would

[42] The concept refers to the situation where the building owner pays for energy retrofits, but cannot recover savings from reduced energy use because they accrue to the tenant (who pays a lower heating bill). Unless the heating is included in the rent, in which case the property owner has an incentive to renovate worst performing buildings.

reap the benefits of lower energy costs. In parallel, the advantage for building owners in terms of property values would be directly accessible only through the increase in rents. This would not be possible in the short term and/or would have relevant economic and social impacts in terms of rent increases for tenants. This is why, in the absence of mandatory obligations and dedicated support to building renovations, the issue of split incentives probably remains one of the most relevant barriers to the uptake of energy renovations in buildings through market measures. The EPBD currently does not include any specific measures to address the lack of incentives for landlords to renovate.

There is a significant lack of information and awareness from both private, public (such as municipalities, the public health sector, social housing) and professional owners or tenants of buildings on the overall energy performance of the buildings they own or live in, possible energy efficiency improvements, costs and benefits, carbon performance and options to decarbonise. Although energy performance certificates (EPCs) regulated by the EPBD are well-recognised tools and provide some of this information, which is also valued by the market[43], the coverage, diffusion and proper advertisement of EPCs is relatively low.[44] 65% of the respondents to the public consultation indicated that EPCs should be updated and their quality improved. Stakeholders criticised the current EPCs for appearing inadequate, with sub-optimal rating methodologies and poor recommendations for improving cost-effective energy performance. They also highlighted the low reliability of the data provided by EPCs, questioning the quality of the calculation methods or of the audits. EPCs are only required at specific moments in the lifetime of a building (sale or rent for the majority of buildings, while public buildings of a certain size should always have a valid EPC and display it). This never happens for many buildings during their life cycle. In addition, the information on EPCs remains limited and is not sufficient to illustrate all the qualities and technologies of buildings nor the full range of benefits that improvements could bring. Carbon performance is for instance not a compulsory element in EPCs. The content of EPCs and the EPC classes attributed to buildings also vary significantly across countries. This limits their value to investors and financial players that operate in multiple markets. In this respect, 75% of the respondents to the public consultation acknowledged the issue.

Closely linked with the information and technical barriers, public financial support for energy renovations are currently also not sufficiently targeted towards deep renovations. In particular, there is a clear link between the lack of appropriate and standardised information tools for building renovations and the difficulty in targeting public financial support towards deep energy renovations able to deliver large benefits in terms of energy

[43] Several studies indicate that a price premium is applied to the most energy-efficient properties, for instance https://doi.org/10.1016/j.apenergy.2016.07.076

[44] See Annex G on EPCs.

consumption and GHG emission reductions[45]. At the same time, regulatory measures are needed to provide the necessary legal certainty, clarity and direction to better guide financial investors and public support schemes. In that respect, the current framework lacks clear definitions of deep and staged renovations[46].

Behavioural barriers, including risk aversion and inertia, are also key drivers behind low renovation rates, at a level that fails to exploit the techno-economic energy efficiency potential of buildings.

2.3.3 The complementary role of regulatory measures and carbon pricing to address the barriers to energy renovations

As illustrated in the previous section, multiple factors hamper the roll-out of energy renovations, and not all of them can be addressed by the EPBD. The policy mix of measures included in the 'Fit for 55' package includes elements able to address the different drivers, in particular carbon pricing, non-regulatory signals (such as targets), regulatory measures, information tools, standards and support measures.

The strengthening of the EPBD and its revision will address measures that are mainly regulatory, including information tools and planning. Current experiences with the EPBD show that the regulatory approach is effective in increasing the energy performance of buildings and in scaling up construction activities and the market uptake of materials, products and highly performing technologies necessary to meet the regulatory levels. The review will deepen the successful policies, leading to higher energy performance levels for new buildings and extending them to existing buildings.

One key complementarity exists in the legal framework between carbon pricing mechanisms and regulatory instruments in the building sector. While the carbon price acts as a key tool in delivering rapid decarbonisation both in the buildings and transport sector, market failures and barriers affecting the building sector would remain unaddressed without regulatory measures and investment support.

The EU Emissions Trading System (EU ETS) currently covers around 30% of building emissions from heating[47]. This is related to the system's coverage of district heating and electricity used for heating purposes. These are direct emissions from larger fossil fuel

[45] This aspect was in particular underlined by the European Court of Auditors' recommendations as part of their special report on 'Energy efficiency in buildings: greater focus on cost-effectiveness still needed', https://www.eca.europa.eu/Lists/ECADocuments/SR20_11/SR_Energy_efficiency_in_buildings_EN.pdf

[46] Staged renovation is a deep renovation delivered in steps, in several packages of measures and over a period of time (e.g. replacing windows in a year, insulating walls a few years later, replacing the boiler after another few years). In this way, the investment costs are distributed over a period of several years, when building owners also benefit from the corresponding energy cost savings from the implemented measure. This makes deep renovations more feasible and affordable. Staged renovations are facilitated by the introduction of the building renovation passport.

[47] This percentage refers to both direct and indirect emissions.

district heating system installations included in the EU ETS (> 20 MW) and indirect emissions from electricity use in appliances, heating and cooling equipment such as heat pumps and lighting. The carbon price from the existing EU ETS is largely passed onto consumers via their electricity bill and heating costs. However, its price signal is limited as not all fuels are covered.

With the proposed extension of ETS to heating fuels as part of the 'Fit for 55' package, all heating fuels will be subject to a carbon price. Consumer heating bills will therefore internalise carbon costs, indirectly incentivising the shift towards low-carbon heating and investments in solutions that reduce energy consumption and exploit the existing energy efficiency potential in the building sector.

Adding to heating costs derived from fossil fuels, the carbon price acts as an economic incentive and makes investments in low-carbon heat and energy efficiency more cost-effective. An ETS extension and higher costs for heating buildings with fossil fuels would result in an additional economic incentive for the energy efficiency measures promoted by the EPBD and the EED, provided that the carbon price signal is sufficiently high. If the price is set at a sufficiently high level, energy efficiency measures would likely become more cost-effective and have a shorter payback period.

The non-rational response of economic agents and the effects of non-economic barriers and market failures, which prevent the markets alone from delivering cost-effective emission abatement solutions, are illustrated by price elasticities – 'the higher, the bigger' being the response[48]. Price elasticities vary from short-term (reflecting the fact that behavioural responses to changes in prices are small as space heating is a necessity) to long-term ones (reflecting the factors that constrain investment).

Price elasticities of consumers to the costs of heating in the residential and service sector are not well documented, but are considered to be low based on the studies available. In the building sector, the information available from the literature is very limited. However, the results indicate that buildings' total energy consumption has a long-term price elasticity of -0.23 on average at EU level[49]. The presence of low elasticities indicate that even if there is a significant carbon price, an abatement decision will not be taken, and that a very high price is needed in the absence of complementary regulatory measures. These constraints may prevent energy consumption from responding to a carbon price signal quickly and strongly enough. Especially in case of low price signals,

[48] Estimates of the price elasticity of demand represent the factor by which the demand for a good or service changes in response to a 1% change in its price. Price inelastic goods have a price elasticity between -1 and 0, with goods being classified as more inelastic the closer their elasticity estimate is to zero.
[49] ICF (2021) ETS Clima study. Other studies show that empirical estimates of the short-run price elasticity of demand for heating fuels in Europe range from -0.025 to -0.26, with long-run estimates ranging from -0.05 to -0.32 for fossil gas and -0.025 to -0.50 for electricity.

carbon pricing alone would be insufficient to drive the uptake of the cost-effective carbon abatement actions in the building sector.

The following tables present the abatement ($MtCO_2$) and energy savings (Mtoe) potential respectively in the residential sector in 2030 for the EU-27, at different carbon prices.

Table 2.2 Marginal energy savings (Mtoe) for residential building sector within EU-27 in 2030[50]

2030	ENERGY CONSUMPTION (MTOE)	ENERGY SAVINGS POTENTIAL (MTOE)	% SAVINGS POTENTIAL
Carbon price 0 (EUR/tC02)		16.1	8%
Carbon price 30 (EUR/tC02)		16.9	9%
Carbon price 50 (EUR/tC02)		17.1	9%
Carbon price 90 (EUR/tC02)		20.6	11%
Carbon price 150 (EUR/tC02)		21.2	11%

Table 2.3 Mitigation measures implemented at each carbon price[51]

CARBON PRICE 0 (EUR/TC02)	ADAPTIVE THERMOSTATS ADVANCED POWER STRIPS RET ADVANCED POWER STRIPS AIR INFILTRATION CENTRAL AIR CONDITIONER TUNE-UP CENTRAL FURNACE EFFICIENT FAN MOTOR CENTRAL HEAT PUMP TUNE-UP CONDENSING GAS BOILERS AND WATER HEATERS INSULATION (DRAFT PROOFING, DUCT SEALING, PIPING) EFFICIENT APPLIANCES (REFRIGERATOR, CEILING FANS, DEHUMIDIFIERS, CLOTHES WASHER AND DRYER, TELEVISION, WINDOW AIR CONDITIONER) HEAT PUMPS (ELECTRIC AIR-SOURCE COLD CLIMATE, GROUND SOURCE) ENERGY EFFICIENT HOMES (20% ABOVE CODE) ENERGY EFFICIENT POOL PUMPS LIGHTING EFFICIENCY (EXTERIOR, CFL, INCANDESCENT) WATER APPLIANCES (FAUCET AERATORS, LOW FLOW SHOWER HEAD) WATER HEATER (HIGH EFFICIENCY GAS STORAGE WATER HEATER, HYDRONIC HEATING, TANKLESS) HIGH EFFICIENCY WINDOWS SOCIAL BENCHMARKING AND HOME ENERGY MONITORING
Carbon price 30 (EUR/tC02)	Crawlspace insulation Early furnace replacement - 70% AFUE - 90% AFUE
Carbon price 50 (EUR/tC02)	Integrated heating and domestic hot water (forced air heating)
Carbon price 90 (EUR/tC02)	Insulation (attic/ceiling, basement wall (R-12), slab (unfinished basement) High efficiency heat recovery ventilators (HRVs) Water heater replacement
Carbon price 150 (EUR/tC02)	95% or higher efficiency furnaces Active solar water heating systems

[50] Source: ICF Consulting.
[51] Source: ICF Consulting.

The analysis in the above tables shows that at higher carbon price levels, more expensive measures – but also more rewarding ones in the longer term – will be adopted. This is also illustrated in the modelling scenarios underpinning the 'Fit for 55' package. With carbon price alone, at the level estimated in the MIX scenario of EUR 48/tonne in 2030, several measures necessary to exploit the energy efficiency potential will not take place, leaving untapped potential.

The 'Fit for 55' package therefore envisages a mix of instruments to address economic and non-economic barriers in a complementary way, together with financial support. In this framework, regulatory measures are crucial to driving demand for decarbonisation solutions and to addressing structural barriers. The EPBD revision aims to strengthen the current measures and introduce new ones to address the persistent barriers to energy renovation, in complementarity with carbon price signals, other regulatory instruments envisaged in the Energy Efficiency Directive, Renewable Energy Directive and the mechanism in the Effort Sharing Regulation.

Standards are needed to direct renovations towards buildings with the highest potential and at the same time with the highest structural barriers of risk aversion, split incentives and information asymmetry, and to stimulate more complex deeper renovations. The carbon price is in fact expected to be effective in driving light renovation, but it would have limited effects on medium to deep ones. According to the analysis made in the Climate Target Plan and confirmed in the scenarios underpinning the 'Fit for 55' legislative proposals, it would need to increase six times from the level estimated of 0.1% each year in the REF baseline scenario.

2.3.4 ***The second key problem****: The EPBD framework is insufficient for the 2050 climate objectives and to foster energy system integration*

Net zero emission buildings have been identified as a key enabling pathway needed to deliver on climate neutrality[52]. While the EPBD, through national long-term renovation strategies, already requires planning towards decarbonisation, there is a lack of a clear pathway to deliver on climate neutrality. There is currently a lack of a coherent framework to allow Member States to develop and plan their building decarbonisation pathway in more detail, with clear milestones and targets towards 2030 and 2040. While around 85 million m² of residential buildings and 40 million m² of service buildings are built each year in Europe[53], the current EPBD requirements for new buildings do not ensure that buildings are built in a way that makes them fully decarbonised ('2050-ready').

[52] 'A Clean Planet for all: A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy', COM(2018) 773 final.
[53] Estimates based on the Odyssee database: https://www.indicators.odyssee-mure.eu/energy-efficiency-database.html

With reference to the pathway towards climate neutrality, existing buildings with poor energy performance are characterised by high energy consumption, high GHG emissions and often relatively poor integration in the energy system. In the majority of cases, worst performing buildings are usually the ones that rely more heavily on fossil fuels for heating and cooling, and where the uptake of renewable energy sources is more difficult because of the poor quality of the technical building system. Even if the building's energy demand could be fully covered by renewable energy, the low energy efficiency of the building would lead to a waste of energy resources.

As a consequence, the current building stock is not always 'technically fit' for the energy transition and ready to be integrated into a decarbonised and digitalised energy system. This is a major barrier to the decarbonisation of heating and cooling and to increasing the uptake of energy from renewables (i.e. geothermal heat) in households. A more energy-efficient building stock is often a prerequisite for the energy switch for heating and cooling from fossil fuels to renewable energy sources. In addition, there are also similar technical and administrative barriers in the existing building stock. This hampers the uptake of e-mobility solutions because of the lack of charging points in residential and private buildings.

2.3.5 The problem drivers of the second key problem

- Lack of standards and requirements for new and existing buildings in line with decarbonisation goal.

The current definition for nearly zero-energy buildings (NZEB) in the EPBD was developed over 10 years ago and does not reflect the goal of decarbonisation and zero carbon buildings enough. In addition, NZEB energy consumption levels differ across Member States[54] and do not address whole-life carbon nor the readiness of buildings to provide flexibility and play an active part in the energy system by integrating smart solutions for storage and demand response/management services to the grid. On these aspects, 57% of the respondents to the public consultation indicated that NZEBs are not ambitious enough.

- Insufficient measures to facilitate the integration of digitalisation and smart solutions in new construction and building renovations.

Digitalisation is a key enabler in the decarbonisation of the building stock. Digital technologies that can be used across the life cycle of buildings, from design and construction to operation, are still not appropriately established in the EPBD framework and in the renovation processes.

First, it has great potential to increase the quality and scalability of energy efficiency solutions, with optimal design and collaboration (for example, building information

[54] See Annex H.

modelling), execution (for example, automated construction techniques), and use of buildings (for example, automated management systems, controllable devices and smart appliances, and data collection). Second, in line with the energy system integration strategy, it gives building users smart and flexible energy services, allowing the development of demand-side management strategies that help further integrate variable and decentralised renewable energy sources into the energy system, as well as energy storage technology. However, the appropriate framework is still not in place for the energy demand side to increasingly contribute to the smart energy grid flexibility effort. Third, digitalisation can enable better resource efficiency and facilitate circular approaches during design as well as construction and renovation. These are essential for lowering embodied emissions and achieving climate neutrality in buildings.

Digitisation is a topic that was often highlighted by stakeholders as requiring targeted measures in the EPBD. Stakeholders underlined its contribution to greater efficiency, transparency of information, flexibility of the energy system and therefore reduction of emissions. To complement this, in the public consultation conducted between 30 March and 22 June 2021[55], 72% of the respondents expressed the view that the EPBD can contribute to making available and accessible a wider range of building-related data on the energy performance of buildings and its related construction and renovation works across its life cycle.

- Insufficient measures to support the uptake of electro mobility in private buildings.

Current requirement for new buildings do not seem adequate to address existing barriers and support the uptake of sustainable mobility and to contribute to transport decarbonisation. With currently up to 90% of electric vehicles[56], recharging taking place at home or at the workplace, the role of buildings in providing recharging infrastructure is crucial, alongside publicly accessible infrastructure, which is regulated in the Alternative Fuels Infrastructure Regulation (AFIR). The share of recharging at publicly accessible points is expected to increase after 2030, but between 60% and 85% of all recharging will still take place at private recharging points[57]. According to a recent study, the lack of deployment of smart private recharging infrastructure is a barrier[58] to the development of the market for EVs. Lengthy and complex approval procedures can be a

[55] The public consultation attracted a total of 535 participants. The majority of people are from the EU (81 responses). Two respondents declared to be non-EU citizens. Most of the responses came from companies/business organisations and business associations (278 responses, 52%), followed by academic institutions (16 responses, 3%). 39 responses were from public authorities (7%), NGOs (12%), trade unions (5 responses, 2%), environmental organisations (1%) and consumer organisations (1%). 35 declared to be other stakeholder type (7%).

[56] "Electric vehicles" (EV) are meant to include the range of vehicles of different sizes and concepts, including also electrically assisted bicycles, as long as they are powered by electricity.

[57] https://ec.europa.eu/info/sites/default/files/revision_of_the_directive_on_deployment_of_the_alternative_fuels_infrastructure_with_annex_0.pdf

[58] Study ENER-B3-2020-332.

major barrier to owners and tenants installing recharging points in existing multi-tenant residential and non-residential buildings. Obtaining the necessary approvals can create delays or prevent their installation.

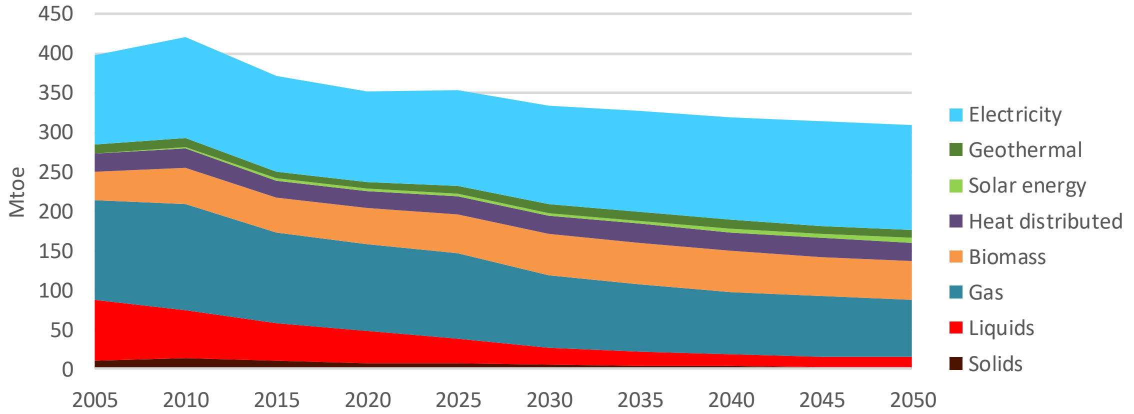
2.4 How will the problem evolve?

2.4.1 The building sector in the Reference scenario

The magnitude of the challenge ahead, caused by the current inefficiency and low rate of renovation and decarbonisation of Europe's building stock, is illustrated by the CTP's impact assessment and the updated scenarios drawn up in other proposals of the 'Fit for 55' package. The current decrease of CO2eq emissions from the use of buildings is estimated to be maximum 1%/year. This is three or four times lower than what would be necessary to sufficiently contribute to the '-55% by 2030' target.

In the baseline of the 'Fit for 55' package (REF), which describes 'business as usual' conditions and evolution based on current policies, primary energy consumption decreases by 32.7% in 2030, but this is insufficient for the net -55% climate target. For final energy consumption, REF projects 823 Mtoe, which is 29.6% below the trajectory of the 2007 baseline and therefore below the agreed 2030 energy efficiency target of at least 32.5%[59].

Figure 2.2: Final energy consumption by fuel in buildings (residential and services)[60]



The use of buildings is responsible for more than 40% of final energy consumption[61]. Residential and service buildings consume 333 Mtoe together each year, with residential

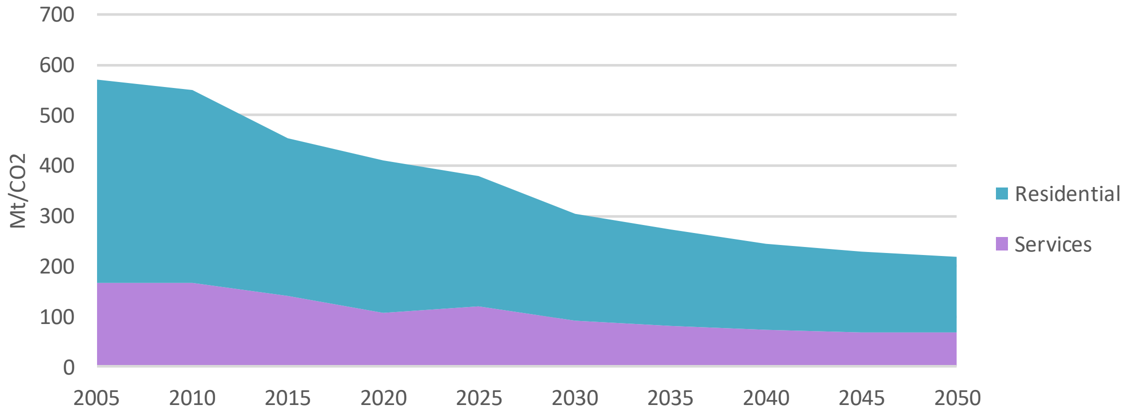
[59] The 2030 energy efficiency target has been realigned with the values of the 2020 reference scenario. On this basis, the current 2030 target can be expressed as a reduction of 9% of final energy consumption in comparison to the level in 2020 reference scenario (REF).

[60] Eurostat and PRIMES model.

[61] This figure refers to the use and operation of buildings, including indirect emissions in the power and heat sector, but not their full life cycle. The embodied carbon in construction is estimated to account for around 10% of total yearly greenhouse gas emissions worldwide, see IRP, Resource Efficiency and Climate Change, 2020, and the UN Environment Emissions Gap Report.

buildings representing almost 65% of the total. Figure 2.2 displays the combined consumption of residential and services in buildings in REF by fuel type.

Figure 2.3: GHG emissions from the use of buildings[62]



In the REF scenario, energy consumption for the use of buildings already falls significantly thanks to policies already in place and better performance and lower costs of technologies (such as heat pumps). However, their effects are partially offset by increased consumption to satisfy higher comfort levels and increased demand also for cooling needs. Looking towards 2050, the importance of fossil fuels decreases and electricity expands its already significant share further. However, solar energy and distributed heat remain marginal. Figure 2.3 displays the projected decline in GHG emissions.

Both residential and service sectors need to reduce their emissions. Due to their share in energy consumption, residential buildings in terms of absolute amounts have to make a bigger effort to reduce emissions than service buildings. The EU's total GHG emissions in the REF in 2030 (including all domestic emissions & intra-EU aviation and maritime) will be 43.8% below the 1990 level. Climate neutrality will not be achieved in the baseline, falling short of the European Climate Law objective.

2.4.2 The need for a more efficient building stock in a progressively decarbonised energy system

In the CTP and the 'Fit for 55' package, REG and MIX 'core' scenarios[63] illustrate the need to step up efforts in comparison to current trends across all sectors. Depending on the policy mix, 'core' scenarios achieve a significant decarbonisation of building stock

[62] Eurostat and PRIMES model.
[63] See the discussion in Chapter 6 and description of core scenarios here: https://ec.europa.eu/energy/data-analysis/energy-modelling/policy-scenarios-delivering-european-green-deal_en as well as Annex 4 in the impact assessment accompanying the amendment to the Renewable Energy Directive, SWD(2021)621 final.

through a fuel switch combined with energy efficiency progress thanks to renovations and the use of more efficiency appliances.

For the decarbonisation of buildings, the reductions needed by 2030 range between -54% and -61% (compared to 2015) in the scenarios for achieving -55% GHG. This is a step change in comparison to the reference scenario in which the level of GHG reductions is -33% in 2030.

The reasoning behind the significantly higher cost-effective emission reductions for buildings (and the power sector) compared to other sectors in modelling is that buildings have greater potential for abatement at a lower cost and therefore compensate for other ‘hard to decarbonise’ sectors. Those sectors are unlikely to level off their expansion and growth trends by 2030 with the increased speed of decarbonisation (e.g. transport, heavy industry that needs technologies such as hydrogen) or to simply achieve a similar level of emission reductions technically (e.g. agriculture, which has very few abatement options).

The power sector also has greater potential and needs to significantly cut its direct emissions too. In the long term, it will be one of the first to decarbonise completely. Furthermore, a strong link exists with the building sector due to the significant trend towards electrification of heating via heat pumps. To some extent (given that heat pumps are very efficient in electricity consumption and electricity is the sector that decarbonises the fastest), with the electrification of heating, direct emissions from buildings are ‘moved’ into the power sector, e.g. by replacing fossil fuel boilers with heat pumps (which run on electricity).

Importantly, core scenarios show that in the absence of energy efficiency, the effort in terms of fuel switch needs to be bigger. This effect would exacerbate climate neutrality pathways, leading to a strain on scarce resources (biomass-based fuels for heating or hydrogen-based innovative synthetic fuels).

To avoid a certain sectoral shift of emissions from buildings to power generation in the medium term or too high demand for low-carbon H&C in the long term, energy needs therefore need to be reduced, together with phasing out the remaining fossil fuel consumption.

Analysis and projections converge, indicating that a cost-effective and feasible pathway towards decarbonisation should rely partly on the decarbonisation of power generation, partly on low-carbon fuels, including the direct use of renewables in buildings (on-site), and partly on reducing the energy needs in key energy consumption sectors. The optimal pathways towards decarbonisation balance renewable deployment and energy efficiency improvements across the energy sectors. In long-term EU scenarios, achieving carbon neutrality[64], demand-side solutions and, in particular, high-performance buildings plays a critical role in reducing the demand for electrical heating in winter, addressing the

[64] In-depth analysis in support of Commission Communication COM(2018).

seasonal supply-demand mismatch. In particular, the temporal mismatch between the non-dispatchable renewable supply and peaks in electricity demand is in fact one of the key challenges to achieving high percentages of renewable electricity supply. Minimising the space heating requirements through the building envelope and its air tightness performance while covering the remaining energy demand by renewable sources, especially electrification, has been identified as an optimal strategy to ensure grid balancing and to find the cost-optimal pathway towards decarbonising the energy sector[65]. While this is true at aggregate level, also at the level of single buildings, analysis shows that while comparing new constructions implementing the NZEB requirement in order to minimise life cycle costs and the environmental impacts across their life cycle, buildings with higher energy performance outperformed those for which electricity production was maximised[66]. Such analysis suggests that the focus should be placed on (i) minimising the space heating requirements through a building envelope with high thermal and air tightness performance; and (ii) covering the remaining energy demand, to a significant extent, by renewable sources that compensate for buildings' specific energy source during their operational phase.

3. WHY SHOULD THE EU ACT?

3.1 Legal basis

The legal basis is Article 194(2) TFEU, the legal basis for Union policy to promote energy efficiency and energy savings. Energy policy is a shared competence between the EU and Member States. As this initiative concerns amendments to an existing Directive, only the EU can effectively address the issues.

3.2 Subsidiarity: Necessity of EU action

Climate change being a transboundary problem, Member States' action alone on buildings' emissions would lead to suboptimal outcomes.

To decarbonise the buildings stock, its annual rate of refurbishment must be scaled up. Low renovation rates are also linked to the underachievement of the energy efficiency goals in 2020, as energy consumption in the buildings sector has not decreased along a pathway compatible with it. The issue of insufficient rates and depths of renovation to achieve the GHG reduction objectives is a common one in the EU. As mentioned in the Renovation Wave Communication, across the EU, deep renovations that reduce energy consumption by at least 60% are carried out only in 0.2% of the building stock per year and in some regions, energy renovation rates are virtually absent. No Member State achieves a yearly deep renovation rate of 1% or more. Similarly, yearly rates of medium renovation (30% or more of primary energy savings) are below 5% in all Member States when looking at both residential and non-residential buildings. Those consistently low

[65] See for instance https://doi.org/10.1016/j.enpol.2021.112565
[66] https://doi.org/10.1016/j.enbuild.2017.01.029

renovation rates show that a step change towards stronger requirements at EU level is needed.

In addition, as laid down in Chapter 2 and in Annex E, the underlying problem drivers and relevant barriers to building renovations, such as market failures (notably split incentives owner-tenant-dilemma), information barriers, organisation and behavioural barriers, lack of targeted finance and technical capacities and skills, prove to be similar in all EU Member States. These economic and non-economic barriers are largely present in all Member States and cannot be overcome solely with economic or monetary incentives. This is acknowledged in the set-up of the 'Fit for 55' package which includes a reasoned policy mix of targets and non-regulatory signals, carbon price mechanisms, regulatory standards and financial incentives.

If buildings were not to be decarbonised in an effective and coordinated manner across the EU, this would lead to an unfair distribution of burden and a spillover effect of higher energy consumption and greenhouse gas abatement costs for the EU as a whole. A key underlying reason is the increasing marginal cost of GHG emission abatement, including for investments targeting buildings' energy performance. The more a building or building stock is already energy performant (because of high insulation and low-carbon heating already installed), the more difficult and thus costly it becomes to tap into additional energy and GHG savings. The fragmentation of the buildings' energy performance, leading to shares of inefficient buildings in certain Member States not being targeted (low-hanging fruits) could therefore lead ultimately to a possible failure in meeting the long-term EU decarbonisation objective, but also reduced energy security due to higher energy consumption

More ambitious and more prescriptive EU level action is therefore necessary to ensure policy alignment towards decarbonisation of buildings across the EU. The role of the EU is crucial to make sure that the regulatory framework reaches comparable ambition levels and is consistently enforced. The revision of the EPBD follows the need to update it to reflect the increased ambition of the EU climate and energy targets. This is on top of the fact that the assessment of the EU-wide impact of the National Energy & Climate Plans that the Commission published in September 2020[67] showed an ambition gap as regards energy efficiency: 2.8 percentage points for primary energy consumption and 3.1 points for final energy consumption in the EU, as compared to the 2030 goals currently in force. Further EU wide measures in the revised EPBD would thus be needed in any case in line with what foreseen in the Energy Union Governance Regulation[68].

[67] https://ec.europa.eu/info/news/commission-publishes-assessment-national-energy-climate-plans-2020-sep-17_en
[68] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R1999&from=EN

3.3 Subsidiarity: Added value of EU action

Setting a common framework for the enhanced decarbonisation of buildings at EU level will ensure that the buildings sector reduces its GHG emissions at the required scale to achieve the EU's energy and climate targets and in the most cost effective way.

Since the adoption of the first EPBD in 2002, the EU legislative framework on buildings' energy performance has prudently expanded, setting a common minimum framework at EU level and leaving significant flexibility for implementation and adaptation to Member States. The experience with joint EU ambition for all new buildings to be nearly zero-energy by 2020 shows the significant impact of mobilising the buildings sector around a common objective and language[69]. Nonetheless, so far similar market signals have been missing for the existing building stock, which represents the largest share of the cost-effective potential[70]. Action at EU level offers a better leverage in mobilising the sector around a common ambition and leads to higher expected market outcomes. The development of industrialised fast-track solutions for the uptake deep energy renovations and zero-emission buildings would benefit from a closer integration of the EU market for energy renovations and sustainable constructions. In order to achieve these objectives, common framework and methodologies on the evaluation of energy performance of buildings and renovation practices have to be established at EU level. The experience from the implementation of the current EPBD shows that a common EU framework allows national policy-makers to build on each other's' best practices, stimulates innovation and increases the benefits of the internal market for construction products and appliances. Additionally, differences in the current national frameworks for monitoring and evaluation of energy performance of buildings prevents the possibility to exploit synergies and economy of scale for cross-border professional and financial investors in energy efficiency renovations of buildings. Today, the absence of a common EU framework methodology and of national databases on energy performance frameworks is identified as relevant to the uptake of private financing for energy renovations.

Construction products and services, heating, cooling, air-conditioning and lighting devices, as well as on-building renewable systems, smart controls, building automation systems, smart meters, and other products are an important part of the internal market. The construction sector overall contributes to 9% of the EU's GDP. A joint EU framework for building renovation will send strong market signals that promote the development of these markets and will lead to economies of scale. In relatively new areas such as industrialised solutions for building renovation, strengthening the common

[69] See Annex H and ongoing Horizon 2020 projects (e.g. RenoZEB, HEART, REZBUILD, ReCO2ST).

[70] This is assessed in various studies, including: (ICF et al.; 2021); *Technical assistance services to assess the energy savings potentials at national and European Level*. See also Annex H of the Impact Assessment supporting the revision of the EED: https://ec.europa.eu/info/sites/default/files/proposal_for_a_directive_on_energy_efficiency_recast.pdf .

language and requirements will help the EU industry expand. Consulted stakeholders underlined the importance of common standards and access to information for the scalability of innovative projects (e.g. turnkey renovations, which benefit from transparent access to information on permits and financing sources). On financing specifically, having a common definition of 'deep renovations' will allow investors to aggregate funding to be channelled to projects which meet the deep renovation criteria.

Action to upgrade the energy performance of the existing building stock will also generate other common EU benefits. As an example, the reduced energy demand from buildings and higher reliance on renewable energy, which is overwhelmingly generated within the EU, will contribute to the security of energy supply for all EU Member States.

Changes to the current EPBD framework do not mean that no margin for manoeuver will be left to Member States. Building typologies, ownership structures, climatic conditions and energy poverty levels vary across Europe. Therefore, while the direction of travel and a common ambition level need to be set at EU level, sufficient flexibility is given to Member States in order to adapt their buildings regulatory and financing policies to national and local circumstances.

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

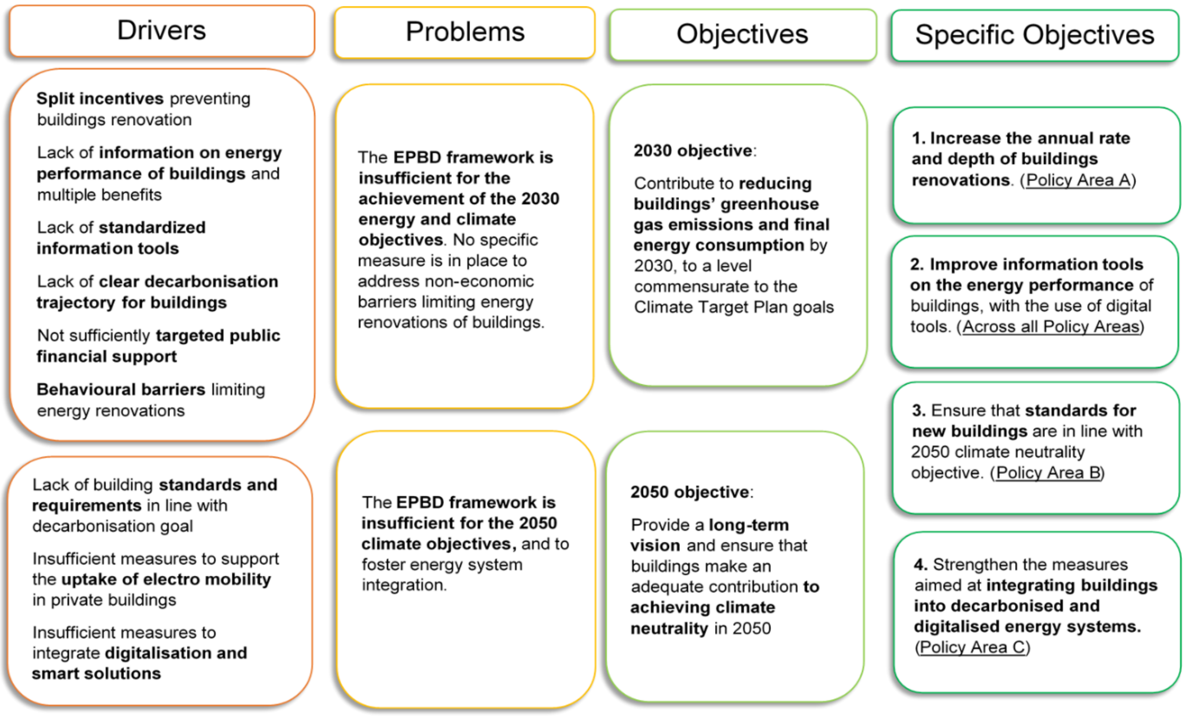
4.1 General objectives

Together with the other actions from the Renovation Wave action plan and the other elements of the 'Fit for 55' package, the revision of the EPBD aims to strengthen the legal framework for the energy performance of buildings to ensure a higher contribution to the achievement of the EU's energy and climate objectives for 2030 and the climate neutrality objective for 2050, in particular through a higher renovation rate.

The revision will also aim to modernise buildings and strengthen their role as an active part in the energy system, for instance through smart charging of EVs. The following figure provides an overview of the problems, drivers and objectives of the EPBD revision. In particular, two general objectives have been identified for this EPBD revision:

- **2030 objective:** Contribute to reducing buildings' greenhouse gas emissions and final energy consumption by 2030, to a level commensurate with the CTP goals.
- **2050 objective:** Provide a long-term vision and ensure that buildings make an adequate contribution to achieving climate neutrality in 2050.

Figure 4.1: Drivers, problems and objectives of the EPBD revision



In order to achieve the general objective and to tackle the key problems and problem drivers identified, four specific objectives that pave the way to the policy options (described in Chapter 5) have been identified. The specific objectives identified aim in particular to address, among the several additional drivers of a broader nature, those that can be directly tackled by the EPBD and contribute to the identified key problems.

As set out in Article 1 EPBD, the EPBD promotes the improvement of the energy performance of buildings within the EU. Several key elements of the Renovation Wave strategy, such as finance, adequately skilled workforce, seismic safety of buildings and safety of workers, fall outside the EPBD scope and cannot, or only to a limited extent, be addressed by the EPBD revision.

4.2 Specific objectives

4.2.1 Increase the rate and depth of building renovations.

The first specific objective addresses the first key problem and related problem drivers, namely the barriers identified to the increase of annual energy renovation rates and deep energy renovations. Increasing the renovation rates and the depth of building renovations is necessary to put the building sector on track towards achieving the 2030 energy and climate targets and the specific target contribution for decarbonisation efforts in buildings. To improve the energy performance of the EU building stock in the most cost-effective way, the scale of building renovations (renovation rates) in EU countries need to increase in parallel with the quality of the energy efficiency improvements achieved by the single renovation (renovation depth). Increasing the renovation rate and thereby realising the energy savings potential in existing buildings is important to cut carbon emissions, improve well-being and reduce energy poverty. The increased rate and depth of renovation should be commensurate with the decarbonisation efforts required to achieve the increased climate target and will have to be maintained also post-2030 in order to achieve EU-wide climate neutrality by 2050. Doing this with circularity in mind will reduce waste and keep embodied carbon low. Several stakeholders[71] supported this and called for 'greener' renovations that integrate circular economy principles.

The aim is to trigger, with updated policy measures, energy renovations at certain moments in the buildings' life cycle, or by addressing split incentives and the organisational barriers to energy renovations[72], also bearing in mind that by addressing the worst performing buildings the benefits are maximised. Improved information and comparability of the energy performance of individual buildings will also increase awareness and contribute to greater renovation efforts. This will also be addressed by strengthening the links between the depth of renovations and the aid intensity accessible through public budget support.

For this objective, there are synergies with the energy-saving goals, policies on the public sector, public building renovation and split incentives[73] in the EED and with the introduction of emissions trading in the building sector. It is supported by the ESR, which sets binding GHG emission reduction targets for Member States that cover several sectors, including buildings.

4.2.2 Improve information on the energy performance and sustainability of buildings, with the use of digital tools.

Improving information on the energy performance of buildings addresses multiple barriers to achieving decarbonisation of the building stock and the climate neutrality goal by 2050. This specific objective aims to address both key problems identified and the information barriers to the uptake of energy renovations and of a clear decarbonisation trajectory for buildings. It specifically addresses the problem drivers linked to the lack of information on the energy performance of buildings and multiple benefits of energy renovations and linked to a lack of standardised information tools on energy performance. By strengthening the reliability of the tools already available to measure the energy performance of buildings, the awareness of the general public as well as professionals of the multiple benefits that could be achieved thanks to deeper renovations would be improved and property values would reflect this.

Overall, the objective is to increase the number of buildings with an EPC, as well as their quality and comparability across Member States, and to further EPC mainstreaming and

[71] In the consultation on the inception impact assessment, 87 feedback responses covered the topic of circularity. These returns mainly came from professional associations/companies, NGOs and public authorities.
[72] doi:10.2790/912494, JRC101251
[73] doi:10.2760/070440, JRC115314

accessibility to consumers and investors. This increased coverage should go hand in hand with the higher quality of EPCs as fully digital tools. By increasing the quality and comparability of EPCs as fully digital tools, the aim is also to reduce the administrative burden for building renovations.

By increasing the scope, range of information and coverage of EPCs and other building information tools such as building renovation passports, the objective is also to ensure that public support such as EU funding can be better targeted towards high-impact projects and qualitative investments. This will also facilitate follow-up in terms of reporting and monitoring and the long-term impact of public support to building renovation. Digitalised EPCs and digital tools could reduce the administrative burden and simplify procedures.

Stakeholders stressed that improving the quality is key as only high-quality EPCs will be trusted by owners/occupiers and the finance sector. In particular, 77% of the respondents to the public consultation pointed out that funding support to renovations should be linked to the depth of renovations. They also underlined that EPCs are the key tool for assessing energy efficiency improvements for financing purposes. Alongside EPCs, stakeholders[74] largely supported the inclusion of the building renovation passport in the revision of the Directive to address the information gap of owners and investors by providing documentation on the renovation roadmap of buildings.

4.2.3 Ensure that new buildings are in line with the 2050 climate neutrality objective.

This objective addresses the second key problem and the related problem drivers of the lack of standards and requirements for new and existing buildings in line with decarbonisation goals. For new buildings and for the transformation of existing buildings, a new vision going beyond nearly zero-energy buildings is needed. This will ensure that new builds are fully compatible with carbon neutrality goals and that lock-in to technologies with a long lifetime, which rely on fossil fuels for heating and cooling, is avoided. To achieve this objective, an update the current nearly zero-energy buildings requirements towards zero-emissions buildings requirements is necessary. The concept of zero-emissions buildings received support from 84% of the respondents to the public consultation.

For new buildings, this will mean designing building performance requirements that ensure much lower energy needs and phasing out fossil fuels for heating and cooling thanks to the deployment of renewables technologies. These include direct renewable-based electrification and modern low-temperature district heating and cooling that harness local renewable energy and waste heat resources. By addressing whole life

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[74] 66 responses to the inception impact assessment encouraged the inclusion of building renovation passports in the revision of the EPBD. Most of these responses came from associations/business organisations as well as NGOs.

carbon and resilience[75], such a new vision would maximise decarbonisation and make new construction future-proof.

For this objective and the previous one there are synergies with the RED for heating and cooling target, the planned introduction of emissions trading for buildings, EED on heat planning and Ecodesign requirements and energy labelling of heating and cooling appliances.

4.2.4 Integrate buildings into decarbonised and digitalised energy systems.

This specific objective targets key enabling conditions to address the second key problem of putting building decarbonisation efforts on the right trajectory towards climate neutrality, as buildings today are not technically fit for the energy transition and for increased renewables deployment. However, this objective also addresses the first key problem and the need to step up energy renovations towards 2030, in particular with regard to the increased benchmarks for RES uptake in buildings as well as the benefits to energy performance through a deeper integration of buildings into a digitalised energy system.

The expected increase in the integration of renewable energy needed to achieve energy and climate goals and pave the way to carbon neutrality will require buildings fit for renewables with high thermal integrity and modern technical building systems. Given that part of the renewable energy will come from intermittent sources, buildings should also be able to provide flexibility and play an active part in the energy system by integrating storage and demand response/management services into the grid thanks to the smartness of their technical building systems. The more flexibility that buildings can offer to 'serve the energy infrastructure system' (mainly the power system) through storage, own power production and connected EVs, the more valuable they will be in the future energy system.

Under this objective, the EPBD revision aims to further modernise buildings and their systems (for heating, cooling, ventilation, renewables, flexibility and storage) across their whole lifetime, with digitalisation as the key enabler. In this regard, policy measures and options will explore the possibility to ensure building preparedness and to strengthen and improve the integration of the smart readiness indicator with new tools like digital logbooks and building renovation passports, in synergy with the forthcoming Digitalisation of Energy Action Plan[76].

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[75] By taking into account in the design of the building the likely evolution of local climate conditions and their possible effects on energy performance and the building's physical integrity during the estimated lifetime of the building.

[76] Action plan on the digitalisation of the energy sector – roadmap launched | European Commission (europa.eu)

Another specific aspect to address under this objective is the problem of lack of charging points in residential and work parking spaces and administrative barriers for the owners of electric vehicles that need access to charging points. According to stakeholders, there is a need to strengthen the existing provisions on e-mobility, in particular for new buildings, and to introduce a 'right to plug' in multi-dwelling buildings. From this perspective, specific policy measures and options are proposed to ensure that new and existing buildings are being prepared for the introduction of e-vehicles and introduce the 'right to plug'. This will also complement the requirements on the deployment of publicly accessible infrastructure in the Alternative Fuels Infrastructure Regulation and is closely linked to the recast Renewable Energy Directive.

4.3 Intervention logic

The intervention logic to the EPBD revision is developed in Chapter 2 – Problem definition, Chapter 4 – Objectives, and Chapter 5 – Policy options. The three chapters are developed in a coherent and interlinked way feeding one into another – from the identification of key problems and problem drivers, general objectives and specific objectives, to policy areas of interventions and policy options. At the beginning of Annex E, the overall intervention logic, from problem drivers to policy options, is presented in a dedicated figure.

5. What are the available policy options?

5.1 What is the baseline from which options are assessed?

5.1.1 The baseline for assessment

All the 'Fit for 55' initiatives share a common baseline, the EU Reference Scenario 2020 (REF). It is the common starting point for energy system modelling in the respective impact assessments for all the proposals adopted in July 2021[77].

The EU Reference Scenario 2020 reflects current and planned policies, notably as stated in Member States' national energy and climate plans, and takes account of COVID-19 impacts. It models the policies already adopted, but not the target of net-zero emissions by 2050. As a result, there are no additional policies driving decarbonisation after 2030. The same baseline approach is followed in this impact assessment and the key parameters

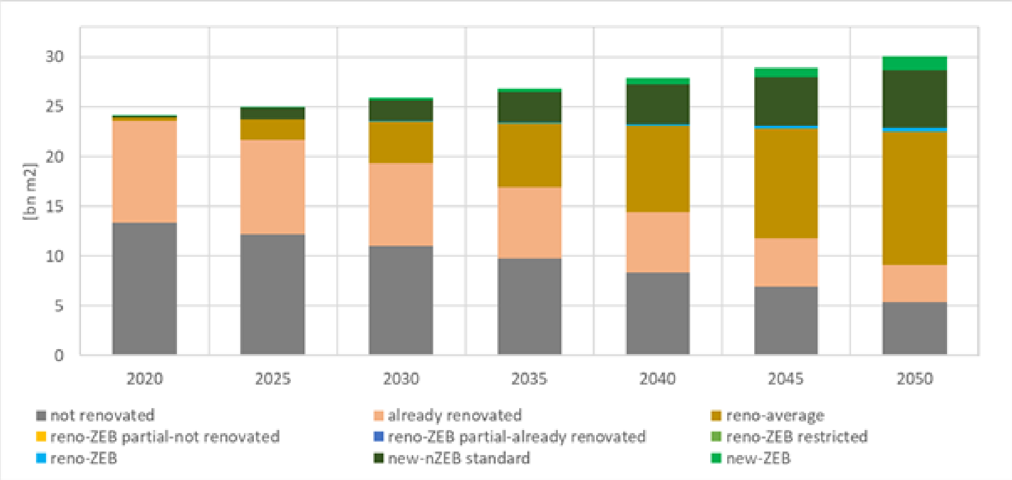
[77] Details can be found in the respective Impact Assessments, for example Annex D of the Impact Assessment Report Accompanying the document "Proposal for a Directive of the European Parliament and of the Council amending Directive 2012/27/EU on energy efficiency". Furthermore, a separate publication dedicated to the Reference scenario contains complete information about preparation process, assumptions and results: EU Reference Scenario 2020 | Energy (europa.eu).

used are aligned to REF. From a methodological point of view, this ensures coherence across the 'Fit for 55' initiatives[78].

The effects of the legislative proposal adopted by the Commission in the July 2021 'Fit for 55' package are therefore not included in the baseline for this impact assessment. The impacts of the revised EED, RED II, AFIR, ESR and of the introduction of a separate ETS on heating in buildings are assessed from the point of view of coherence and complementarity, in particularly in section 7.2.

In addition, the interplay between the 'Fit for 55' proposals is modelled by specific policy scenarios. This is done by the central policy scenario (MIX) and by a dedicated scenario (MIX-without-EPBD) which with a certain level of approximation disentangle the EPBD policy drivers (See section 6.2).

Figure 5.1: Floor area development in billion m², renovation and new construction levels, EU, Baseline Scenario (BSL)[79]



Source: Guidehouse et al.

The specific baseline used in this impact assessment focuses on the buildings stock only (and not to the overall energy system) and the impacts of the policy options are assessed

[78] Differently, the 'Gas decarbonisation package' which is also part of 'Fit for 55' follows a different approach and includes the expected impacts of the proposals adopted in July 2021 in the baseline of its impact assessment. For this reason, it adopts the MIX scenario as a starting point/baseline. The "Gas decarbonisation package" proposal focuses on policies related to infrastructure solutions, which are not dependent from the policy choices related to the policy mix driving energy demand for decarbonised fuels. In addition, the "Gas decarbonisation package" is not expected to have in itself impacts on the size of energy demand. The policy options under in the "Gas decarbonisation package" and their relations with the MIX and REF scenario are therefore fundamentally different from those in the EPBD revision.

[79] Source: Guidehouse et al. (2021). In this impact assessment, this reference identifies the following study, to be published: Technical assistance for policy development and implementation on buildings policy and renovation. Support for the ex-ante impact assessment and revision of Directive 2010/31/EU on energy performance of buildings Service request 2020/28 – ENER/CV/FV2020-608/07; DG Climate Action CLIMA.A4/FRA/2019/0011.

bottom-up. Given the long lifecycle of buildings, to illustrate the expected evolution of its energy performance and overall consumption, and the consequent CO_2 emissions, it is therefore important to look at the renovation of floor area over time. Figure 5.1 illustrates the expected renovation of the EU floor area (both residential and non-residential buildings) in the coming decades based on current policies and technology trends.

Approximately 80% of the 2050 building stock already exists today. Thanks to existing policies, technological drive and autonomous trends, the floor area renovated will slightly but progressively increase in the coming decades. It is estimated that more than half the existing building stock (13.3 billion m^2 out of a total of 24 billion m^2) has not been renovated since construction, while the remaining part has been renovated to a certain extent. The figure above shows that at current renovation levels the non-renovated share will progressively decrease. However, in 2050 about 40% of the stock will still remain in its original state, while in 2030 and 2050 respectively 17.6% and up to 60% of the stock will be subject to renovation to average levels, locking-in a significant amount of potential energy and emissions savings that could be achieved with higher rates of renovation.

The development of the EU floor area also illustrates that new construction more than compensate for demolition by 2050. In line with current renovation rates and trends, it also shows that most energy renovations are shallow ('reno-average') while deeper renovations (e.g. 'reno-ZEB') happen at a much lower rate. It is also assumed that until 2050 a small share of new buildings will go beyond the current NZEB standard[80]. Without accounting for new builds, in the baseline scenario the total final energy consumption of the building stock will decrease by 1.4%-1.7% every year[81] in the coming decades.

5.2 Description of the policy options

Based on existing studies, on the inputs from stakeholders and on internal analysis, a range of policy options and measures were screened to respond to the problems identified. The selection of options also builds on the analysis and stakeholder consultation made in preparation of the Renovation Wave strategy, which already identified key policy measures to be considered in the revision of the EPBD.

The measures identified were examined in detail and various options for their design were considered. Stakeholders were consulted specifically on each area and the available information was examined. The options are grouped into three areas (A, B, C)

[80] The energy performance associated to the different renovation types (e.g. 'reno-average', 'reno-ZEB') is described in Annex D.

[81] New buildings constructed between 2020 and 2050 are not included in this figure. Therefore, the total final energy consumption of the building stock would in reality be slightly higher.

responding to the specific objectives as described in Chapter 4 and addressing specific barriers identified in Chapter 2. The above figure visualises which are the policy measures contributing to each of the specific objectives identified.

Figure 5.2: Overview of objectives and policy options

Area A. Measures to increase the number of buildings being renovated and renovation depth.

Area A is at the core of the EPBD revision and contributes to the main objective of reducing buildings' greenhouse gas emissions and final energy consumption by 2030, to a level commensurate with the CTP goals. As regards the specific objectives of this initiative, the measures proposed in Area A aim at an increase of the number of buildings being renovated, especially those with a very low energy performance.

In relation to the problems identified in Chapter 2, area A addresses the first key-problem which is that the EPBD framework is insufficient to the achievement of the 2030 climate objectives and lacks measures to address the non-economic barriers limiting energy renovations. The underlying problem drivers are illustrated in the below table.

Table 5.1: Problems drivers addressed by the measures in Area A.

Problem drivers/barriers	MEP	BRPS	EPCQ	DEEP	LTRS

	S				
Split incentives	++				
Public financial support not sufficiently targeted toward deep renovations	+	+		++	+
Lack of information on energy performance of buildings and multiple benefits of energy renovations			+	+	
Lack of well-communicated decarbonisation trajectory	+				+
Lack of standardised information tools on energy performance			+		
Behavioural barriers	++	+	+		
Lack of standards and requirements for new and existing buildings in line with decarbonisation goal		+		+	
Insufficient measures to facilitate the integration of digitalisation and smart solutions in new construction and building renovations		+			
Insufficient measures to support the uptake of electromobility in private buildings					

This area addresses as well the second specific objective of the EPBD revision, which is to improve information on energy performance and sustainability of buildings with the use of digital tools. It contributes in particular to the improvement of the quality and comparability of information tools on energy performance of buildings across the EU. Respondents to the open public consultation have shown a key interest in strengthening some of the EPBD tools and provision under this policy area. In particular, 75% of respondents supported the introduction of minimum energy performance standards (MEPS) for buildings in the revision of the EPBD[82], 68% were in favour of the introduction of a legal definition of "deep renovation", and 89% confirmed the need to strengthen the monitoring of the objectives identified in the Long-Term Renovation Strategies. Some stakeholders have spoken against the introduction of MEPS, arguing that their set up should be handled at Member State level. They also stated that Member States are still implementing the Clean Energy Package and that excessive regulation should be avoided. Rather, indicative guidance should be provided with technical and financial support. The large majority however expressed the need for a EU framework giving sufficient flexibility to Member States to adapt to local conditions. Few respondents indicate that the MEPS would not be necessary if the EU ETS is extended to the building sector. Few also consider that such minimum requirements will have a too strong impact on property rights that cannot be justified even in light of the need to act against climate change.

[82] The view of stakeholders on MEPS, collected in the different consultation activities supporting the EPBD revision is presented in Annex G.

The measures in area A are:

- *A.1 Minimum energy performance standards (MEPS): MEPS1, MEPS2, MEPS3, MEPS4*
- *A.2 Buildings renovation passport (BRP): BRP1, BRP2, BRP3*
- *A.3 Energy performance certificates (EPCs) – strengthening quality and comparability: EPCQ1, EPCQ2, EPCQ3*
- *A.4 Deep renovation standard: DEEP1, DEEP2*
- *A.5 Long Term Renovation Strategies (LTRS): LTRS1, LTRS2, LTRS3*

A.1 Minimum energy performance standards (MEPS)

MEPS are addressing the first key problem related to the non-economic barriers limiting energy renovations, in particular the split of incentives, the lack of a well-communicated decarbonisation trajectory and behavioural barriers leading to market failures. MEPS are policy instruments which require buildings to be renovated and improved to meet a specified energy performance standard at a chosen trigger point or date and can include standards that tighten over time. As such, MEPS drive an increase of rate of renovations which is necessary according to the analysis underpinning the CTP in order to reduce GHG in buildings by around 60% by 2030 as compared to 2015.

MEPS are already in use both in the EU and worldwide. The experiences from France, Belgium, Netherlands, Germany, Greece, England, Wales, and Scotland have been examined to identify the best policy design and success factors. Examples from regions where MEPS have been rolled out show that MEPS contribute to improved energy standards across the targeted stock and that high levels of compliance can be achieved if MEPS are accompanied by adequate enforcement framework and a policy-signalling effect on the markets. MEPS are also effective in addressing one of the most critical barriers to energy renovations, which is the split of incentives and benefits to renovations occurring for buildings which are rented and not owner-occupied. A detailed overview of MEPS applications is available in Annex F.

The set of options identified build on the success factors and lessons from the existing MEPS. The key criteria taken into account are also the consistency with the current EPBD architecture, to maximise the synergy with its existing tools to increase effectiveness, while respecting subsidiarity. As regards subsidiarity, the options identified distinguish between MEPS based on a common EU framework, MEPS based on national plans and voluntary MEPS.

Several designs are possible, as illustrated by the varied experiences worldwide. The modulation of options has been made on the basis of the following three key design features: (a) identification of targeted buildings, (b) metric of the energy performance standard, and (c) trigger point for the implementation of MEPS. Each design feature can be modulated in a way to match increasing ambition levels.

By combining the above design criteria and features, the following specific options were identified. In **MEPS1** the standards are established at EU level but they will only cover limited amount of buildings, to ensure minimum common efforts. The trigger point is the moment of transaction of the buildings (rented or sold). Buildings will be bought or rented only under the condition to achieve an energy performance at a level at least equivalent to a certain EPC class, or subject to an upgrade of their energy performance within a certain time span. The minimum EPC class (expressed as primary energy demand and measured in kWh/(m^2·y)) to be applied for buildings transactions will be progressively increased, for instance from class E in 2027 to Class D in 2030 and Class C in 2033, following a trajectory compatible to the long-term goal of decarbonisation of the building stock. This option can be implemented by specific requirements in the EPBD, to be based on national EPC schemes which are already in place in all MSs but which would have to be updated to ensure that similar efforts are made across the EU, while taking into account national and regional specificities. While specific compliance measures will be necessary, enforcement will be supported and facilitated by the provisions already existing in the current EPBD, as EPCs are already required for every building transaction. MEPS1 should also include specific exemptions for buildings for which energy renovations are subject to certain technical constraints. As the targeted buildings under MEPS1 will only cover a limited fraction of the EU building stock, MSs could decide to apply MEPS to the rest of the building stock, on a voluntary basis.

Under options **MEPS2** and **MEPS3** MSs are allowed more flexibility in setting minimum energy performance standards in comparison to MEPS1, both as regards the trigger points and the type of buildings or building segment to be affected. In MEPS2 and MEPS3 there are no measures established at EU level, and MEPS are instead to be established at national level. The national MEPS schemes will have to follow a trajectory in line with the transformation of the national building stock into zero-emission buildings by 2050. Flexibility will be left to Member States to set locally relevant standards and to best adapt MEPS to national or local specificities in terms of buildings ages, specific ownership structure and climatic conditions. MEPS will have to be designed based on the national milestones and goals set by MSs in their LTRS, and contribute to their achievement. Specific national criteria could be set up also to allow that MEPS are framed to address indoor air quality concerns, so to target the buildings types with poor energy performance, which affects the health and well-being of people. MEPS2 and MEPS3 differ for the targeted buildings, as in MEPS3 only non-residential buildings will be affected (public buildings, offices, hotels, etc.), while under MEPS2 standards apply progressively to the entire building stock. MEPS will have to be designed to complement (where existing) the national schemes providing incentives to renovation such as tax exemptions or fiscal and financial measures. Additional provisions which could support national MEPS relate to addressing the barriers to renovation in multi-family buildings, for example by removing unanimity requirements in co-ownership structures, or allowing co-ownership structures to be direct recipients of financial support.

Differently from the other options which foresee that the metric for MEPS is the overall building energy performance based on the EPC class, **MEPS4** has a narrower scope as it is based instead on the performance of the heating and cooling appliances installed in the building or building unit. The trigger point of application is their planned replacement, which could be done only with appliances which are best in class based on their energy label or based on carbon emission performance levels. This option can be implemented by specific requirements in the EPBD, building on the existing provisions on technical building systems under Article 8. Compliance can be ensured via the inspections mechanisms already foreseen. Generally, the replacement of the heating and/or cooling appliances alone without a combination of improvements to the thermal integrity of the building can lead to suboptimal results and lock-in effect that cannot guarantee that a building is renovated over time in a way to become '2050 ready'. To avoid lock-ins and suboptimal choices resulting from the implementation of this option, the planning of a staged renovation with the support of a building renovation passport could be envisaged.

The options identified are not alternative to each other but can be combined to increase impacts and effectiveness. The advantages of combining options are discussed in Chapter 6.1. Aspects of technical feasibility and exemptions to be applied are to be provided for each of the options, and can build on the exclusions already identified in the EPBD for the implementation of minimum energy performance requirements[83]. Specific measures and a more targeted set of accompanying measures, could also be established for multi-ownership and multi-apartment buildings.

All options will only be acceptable and successful if specific financial instruments (such as energy efficiency mortgages) and funding schemes are made available to support the affected building owners (in particular low-income households), which would face increased investments costs upfront, while the reward in terms of lower energy bills and other benefits will be spread along a longer period[84]. This aspect has been clearly underlined by stakeholders, which indicated that targeted financial support for low to middle-incomes households coupled with minimum energy performance standards are the main areas where to focus to address energy poverty. In connection with MEPS, some stakeholders also highlighted the need to respect cultural heritage in buildings as part of the cultural heritage of the EU and the higher costs of their renovation.

A.2 Buildings renovation passport (BRP)

BRPs are stepwise roadmaps with renovation measures tailored to individual buildings, typically with a 15-20-year timeline[85]. BRPs are being implemented already in some

[83] In article 4(2) of the EPBD, specific exemptions to the application of minimum energy performance requirements are foreseen.
[84] Bertoldi, P, Economidou, M, Palermo, V, Boza-Kiss, B, Todeschi, V. How to finance energy renovation of residential buildings: Review of current and emerging financing instruments in the EU. WIREs Energy Environ. 2021; 10:e384. https://doi.org/10.1002/wene.384
[85] BPIE (2018).

countries or regions[86] and are already mentioned as optional tools in Article 2a(1)(c) of the EPBD.

Achieving a successful deep renovation requires expertise and careful detailing of the renovation measures, especially when it is achieved in several stages. The BRP can facilitate this by providing a tailored renovation roadmap for a specific building, which can be carried out in one stage or multiple steps over several years, thus helping owners and investors to better align renovation according to, on one hand, short-term individual needs and financial availability and, on other hand, long-term requirements[87]. The majority of the respondents to the public consultation recognised the need to establish this new tool, and to favour its development through guidance, best practices exchanges and funding to develop the appropriate framework.

The feasibility study on the possible introduction of a European BRPs pursuant to Article 19a EPBD concluded that 'existing Building Renovation Passports have proven that the instrument is effective in providing renovation advice taking into account the long-term vision for the building stock. It influences the renovation rate (number of energy renovations), renovation depth (scope of the renovation and energy savings to be achieved), the timing of the works (building owners with a BRP tend to renovate earlier than they previously planned) and the quality of the works (fewer mistakes and unwise renovation decisions)[88].

On the basis of the lessons learnt from existing experiences, and of the preferences expressed by stakeholders, the following three options have been identified. **BRP1** reflects the possibility to introduce a voluntary framework for BRPs in the EPBD, to be implemented in subsequent steps, mirroring the gradual process involving industry and other stakeholders which has led to the development of the Smart Readiness indicator. Under BRP1 the national implementation of BRP is voluntary, interested actors develop their BRP product autonomously on the basis of the common EU framework, and its deployment is led by market conditions. In **BRP2** MSs are required to set up a national common framework for BRPs, which nonetheless remains an optional tool. The use of the BRP becomes mandatory for financial incentives for staged deep renovations in **BRP3**, which is the most ambitious option.

The building renovation passport will be digital, issued by a qualified and accredited expert, following an on-site visit. It will comprise a renovation roadmap indicating a sequence of renovation steps building upon each other, with the objective to transform

[86] Known implemented BRPs are the Flemish Energy Performance Certificate [Belgium], the local Energy House Passport [France] and private Energy Efficiency Passport [France], the Individual Renovation Plan [Germany], as well as pilots tested in the iBRoad project (with pilots in Poland, Portugal, Germany, Bulgaria and stakeholder engagement in Greece, Romania and Austria). Ireland is piloting a building renovation passport, based on the iBRoad model.

[87] Fabbri, M et al. (2020). "Final report – Technical study on the possible introduction of optional building renovation passports". European Commission. (Available: Online)

[88] Ibidem.

the building into a zero-emission building by 2050 at the latest. It will have to indicate the expected benefits in terms of energy savings, the impact on energy bills and greenhouse emission reductions as well as wider benefits related to health and comfort. It will contain information about potential financial and technical support. The requirement to have a BRP on the basis of which to renovate buildings can either apply to specific building types, or to trigger points, like for instance becoming a pre-condition to access certain funding instruments.

Independent control systems for the building renovation passports will have to be established, and the EPC should indicate if a building renovation passport is available for the building.

A.3 Energy performance certificates (EPCs) – strengthening quality and comparability

Energy performance certificates (EPCs) are a well-established instrument under the EPBD[89]. Their purpose is to provide information on a building's energy performance status and to offer suggestions for cost-effective improvements. On an aggregate level, they offer information about the performance of the building stock.

The strengthening of the EPC framework in the EPBD revision pursues different goals, and options linked to these goals are therefore presented separately in this impact assessment. Under *Area A* the options to improve **quality and reliability** are presented, as those are considered to be instrumental to support and facilitate a successful roll-out of MEPS.

Options **EPCQ1** and **EPCQ2** foresee the introduction in the EPBD of a common and digital template for EPCs (voluntary or mandatory). The standardisation of EPCs will facilitate its acceptability and recognition by users, and the harmonisation of this tool could also be deepened to its content and to the calculations to be applied while compiling EPCs. Options **EPCQ1** and **EPCQ2** differ from **EPCQ3** as regards the modality to pursue the goal of establishing more homogeneous rating of buildings across countries. While in **EPCQ1** and **EPCQ2** benchmarks to facilitate the harmonisation of energy performance classes across MSs remain voluntary, in the most ambitious option **EPCQ3** MSs are required to harmonize to a greater degree, by establishing the highest and lowest classes of energy performance and ensuring an even distribution of energy performance indicators among the classes. The EPC 'class A' will correspond to zero-emission buildings and the letter G will correspond to a certain percentage of the worst-performing buildings in the national building stock. Other important routes to ensure that EPCs become more reliable relate to the conditions under which EPCs are issued and to the ex-post quality controls in place. Those are made more stringent in option **EPCQ3**. Reporting measures could enhance the transparency, credibility and reliability attributed

[89] See Annex G for an overview of the current implementation of EPC across Europe.

to EPCs, by requiring that certain information is regularly disclosed to the general public (in respect of GDPR rules) and to the European Commission.

According to the public consultation, 65% of respondents consider that EPCs need to be updated and their quality needs to be improved. The suggested areas for improvement include requiring on-site visits, use of metered data, improved quality control schemes and training of experts. The value of site visits is recognised in inspection schemes, such as the inspection schemes in-line with Articles 14 and 15 of the EPBD. This is due mainly to the feasibility to produce more detailed and better tailored recommendations which fit to the actual situation in the building. Site-visits and inspections also allow the evaluation of elements such as the state of the installations, indoor air quality or indoor environmental quality. These elements are otherwise difficult to evaluate through indirect means, unless it is through more developed monitoring systems, such as those found in Building Automation and Control Systems. Finally, the direct contact with the expert is also valued as it increases the perception of quality and reliability. A better integration between EPCs and inspection would provide additional benefits.

76% of respondents think that harmonisation of EPCs is needed to accelerate the increase of building performance: 46% indicate that this can be achieved by introducing a common template, while 15% think that harmonisation is not needed. In particular, stakeholders suggest that harmonisation of EPCs is needed in terms of calculation methodology, scope, quality and availability of information and implementation process, while ensuring sufficient flexibility to cater for each Member State’s specificities, to adapt to local circumstances, to ensure reliability and allow for MSs to be more ambitious.

In the open public consultation, stakeholders have also pointed out the very relevant role of EPCs in linking targeted financing to deeper renovations, by underlining that EPCs are the key tool to assess energy efficiency improvements for financing purposes.

A.4 Deep renovation standard

As stated in the Renovation Wave strategy, the introduction of a ‘deep renovation’ standard will “enable anchoring significant private and public financing to transparent, measurable and genuinely “green” investments”. Such a standard, or definition, can help creating an enabling framework for deep renovations that are currently not cost-effective from a purely financial perspective, by providing clarity to investors and authorities in charge of designing incentives and funding schemes about the type of interventions that can be qualified as deep. The Taxonomy delegated act has defined requirements for building renovation and individual renovation measures to be considered sustainable[90]; investors may decide to tie financial support for building renovation to Taxonomy

[90] A building renovation is taxonomy-compliant if it leads to 30% energy savings or complies with minimum energy performance requirements.

compliance. A deep renovation standard could go beyond the Taxonomy requirements and set a "gold standard" for building renovation that is fully compliant with the path to zero-emission buildings; compliance with the deep renovation standard could give access to additional financing beyond standard financial support.

Today, "deep renovation" is commonly understood as achieving 60% energy savings[91], disregarding the starting point of the renovation and the standard to be reached. With a view to the need for all buildings to be fully decarbonised by 2050 at the latest, the new deep renovation standard will set the attainment of the new zero-emissions building standard (see chapter 5, section B.1) as the goal to be achieved, however not counting shallow renovations leading to this result.

Deep renovation is not always achievable in one go, due to high upfront costs and the extent of the required works; however, a first step of a staged renovation is a better measure towards decarbonisation of a building than a complete renovation to lower standards[92]. The deep renovation standard should therefore also define "staged deep renovation", for example as a series of renovation measures set out in the Building Renovation Passport which achieve the zero-emission building standard over a certain number of years. Option **DEEP1** provides for the introduction in the EPBD of a standard for deep renovation, including staged deep renovation, which transforms a building into a zero-emission building. In **DEEP2**, Member States are required to provide a higher level of financial support for building renovation which complies with the deep renovation standard than for building renovation which does not.

The 68% of the respondents to the public consultation identified the need to develop a legal definition for "deep renovation" that takes into account wider environmental, social and health aspects, by including embodied GHG emissions, as well as accessibility, air quality and climate resilience considerations. A few of the stakeholders expressed the need to see the seismic risk taken into account in the regions around the Mediterranean.

A.5 LTRS – Long Term Renovation Strategies

Under the EPBD (Article 2a), all EU countries are required to submit to the Commission a Long-Term Renovation Strategy (LTRS) outlining clear plans to support the renovation of their national building stock into a highly energy-efficient and decarbonised building stock by 2050. The framework for the establishment of long-term buildings renovation strategies in the EPBD was put in place before the commitment to carbon neutrality by 2050 and to the reduction of GHG by 55% by 2030. Therefore, to be aligned with higher climate ambition, to support the need to increase the rate of renovations, under **LTRS1** the cycle to prepare LTRS is shortened to 5 years, and in addition to that in **LTRS2** a

[91] See 2019 Commission Recommendation on Building Renovation (EU) 2019/786.

[92] For example, the thick insulation of one façade, to be followed by similarly thick insulations of other façades, is a more desirable renovation than a thinner, simultaneous insulation of all façades which precludes additional insulation layers in the future.

specific monitoring and reporting framework is established, taking advantage of what is already in place for NECPs under the Governance Regulation. In **LTRS3** the requirements are enlarged, including the reporting of the deployment of renewable energies in buildings and operational greenhouse gas emissions and goals. Carbon metrics, covering the whole life cycle of buildings[93] are necessary for achieving zero-emission buildings and climate goals, in addition to operational energy performance metrics and the LTRS shall include an overview of policies and measures for the reduction of whole life-cycle greenhouse gas emissions in the construction, renovation, operation and end of life of buildings. The LTRS would then evolve into a more operational plan, to be renamed "Building Renovation Plan", which shall include a detailed overview of national building sectors, establishment of specific targets, presentation of existing and planned measures to achieve the targets and specific monitoring and reporting framework on the cost-effective use of Union and national financings, leverage of private financing and use of financial instruments, in order to better direct and align spending to achieve the long-term goals set out[94].

The policy options for LTRS are in line with the findings of the open public consultations, where 61% of the respondents identified the need to amend the existing provisions in the EPBD on lTRS. In particular, 89% of the overall respondents underlined that the European Commission should strengthen the monitoring mechanism of the objectives identified by the Member States in their LTRS. The majority of the respondents in this regards pointed to the development of a common template with a monitoring framework requesting specific data and indicators.

Area B. Measures to enable the decarbonisation of new and existing buildings

This area of action is mainly targeting the second key problem identified that the EPBD framework is insufficient for the 2050 climate objectives and to foster energy system integration. The policy options therefore address the underlying problem driver of a lack of standards and requirements for new and existing buildings in line with decarbonisation goals. In addition, the policy options are aimed at providing a long-term vision for buildings in line with climate neutrality in 2050. The measures in Area B also address the need to improve information on energy performance and sustainability of buildings with the use of digital tools.

The options have been developed to upgrade the existing EPBD tools in line with increased climate ambition, so to ensure that existing standards and information tools would provide clear information about the carbon emission performance of the building and adequately inform the public about the measures to decarbonise them. The following table illustrates the main problem drivers addressed by the policy measures in this area.

[93] From production and transport of materials, the construction, to the demolition/reuse.

[94] This is in line with specific recommendations from the European Court of Auditors, Special Report 2020 "Energy efficiency in buildings: greater focus on cost-effectiveness still needed", https://www.eca.europa.eu/Lists/ECADocuments/SR20_11/SR_Energy_efficiency_in_buildings_EN.pdf .

Table 5.2: Problems' drivers addressed by the measures in Area B.

Problem drivers/barriers	**ZEB**	**EPCI**
Split incentives		
Public financial support not sufficiently targeted toward deep renovations		+
Lack of information on energy performance of buildings and multiple benefits of energy renovations		+
Lack of well-communicated decarbonisation trajectory	+	
Lack of standardised information tools on energy performance		+
Behavioural barrier	+	
Lack of standards and requirements for new and existing buildings in line with decarbonisation goal	++	
Insufficient measures to facilitate the integration of digitalisation and smart solutions in new construction and building renovations	+	+
Insufficient measures to support the uptake of electro mobility in private buildings		

As indicated by stakeholders and in line with the energy efficiency first principle, while an operational carbon metric should become integral part of the EPBD, it should not prevail but rather be considered a complementary one going hand in hand with indicators for energy efficiency and integration of renewable energies. In addition to reducing operational carbon, there is also a need to address carbon emissions over the full life-cycle of a building which is why a calculation and disclosure of life cycle carbon emissions is proposed in some of the options for new construction, with a link to the EPC of the building.

As regards standards for new buildings, Article 9 of the EPBD states that Member States shall ensure that new buildings occupied and owned by public authorities are NZEBs[95] (Nearly Zero-Energy Buildings) after 31 December 2018 and that all new buildings are NZEBs after 31 December 2020. The EU legislative framework for buildings requires EU Member States to adopt their detailed national application of the EPBD definition on

[95] In accordance with the EPBD, a NZEB is a building that "has a very high energy performance with the nearly zero or very low amount of energy required covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby". The first part of this framework definition establishes energy performance as the defining element that makes a building an 'NZEB'. This energy performance has to be very high and determined in accordance with Annex I of the Directive. The second part of the definition provides guiding principles to achieve this very high energy performance by covering the resulting low amount of energy to a very significant extent by energy from renewable sources.

NZEB[96], supported by national policies for their implementation, which has led to the integration of the NZEB concept into national building codes and international standards. The legislative framework for NZEB was established in 2010, and the current NZEB definition does not ensure that buildings constructed today are '2050 ready', and that they could benefit from the already existing cost-efficient technologies that enable buildings to be zero-emission. While the implementation of NZEBs from 2021 (and 2019 for public buildings) onwards represented one big opportunity to increase energy savings and minimise greenhouse gas emissions, such definition is not anymore aligned with increased climate ambition. A more modern vision for new and deeply renovated buildings will have to include aspects related to green-house gas emissions related to the energy system services such as RES production, flexibility and storage and whole life carbon. In addition, other aspects could be addressed by Member States, such as climate resilience, seismic safety, fire safety and aspects of indoor air quality for new and renovated buildings. On the latter, several stakeholders called for higher ambition for health protection in buildings.

Another important set of measures relate to the introduction of a mandatory carbon metric for operational carbon in EPCs, as although some MSs have already implemented it[97], this is currently not a required element for EPCs. A visible indication of carbon emissions would raise awareness, create a positive dynamic in the markets of construction and renovations across its value chains, and drive informed decisions by all operators involved in the purchase or renting properties. In the options corresponding to higher ambition, the EPC will include a mandatory operational carbon metric, and if a calculation of whole life carbon has been made for the building it will also be mandatory to include it in the EPC.

<u>The measures in Area B are:</u>

- *B.1 Introduction of a definition of "zero-emission buildings"(ZEB): ZEB1, ZEB2, ZEB3*
- *B.2 EPCs - Increase the scope of information and coverage of EPC:EPCSI1, EPCSI2, EPCSI3*

B.1 Introduction of a definition of "zero-emission building".

The concept of (net) zero greenhouse gas (GHG)/carbon emission(s) buildings is gaining wide international attention and is considered to be the main pathway for achieving climate neutrality targets in the built environment. A 'zero-emission building' standard should ultimately aim at maximising the efficient and smart use of energy, materials and space. Different terms and definitions can however be used, therefore the first step which

[96] The implementation of NZEBs is connected to the assessment of cost optimality and high performance technical solutions in buildings.
[97] 16 MS have already introduced carbon metrics in EPCs (mostly voluntary).

has been considered is the establishment of a sound technical qualitative definition to be introduced in the EPBD, to be applicable to new buildings and based on key criteria which contribute at the same time to achieve high energy efficiency, to limit or neutralise GHG emissions and to contribute to energy system integration (i.e addressing flexibility and storage which will be crucial for new constructions). These aspects have been examined in detail and the available approaches to define and operationalise the “zero emission” concept to buildings are presented in Annex H.

Among the available approaches, the following have been retained: A zero emission building shall be defined as a building that has a very high energy performance that complies with specific benchmarks. The very low amount of energy still required has to be fully covered by energy from renewable sources.

The approaches and timeline to its gradual phase-in have been examined and different options have been identified. **ZEB1**, **ZEB2** and **ZEB3** differ as regards the degree of harmonisation and level of flexibility in adapting the ZEB standard to national and local specific conditions. The scope of GHG emissions considered is also different, with ZEB1 and ZEB covering only operational carbon emissions while in ZEB3 also embodied emissions are considered.

While in **ZEB1** an approach similar to what the EPBD had established in 2010 for NZEBs is followed, in **ZEB2** numerical benchmarks or thresholds are established at EU level, thus guaranteeing a more standardised definition and easing compliance. In **ZEB3** the qualitative zero-emission definition includes further criteria introducing the consideration of whole life-cycle emissions. The aspiration is to introduce the consideration of whole life-cycle assessment of GHG emissions into building design and construction, by requiring their accounting and reporting for new buildings. This first step would increase awareness and the available data on whole life cycle emissions, provide an incentive to circular solutions and to the use of recycled materials, and pave the way for the development of further policies in the field.

B.2 EPCs - Increase the scope of information and coverage of EPC

Alongside the measures needed to improve quality and reliability of EPCs under Area A, here options to (i) enlarge the scope of the information to be presented in each certificate and (ii) to extend the overall use and coverage of EPCs are described.

Currently EPCs must be issued for all buildings or building units which are sold, or rented out to a new tenant. Public buildings above a certain size also need to display EPCs. According to the available data, only a limited share of buildings have an EPC. Most building owners and occupants are therefore not aware of the building’s energy performance and of the measures which could be undertaken to improve it. To increase the number of buildings having an EPC, the options **EPCSI1-EPCSI3** foresee that additional buildings must have an EPC, with a varying degree of coverage for instance linked to specific trigger points (renewal of rental contracts, renovation[98], access to public fund, or replacement of a heating installation or another technical building system or building elements, e.g. windows). Another trigger to increase the information value of EPCs is to shorten its validity. The current validity period is considered by experts and stakeholders as too long, hampering the capability of EPCs to provide a valid and up-to-date representation/asset rating of the building performance.

Pursuant to Article 11 EPBD, the EPC must include the energy performance of a building (in kWh/m^2 year) and recommendations for improvement. The EPC may include additional indicators such as CO_2 emissions or the percentage of energy use from renewable sources, and such indicators are in fact already present in some national or regional schemes (see Annex G). To strengthen the information role of EPCs in driving decarbonisation, and its use in conjunction with other EPBD tools and measures, it is necessary that additional information is widely available to all EPC users. The options **EPCSI1** and **EPCSI2** address this aspect, and foresee that additional indicators are to be displayed in EPCs, with a varying degree of detail and flexibility. These options present a strong synergy with the suggested provision of a common EPC template. Key indicators to be included in EPCs relate to GHG emissions and the use of renewable energy, storage and flexibility capacity, e-charging points, the breakdown of different energy uses (e.g. heating, ventilation, lighting, etc.) or the type of systems installed and. EPCs could also indicate if a calculation of whole life-cycle greenhouse gas emissions has been made. Information in EPCs could expand also to cover technical details and information about the presence of indoor air quality sensors etc.

A key mandatory element of an EPC is the recommendations to improve the energy performance of the buildings. Stakeholders and experts indicated that this element has so far had limited value in absence of clearer fixed content. **EPCSI3** foresees that additional guidance or requirements are provided in the EPBD, allowing to quantify the estimated costs and energy savings which could be achieved by renovating the building or some of its elements, and linking those to the long-term goal of decarbonisation of the building stock. The recommendations in EPCs could also include specific assessment of the preparedness of the building technical system to the installation of highly efficient heating appliances, and could be substituted by a building renovation passport (BRP). EPC and inspections of heating and cooling systems can support the recommendations made by one another and allow for cross-checking of information and monitoring of results.

[98] Currently it is not mandatory to issue EPCs in conjunction to a major renovation. In some countries, especially in conjunction with the use of incentives schemes, it is foreseen to issue EPCs before and after the intervention, to demonstrate the impact of the energy renovation on the asset rating.

In the public consultation, stakeholders suggested to shorten the validity of the EPC and to increase the scope of information. It was also suggested that EPCs should be mandatory to access financial incentives for building renovation. As regards the scope of information in EPCs, 59% of stakeholders find it important or very important to increase the number of mandatory indicators in the EPC to include greenhouse gas emissions, generation of renewable energy, breakdown of different energy uses (i.e. heating, ventilation or lighting) or type of systems installed. Stakeholders also suggest to include information on demand-side flexibility, IEQ, EV recharging and storage among other additional indicators. As regards the recommendations, 68% of respondents suggest that the EPC should include further information on estimated costs, energy saving or cost savings, and 62% see a need for increased interoperability with other tools such as Building Renovation Passports, SRI and digital building logbooks. 55% of respondents suggest to tailor the recommendations towards deep renovations.

Area C. Measures to increase the modernisation and quality of buildings and of their systems, enabled by digitalisation of information tools

The options in Area C address the second key problem that the EPBD framework is insufficient for the 2050 climate objectives and to foster energy system integration. Area C relates specifically to the problem drivers of insufficient measures to facilitate the integration of digitalisation and smart solutions in new construction and building renovations and insufficient measures to support the uptake of e-mobility in private buildings. Therefore, options have been developed for stronger uptake of e-mobility and of smart solutions for energy management in buildings. The following table illustrates the main problem drivers addressed.

Table 5.3: Problems' drivers addressed by the measures in Area C.

Problem drivers/barriers	EM	EPCD	SRI
Split incentives	+		
Public financial support not sufficiently targeted toward deep renovations			
Lack of information on energy performance of buildings and multiple benefits of energy renovations		+	
Lack of well-communicated decarbonisation trajectory			
Lack of standardised information tools on energy performance		+	
Behavioural barriers	+		
Lack of standards and requirements for new and existing buildings in line with decarbonisation goal			+
Insufficient measures to facilitate the integration of digitalisation and smart solutions in new construction and building renovations	+		++
Insufficient measures to support the uptake of electro	++		+

mobility in private buildings			

The measures in Area C are:

- *C1. Measures to remove building-related barriers to e-mobility : EM-1, EM-2, EM-3*
- *C2. Enhance the role of EPCs as digital tools: EPCD1, EPCD2, EPCD3*
- *C3. Measures to support the implementation of SRI: SRI1, SRI2*

C1. Measures to remove building-related barriers to e-mobility

The analysis of pathways achieving a reduction of GHG by 55% in the CTP shows that electrification of transport is one of the most promising avenues for reducing the GHG emissions arising from individual mobility. The lack of easily available recharging points in private buildings can be a barrier when deciding whether to shift from a conventional car to an electric one. Providing for recharging infrastructure both in and close to buildings is therefore critical to enabling electrification of the transport sector[99].

The EPBD requires the installation of recharging points in certain parking spaces adjacent to residential and non-residential buildings and sets ducting requirements that allow for subsequent installation of recharging points in new or renovated residential buildings of a certain size (as well as for non-residential buildings), while the deployment of publicly accessible recharging points is addressed in AFID and reviewed in the AFIR proposal.

The requirements present in the EPBD since its revision in 2018 are however not fit anymore to provide a number of recharging points aligned with an increased uptake of electric vehicles, as the requirements are too low because they only cover buildings with more than 10 parking spaces. Policy option **E-M1** enlarges the scope of the current provisions to ensure preparedness to electric recharging for all new buildings and buildings undergoing major renovation, while **E-M3** extends the readiness also to the availability of parking space for bikes and strengthen the requirements for existing large non-residential buildings. To enhance the “right to plug”, **E-M2** foresees that identified administrative barriers are removed and measures are undertaken to enhance the availability of technical assistance for households wishing to install recharging points. In line with AFIR and the revised RED it is proposed that recharging points shall be capable of smart charging and if positively assessed by the regulatory authority be capable of bidirectional charging.

According to the results of the public consultation, requirements for the installation of recharging points (65%), the right to plug (for both tenants and owners) (62%) and the inclusion of provisions for recharging points for vehicles other than cars (52%) are all

[99] Velten, E.K., Stoll, T., Meinecke, L. (2019). Measures for the promotion of electric vehicles. Ecologic Institute, Berlin. Commissioned by Greenpeace e.V.

necessary. 72% of respondents think that the installation of recharging points to support smart charging is needed.

C2. Enhance the role of EPC as digital tools

There is an increasing amount of data on building energy use and building occupants' energy consumption patterns. Collecting data and making them available in a transparent way would be useful for policymaking in buildings and social policy[100], and would support the creation of innovative energy and buildings services and the reduction of administrative burden relative to permitting and other regulatory procedures. To digitalise data collection about the building stock across Europe, the key challenge is to create a framework that systematises data collection, by allowing open interfaces and the integration of data from different sources and the automation of the process with minimal manual intervention. In addition, digitalisation of data collection should ensure compliance with data protection regulation and ensure digital security.

Data from EPCs can be combined with data from other sources, such as EPBD inspections schemes, administrative tools (e.g. building cadastre or building permits), observatories (e.g. on energy poverty) and information from research initiatives. Acces to building information is generaly very limited and could be improved.

To these ends, national databases of repositories of energy performance certificates are required in option **EPCD1**, with different criteria qualifying accessibility for users and reporting functionalities in its suboptions. Option **EPCD2** identifies key linkages to the EPC database to be allowed by national rules. Option **EPCD3** requires a mandatory national database, enhancing interoperability with other data sources and facilitating administrative compliance.

In the public consultation, stakeholders stressed the need for EPCs to be digital and the importance of EPC databases. 61% of respondents found it important or very important for MSs to develop an accessible EPC database with further information on the EPC, to include benchmarks and comparison tools to allow the comparison of similar buildings. Stakeholders also highlighted the importance of providing access to data as well as promoting data exchange and sharing.

C3. Measures to support the implementation of SRI

The ongoing voluntary application of the smart-readiness-indicator (SRI), based on the existing EPBD framework[101], is a chance to enable smart readiness of buildings and use efficient operation modes for individual buildings as well as the optimal system balance

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[100] For instance for the monitoring of LTRS or MEPS implementation.
[101] https://ec.europa.eu/energy/sites/ener/files/smart_readiness_buildings_implementing_act_c2020_6929.pdf

between buildings and a renewable energy system and the transmission/distribution system[102].

To enlarge its application, the option **SRI1** foresees its integration with other information tools, while in **SRI2** its voluntary nature is revisited and SRI becomes mandatory for large non-residential buildings, in coherence with the current provisions of the EPBD on building automation and control systems. However, several stakeholders did not support that option, and suggested instead to focus on implementing SRI on a voluntary basis, and to develop links with other schemes.

5.3 Options discarded at an early stage

While the Inception Impact Assessment included the possibility to achieve the goals of the EPBD revision without regulatory measures, by means of reinforced non-regulatory policy instruments and additional guidance and support measures, such as technical assistance, information campaigns, training, project financing etc., this option was discarded at an early stage of preparation of this assessment. On the basis of the studies examining the problems underlying low renovation rates and their drivers, it was estimated that such an approach would be insufficient to remove the barriers preventing higher rates of energy renovations, or to provide trusted and comparable tools to investors. Stakeholders were also almost unanimous in recognizing the need for strengthened requirements to drive higher and deeper renovations, although not necessarily for all the supporting measures.

This is particularly the case for the development of minimum energy performance standards, and for the standards for new buildings, which requires to be enshrined in legislation to be effectively enforced. In the Renovation Wave strategy, the Commission already indicated that the strengthening of the regulatory framework would be essential to achieve the goals of doubling and deepening the rate of renovation of buildings, and indicated specific areas of reinforcement for the EPBD. Therefore, in the subsequent chapters, the package of measures included in the different options to be assessed include a mix of regulatory and non-regulatory measures[103] and no options features only non-regulatory measures.

Other measures which have not been assessed in detail include minimum energy performance standards based only on indoor air quality indicators. While such option was envisaged by some stakeholders and consideration on the indoor environment have become prominent during the COVID-19 pandemic, the appropriate indicators still have to be developed. In addition, while a very efficient house with poor air quality is not acceptable and both aspects can and normally are achieved in a complementary way,

[102] Verbeke, S.; Waide, P.; Bettgenhäuser, Kjell; Uslar, M.; Bogaert, S. (2018): Support for setting up a Smart Readiness Indicator for Buildings and related impact assessment. Final Report. vito, ECOFYS, Waide Strategic Efficiency, Offis.
[103] As for instance under BRP1 and EPCQ1.

higher environmental quality alone would not necessarily deliver also energy savings and the emissions abatement in the building sector, which is the primary aim of the EPBD revision.

The options to require that all buildings should have a BRP in place was also discarded as entailing excessive costs and BRP deliver benefits only in some circumstances.

Based on the CTP analysis and conclusions (MIX scenario, see also Annex J) and the Renovation Wave strategy, the options have been limited within the current boundaries of the EPBD.

Policy instruments and options outside the EPBD scope which could deliver higher renovation rates, e.g. through taxation or other fiscal measures, have not been assessed in preparation of this proposal. National tax-exemptions schemes and other forms of financial incentives through fiscal or non-fiscal measures, which are the competence of MSs, are fully complementary to the options proposed. Such incentives schemes will support the delivery of the ambition of the national renovation plans and will improve the affordability of the renovation investments which will be triggered and regulated via the EPBD.

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

6.1 How the measures are grouped and assessed

The assessment of the impacts of the policy options considered for the revised EPBD starts with the aggregation of the measures and sub-options identified in Chapter 5, based on the following criteria:

- The strengthening of existing measures and the introduction of new ones to address the key problems underlying the revision of the EPBD follows the logic of identifying options of a variable level of policy intensity. The intensity has been regulated either on the basis of a progressive increase in the scope of their application – to a wider number of buildings or players – or of the stringency of the requirements proposed. For MEPS, this has been obtained by adding different MEPS mechanisms with distinctive trigger points and scope, covering a higher share of worst performing buildings and of the overall building stock. The four options are sufficiently varied in scope of application and intensity to allow for a good understanding of the different impacts that they could achieve on key performance indicators.

- The measures proposed for the revision support each other within the coherent and structured policy framework of the EPBD. Synergies exist across instruments in the different areas identified. For this reason, their effects and impacts are assessed jointly across the different areas and in groups of measures.

- Given the strong synergies and mutual support as indicated above, the impacts are associated across all areas, and the measures to which the majority of impacts are associated are highlighted in bold in Table 6.1.

On this basis, beyond the baseline, we have identified four different options for the EPBD revision packaging measures, characterised by progressively higher ambition levels (from low ambition to high ambition). Options 3 and 4 both show high ambition and differ only in the combination of MEPS sub-options. This chapter presents the main environmental, economic and social impacts expected from the above four options.

Table 6.1: Groups of measures across options

Areas	Baseline	Option 1. Low ambition	Option 2 Medium ambition	Option 3 High ambition I	Option 4 High ambition II
Area A. Measures to increase the number of buildings being renovated and renovation depth	EPC LTRS	**MEPS1** BRP1 EPCQ1 DEEP1 LTRS1	**MEPS1+ MEPS3** BRP2 EPCQ2 DEEP2 LTRS2	**MEPS1+ MEPS2** BRP3 EPCQ3 DEEP2 LTRS3	**MEPS1+ MEPS2+ MEPS4** BRP3 EPCQ3 DEEP2 LTRS3
Area B. Options to enable decarbonisation of new and existing buildings	NZEB EPC	**ZEB1** EPCSI1	**ZEB2** EPCS2	**ZEB3** EPCSI3	**ZEB3** EPCSI3
Area C. Measures to increase the modernisation and quality of buildings and of their systems, enabled by digitalisation of information tools	EM EPC SRI	**E-M1** EPCD1 SRI1	**E-M2** EPCD2 SRI1	**E-M3** EPCD3 SRI2	**E-M3** EPCD3 SRI2

Before presenting such results, it is important to explain how the effects of national schemes that set minimum energy performance standards (MEPS2, MEPS3) have been modelled[104]. This also brings with it policy considerations.

For MEPS2 and MEPS3, national MEPS schemes are modelled as standards that impose a progressive renovation pathway between 2025 and 2050. Through a combination of staged and single deep renovations, Member States gradually achieve higher shares of

[104] Annex F, Section 7.1 presents additional modelling choices.

buildings renovated to high standards, close to 'zero-energy building (ZEB) levels', thereby achieving decarbonisation of building stock by 2050. This is a simplification of the different choices that national authorities could make in implementing national MEPS alongside the trajectory and criteria established in the EPBD. Based on these choices, some building segments could be targeted as a matter of priority.

Importantly, the transformation modelled is required to achieve' a decarbonised building stock in the absence of other policies, which overestimates the regulatory effort and makes the decision to renovate more costly (in the absence of other incentives). In particular, in the context of the 'Fit for 55' package, this modelling mechanism does not take into account the effects of other EU instruments, which could also trigger decisions to renovate buildings or make the economic case for it more favourable. These instruments could be regulatory ones (like Article 6 of the Energy Efficiency Directive (EED) Recast or Article 23 of the Renewable Energy Directive on binding RES heating & cooling (H&C) targets) or market-based in the form of carbon pricing or enabling condition types (like Article 8 of the EED Recast, which makes funding more easily available). From a modelling perspective, this is a conservative approach as it is likely to overestimate the renovation efforts that would need to be triggered by MEPS2 and MEPS3 and the costs for consumers. From a policy perspective, this means that what is modelled by MEPS2 and MEPS3 is a **'maximum effect'.** In reality, the impact of MEPS (and corresponding effects in terms of benefits, costs and investments) could be lower as some renovation efforts would be incentivised by other policy instruments. These will be factored into the specific design of national MEPS mechanisms. Bearing this 'maximum effort' perspective in mind is crucial in designing the national mechanisms to introduce and enforce MEPS. These should be adaptable and coherent with other policies at EU and national level.

6.2 Impacts of the EPBD revision as part of scenarios delivering the increased climate target

In addition to assessing the impact of the EPBD revision alone, as explained in Section 6.1, we also need to see how they combine with the other 'Delivering European Green Deal' (DEGD) initiatives (also referred to as the 'Fit for 55' package) and what their cumulative impact is on the energy system and the economy as a whole. This exercise was performed with the 'core scenarios'[105] REG, MIX, MIX-CP, used in the impact

[105] See the description of core scenarios here: https://ec.europa.eu/energy/data-analysis/energy-modelling/policy-scenarios-delivering-european-green-deal_en as well as Annex 4 in the impact assessment accompanying the amendment to Renewable Energy Directive SWD(2021)621 final.

assessment underpinning initiatives tabled by the Commission in July 2021[106]. The EPBD revision with these scenarios is captured[107] by the following:

- an increased rate and depth of renovations (notably of deep and medium renovations instead of only light renovations)[108];
- an increased uptake of renewable H&C solutions (notably heat pumps) accompanying renovations – heat pumps become an attractive choice for low energy consumption of a deeply renovated building;
- more stringent and better enforced standards for new buildings[109];
- enabling conditions created by legal certainty on the measures described above and additional actions such as the building renovation passport to increase consumer awareness[110].

In fact, these elements were already part of the Climate Target Plan scenarios[111] that were later fine-tuned (as concerns both the baseline and preferred policy options) in the DEGD core scenarios.

The drivers described above – increased renovations also covering H&C equipment change and better performance of new buildings – can be found in the majority of decarbonisation pathways: in the Commission's own analysis (2050 Long-Term Strategy[112]), in Intergovernmental Panel on Climate Change work[113], or in stakeholders' own analysis such as 'Net Zero by 2050' from the International Energy Agency[114]. While the intensity of these drivers and their impact vary depending mainly on whether

[106] See the 'Delivering European Green Deal' website: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

[107] Drivers capturing the EPBD revision are present in REG and MIX core scenarios, while the' MIX-CP scenario has those drivers increasing only slightly from the baseline level.

[108] Importantly, the renovations increase in MIX (compared to REF2020) is incentivised not only by drivers illustrating the revision of EPBD, but also the horizontal energy savings obligation (as in Article 8 of the proposal for a EED recast). Reflecting policy options described in Section 5, the whole increase of deep renovations (thanks to the introduction of deep renovation standards) and the partial increase of medium renovations (thanks to the introduction of MEPs and obligation to apply MEPs to buildings under transaction) is assigned to the EPBD revision. Removing these drivers would mean that some renovations do not happen and some are only light ones thanks to the operation of Article 8 of the proposal for a revised EED.

[109] Thanks to the introduction of long-term renovation strategies and the ZEB standard definition.

[110] In modelling terms, such enabling conditions translate into more frequent investment decisions as economic agents have full information about costs and benefits expected and in general perceive lower transactional costs.

[111] See impact assessment accompanying Climate Target Plan SWD(2020)176 final. All CTP scenarios except one (CPRICE scenario driven by carbon pricing) have drivers on building renovations and new building standards.

[112] In-depth analysis in support of Commission Communication COM(2018) 773.

[113] https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_Chapter2_Low_Res.pdf

[114] See: Net Zero by 2050 – A Roadmap for the Global Energy Sector, https://www.iea.org/reports/net-zero-by-2050

scenarios are constructed top-down (target-driven) or bottom-up (measures-driven), they are, in most of the scenarios, part of the toolbox and have a visible impact on reducing energy demand in the building sector and on the fuel switch. The exceptions are carbon pricing-driven scenarios. These usually show that even high levels of carbon pricing do not properly incentivise renovations of building shells in particular (due to the multiple and non-economic barriers explained in Chapter 2). They therefore require an even more significant fuel switch. This results in a lower energy renovation rate overall (see Figure 6.12 below, with the MIX CP scenario representing the scenario with greater reliance on carbon pricing) or scenarios that by design concentrate only on the fuel switch, neglecting energy efficiency and therefore have the shortcoming of showing very high demand in low-carbon energies[115]. A case in point is the 'delayed retrofit case' of the International Energy Agency[116].

Among DEGD scenarios, the central MIX scenario has ambitious drivers that effectively represent the preferred options for the revision of EPBD working in synergy with carbon pricing. On the REG scenario, it shows a further increased regulatory effort, with correspondingly higher investment expenses, also required by lower income households. Conversely, the MIX-CP scenario shows a very high carbon price (EUR 80/tCO2 in 2030 in the building and transport sectors with only a lower intensification of regulatory measures) that would translate into high energy prices for all consumers (thereby having a regressive effect if not mitigated by revenue use). The MIX-CP scenario illustrates very well that carbon pricing alone, even at higher levels, does a poor job of incentivising renovations of buildings to optimal levels (in particular their thermal envelope), as it alone cannot tackle market and non-market barriers described in the problem definition of this initiative (Figure 6.1). The economic incentives of carbon pricing and revenues raised can be used for other measures to tackle those barriers more effectively and address social impacts of carbon pricing[117].

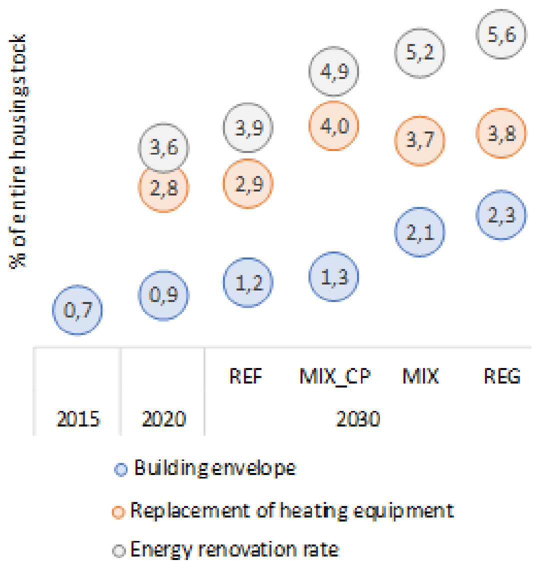
The common analysis produced for the 'Fit for 55' package provides elements that illustrate the interactions between regulatory measures targeting energy consumption in

[115] This is the case of some scenarios advocating a 100% renewables-based energy system and usually showing high demand in biomass or land (for wind or/and solar power).
[116] This scenario shows that (on the global level) a delay in reaching 2.5% of annual renovations by 2030 would require a very steep increase of renovations post-2030 (in order to reach carbon neutrality) and, even if we catch up, would cause an increase in residential space heating energy demand of 25% by 2050, in space cooling of more than 20%. This translates to a 20% increase in electricity demand, putting strain on the power sector, which would need much more low-carbon generation capacity. See: Net Zero by 2050 – A Roadmap for the Global Energy Sector, https://www.iea.org/reports/net-zero-by-2050
[117] See Chapter 2.2. As explained in DEGD initiatives, the low ambition policy options consisting of additional guidance only for energy efficiency or renewables polices would likely lead to results of the MIX-CP scenario. Conversely, the most ambitious regulatory options would yield results similar to the REG scenario with low/irrelevant carbon price applied in sectors beyond the current ETS. Moreover, the low ambition outcome of the legislative processes or delays in implementation – be it on regulations or on carbon pricing – would be illustrated by the MIX-CP or REG scenarios respectively.

buildings, in particular the EPBD and the proposal for a new emissions trading system (ETS) to abate greenhouse gas (GHG) emissions in this sector as well as the contribution of decarbonisation of buildings to the EU GHG target.

Among the three core policy scenarios[118] produced in the context of the 'Fit for 55' package, the MIX-CP scenario describes a policy environment where the drivers for energy efficiency and renewable energy uptake in buildings are closer to the existing energy policy framework (represented by the 2020 Reference scenario). In particular, it achieves lower renovation rates of buildings' thermal envelopes, close to Reference. Likewise, it has low drivers for renewables uptake in H&C, close to reference levels, but significantly incentivises the uptake of renewable energy in heating and cooling, including of heat pumps in buildings via carbon pricing. This scenario falls short of the proposed new 2030 targets related to energy efficiency and renewable energy. However, the MIX-CP scenario achieves the 55% net GHG emissions 2030 target.

Figure 6.1: Renovation rates in the Delivering the European Green Deal scenarios



Source: Primes

[118] The 'Fit for 55' three core policy scenarios, including the MIX-CP scenario, are described in 'Annex E Analytical methods' of the impact assessment (SWD(2021) 623 final) accompanying the proposal for a revision of the Energy Efficiency Directive (COM(2021) 558 final), as well as in 'Annex 4: Analytical methods' of the impact assessment (SWD(2021) 621 final) accompanying the proposal for a revised Renewable Energy Directive (COM(2021) 557 final). Detailed results can be found at: https://ec.europa.eu/energy/data-analysis/energy-modelling/policy-scenarios-delivering-european-green-deal_en

The lower ambition energy policy framework entails on the one hand a higher carbon price in the 'new ETS' sectors than in the MIX scenario[119] (EUR_{2015} 80/ t CO2 in MIX-CP, against EUR_{2015} 48/ t CO2 in MIX[120]) and, on the other hand, a lower contribution of buildings to GHG emissions reductions[121]. The lower CO_2 reductions in buildings is to be compensated, in the MIX-CP scenario, by higher reductions of CO_2 emissions in the power system and non-CO_2 emissions compared to the MIX scenario.

The MIX-CP scenario therefore illustrates the importance of having a policy framework that can trigger a reduction in energy consumption and shift towards low carbon fuels in buildings. This is the aim of a proposal for a revision of the EPBD, to complement the proposal for a new ETS that covers emissions from buildings and road transport.

The central MIX scenario illustrates that ambitious renovations and investors' certainty created by it are part of the well-balanced policy mix towards the GHG target of 55% and, in the longer term, climate neutrality. But the MIX scenario on its own cannot answer the question of how much of GHG reductions, energy savings, renewables deployment or cost increases can be attributed to drivers that illustrate the revision of the EPBD.

For this purpose, a counterfactual MIXwoEPBD scenario variant was developed that removes the main policy drivers that represent the EPBD revision, but keeps other MIX drivers (notably carbon price to the same level) frozen at the levels present in the MIX scenario (see Annex D for a description of the scenario). Using this design, the MIXwoEPBD variant complements MIX-CP, which similarly had few EPBD revision relevant drivers, but compensated for this with increased carbon pricing.

As a result, gaps to the energy targets appear in the MIXwoEPBD variant, which also results in fewer contributions to GHG reductions. These gaps are substantial, and bridging them can be attributed to the EPBD revision. This approach therefore provides the necessary insights to see the value added of the EPBD within the complete set of DEGD proposals. It does have weaknesses: it is a static counterfactual (the real-life carbon price would have increased as already illustrated in the MIX-CP scenario). It captures only implicitly the more granular impacts of EPBD revision such as building passports, long-term strategies or actions in the area of modernisation and quality of buildings and of their systems. These are enabled by the digitalisation of information tools and the impacts of the EPBD revision on e-mobility deployment, which to some

[119] The MIX scenario includes a balanced approach between price-based mechanisms (like the ETS) and sectoral regulatory instruments.
[120] See Table 15 of the impact assessment (SWD(2021) 623 final) accompanying the proposal for a revision of the Energy Efficiency Directive.
[121] See Table 15 of the impact assessment (SWD(2021) 623 final) accompanying the proposal for a revision of the Energy Efficiency Directive.

extent may also be captured by other policies, including the market signalling function of the carbon price effect. The quantitative assessment of the impacts of the specific policy options proposed is mainly performed using a building stock model and assessing the effect of the measures proposed bottom-up.

Bearing in mind these limitations, the variant still provides a useful assessment that is reflected in the sections below. It does so by complementing the main analysis, which compares the EPBD revision alone to the baseline with the analysis of gaps created by the MIXwoEPBD variant. The following sections provide a summary of the MIXwoEPBD variant, while Annex D contains a more detailed description.

Results of MIXwoEPBD variant analysis

By removing the drivers illustrating the EPBD revision, a gap is created between the variant and the MIX scenario. Bridging the gap can be attributed to the revision of the EPBD. We can therefore identify the absolute impact in terms of bridging the gap with the GHG target of 55%, the newly proposed energy efficiency target[122] and renewable energy targets[123] (e.g. in amounts of CO_2 saved, energy saved, renewables uptake or costs/investment increase). In addition, these absolute amounts due to EPBD revision can be compared to the full gap between the REF2020 and MIX scenario to be bridged by all DEGD measures, thereby providing information in terms of relative impact or required impacts by other policy drivers[124]. The following impacts can therefore be identified from the below analysis of the MIXwoEPBD variant. Table 6.2 presents a summary of key results.

Energy system impacts

The MIXwoEPBD variant creates a significant gap to the necessary 2030 energy efficiency in final energy consumption. Bridging this gap corresponds to 24% of the total, economy-wide final energy savings effort between the REF2020 and MIX scenario. The savings in final energy consumption have effects on primary energy consumption. A gap to the necessary 2030 energy efficiency in primary energy consumption therefore

[122] The newly proposed energy efficiency targets for primary and final energy consumption (see COM(2021) 558 final) of at least 9% in 2030 compared to the level of efforts under the 2020 Reference Scenario. The new way of expressing the level of ambition for the EU's targets corresponds to a reduction of 36% for final energy consumption and 39% for primary energy consumption respectively when compared to the 2007 Reference Scenario projections for 2030 (i.e. the current way to reflect the energy efficiency targets).

[123] As proposed in COM(2021) 557 final, i.e. an EU overall target of at least 40% renewable energy in gross final energy consumption by 2030 and a specific EU target of 1.1 p.p. annual increase in renewable energy in the heating and cooling sector.

[124] For example, the EPBD revision of brings an additional 18 Mtoe of final energy consumption savings out of 77 Mtoe needed between REF2020 and MIX. It therefore contributes 24% of the final energy consumption reduction effort.

also emerges. Bridging this gap corresponds to 10% of the primary energy savings effort between the REF2020 and MIX scenario. The impacts are most pronounced in the residential sector, where EPBD revision brings 41% of energy savings effort, and in the services sector, where EPBD revision represents 37% of the effort.

The impacts of EPBD revision are also significant on the renewables share, which becomes bigger thanks to energy savings but also thanks to an absolute increase in the amount of renewables in the H&C sector as deep renovations are often coupled with the installation of renewable H&C equipment (notably heat pumps). As a result, the overall RES share grows by 0.9 percentage points (p.p.) between MIXwoEPBD and MIX, which represents 18% of the effort between REF2020 and MIX. The change is more pronounced in the RES H&C share, which grows by 2.4 p.p., representing 46% of the effort.

Environmental impacts

The MIXwoEPBD variant, in the absence of drivers illustrating the EPBD revision, therefore results in particular in the underachievement of the energy target, which also impacts GHG, reducing the contribution to emission reductions by 0.6 p.p. to 2030. This assumes that the new ETS would not contribute to bridging the cap (carbon pricing assumed static compared to MIX) and would therefore not compensate for the reduced deployment of the EPBD revision.

The differences are the most pronounced in the building sector, where the EPBD revision would deliver up to 50% of the decarbonisation effort in the residential sector and up to 45% in the services sector.

Economic impacts

The MIXwoEPBD variant shows that in the absence of the EPBD revision, the system costs would fall by EUR 12 bn/year in 2021-30 (metric excluding carbon pricing and disutilities). This is explained by the fact that some investments in renovations would not take place. But the reductions on the side of investments are partly offset by increased expenditure for heating fuel and smaller savings in energy expenditure, which could be achieved by switching to renewables (many of them with lower operational costs). Put differently, the EPBD revision brings a 38% increase in total system costs between REF2020 and MIX, taking into account increased investment needs but reduced energy purchase expenditure.

Zooming in on the investments, the MIXwoEPBD variant shows that in the absence of the EPBD revision, investments would fall by EUR 34 bn/year in 2021-30. Put differently, the EPBD revision brings a 33% increase in total system costs between REF2020 and MIX. While the figure is significant, the reductions in energy purchase expenditure in the building sector must be also highlighted: over EUR 3 bn/year in 2021-

30. Renovations involve reducing operating expenditure, but at the cost of increased capital expenditure.

With clearly reduced fossil fuel expenditure, the fossil fuels import bill is also lower thanks to EPBD revision. The savings between MIX and MIXwoEPBD amount to EUR 13 bn over 2021-30 and amount to 12% of the effort between REF2020 and MIX.

Social impacts

Building-related energy expenditure as a share of private consumption increases by 0.2 p.p. in 2030 because of the EPBD revision as renovation investment costs will be higher than fossil fuel savings also for consumers.

Table 6.2: Key results of the MIXwoEPBD variant in comparison to MIX and REF scenarios

EU27 2030 results unless otherwise stated	**metric**	**REF**	**MIX**	**MIX-woEPBD variant**	**Difference MIX vs MIXwoEPBD**[133]	**Difference MIX vs MIXwoEPBD compared to difference MIX vs REF** [134]
Energy and environmental impact						
CO2 emission in residential sector	Mt CO2 eq	211.6	142.2	176.8	-34.6	50%
CO2 emission in services sector	Mt CO2 eq	91.2	69.1	79.1	-10.0	45%
CO2 emission in residential and services sectors	Mt CO2 eq	302.8	211.3	255.9	-44.7	49%
CO2 emissions reduction (intra-EU scope, excl. LULUCF)	Mt CO2 eq	2850.3	2376.0	2407.1	-31.1	7%
Total GHG emissions reductions (incl. intra EU aviation and maritime, excl LULUCF) compared to 1990	Mt CO2 eq	43.4%	52.9%	52.2%	0.6	7%
PEC2020-2030	Mtoe	1124.3	1021.9	1032.5	-10.6	10%
FEC2020-2030	Mtoe	883.0	806.4	824.5	-18.1	24%
FEC in residential sector	Mtoe	215.4	182.2	195.8	-13.6	41%

FEC in services sector	Mtoe	118.0	106.6	110.7	-4.2	37%
FEC in residential and services sectors	Mtoe	333.4	288.7	306.5	-17.8	40%
Overall RES share	%	33.2%	38.4%	37.5%	0.9 p.p.	18%
RES H&C share	%	32.8%	38.4%	35.6%	2.4 p.p.	46%
Economic impacts						
Investments (excl. transport) (2021-30)	€15 bn /year	296.7	402.0	367.6	34.4	33%
Energy purchase expenditure in buildings sector (2021-30)	€15 bn /year	463.6	451.9	455.3	-3.4	29%
Energy system costs excl. carbon pricing and disutility (2021-30)	€15 bn /year	1518.0	1550.1	1537.8	12.3	38%
Average price of electricity	€/MWh	157.9	157.7	157.5		no visible impact
Fossil fuels imports bill for the period 2021-30	bn €'15/10 years	2274.4	2159.7	2173.1	-13.4	12%
Social impact						
Energy-related expenditure in buildings (excl. disutility) share in private income	%	6.9%	7.5%	7.3%	0.2 p.p.	41%

Source: PRIMES

6.3 Environmental impacts

The environmental impacts of the policy options assessed cover energy use, GHG emissions, the use of materials, water and air pollutants. These impacts not only occur through changes in production or consumption patterns within the EU, but also in other countries that manufacture and trade products or materials imported into the EU. The impacts of the options have been assessed using the modelling tools described in detail in Annex D.

6.3.1 Impacts on building renovations and new buildings

The key dimension for assessing impacts of policy options for the revision of the EPBD is the transformation of the building stock and its energy performance over time. The dynamic of transformation is illustrated by the renovation of floor area to variable depths/intensities and by the energy performance of new builds.

The MEPS options relate to different segments of the building stock, which are also distributed differently across Member States.

Table 6.3: Building stock covered under MEPS[125]

	Segments of the building stock	**Share of the building stock (EU average)**	**Differences across Member States in the share of the building stock covered**
MEPS1	Worst performing buildings, rented/sold	On average rented every 18 years and sold every 50 years, with worst performing buildings representing a variable share of the buildings under transaction For residential buildings, the share of building transactions at EU level in 2018 was around 4%/year, including sales, renting and renting at reduced rates[126].	Could be large for residential buildings, depending on differences in the efficiency of the building stock (starting point) illustrated in Figure 2.1, ownership structure (Figure 2.7 for residential sector), the dynamics of the property and rental markets, and the share of small and large multi-family houses in residential buildings.
MEPS2	All worst performing buildings	Gradually covering all buildings by 2050, depending on the priorities of the national schemes	Could be large, reflecting the differences in the starting point (average efficiency of the building stock).
MEPS3	Non-residential buildings	Gradually covering up to 25.8% of the building stock	Moderate, with most countries close to average with some outliers (from 8.8% in Cyprus to 47.6% in Estonia). Figure 2.9
MEPS4	All buildings in which heating and cooling appliances are replaced	Approx. 4%/year (all stock replaced in around 25 years)	Expected to be moderate (national data not available)

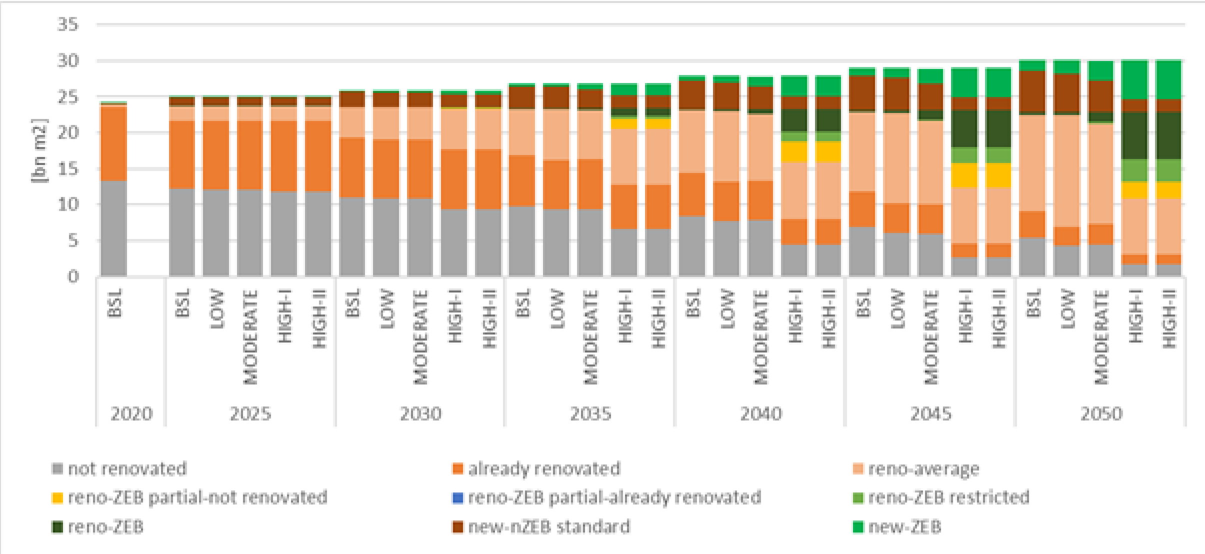
All MEPS sub-options will produce different effects depending on the starting point in each country, with more efforts in the countries with the largest share of inefficient buildings on the basis of EPC classes. MEPS2 has the potential to be more complete in terms of covering the whole stock gradually, although the effects would also depend on the specific pathway identified in Member States and adapted to the national conditions. MEPS1, MEPS3 and MEPS4 will only cover a limited subset of the building stock.

[125] See also Annex F on the differences related to the buildings to be targeted under MEPS schemes.
[126] Calculations based on Eurostat SILC microdata. For Denmark, Estonia, Latvia, the Netherlands and Finland, data was not available. The most recent reliable data for Romania and Bulgaria are from 2016, and for Hungary from 2017.

It is assumed that some 55% of buildings are not renovated at present, while around 43% have undergone some kind of renovation since they were first built[127]. Only 1.3% and 0.8% respectively have been renovated at average and deep renovation levels in 2020.

In the baseline scenario, the EU floor area is expected to be transformed over time by standard and shallow renovation (labelled 'reno-average'), with only very low shares of ambitious renovation (labelled 'reno-ZEB'). It is also expected that a small share of new buildings will go beyond the current new standard (nearly zero-energy buildings/NZEB) until 2050 and be built to a higher standard, which is referred to as 'new ZEB' (Figure 6.2). These assumptions reflect the historical trends in renovations and the most likely development under the current policy framework.

Figure 6.2: EU floor area development in the baseline and considered scenarios[128]



Source: Guidehouse et al.

The impacts on **floor area development** already become visible by 2030 in the most ambitious scenarios HIGH-I and HIGH-II, when stronger policy signals lead to more renovation activities. A slightly higher share of renovated buildings also stands out as a consequence of anticipating activities before the introduction of MEPS (Figure 6.1). The additional renovated floor area over 2021-2030 ranges from 16-17% in the LOW and MODERATE scenarios up to 23% in the two most ambitious scenarios. By 2050, the additional renovated floor area will reach 46-53% and 66% of the building stock respectively in the least ambitious and most ambitious scenarios. In the least ambitious

[127] This is why the building stock has two status quo levels in 2020 ('not renovated' and 'already renovated'), to which different energy needs are associated for the scenario calculations.
[128] Based on Guidehouse (2021).

scenarios, almost all of the additional renovations are done at an ‘average’ level[129] all over the period up to 2050.

By contrast, in the most ambitious scenarios there is a progressive increase in ‘depth’ in the renovation of **existing buildings** after 2030, where ZEB renovations that achieve higher savings start to significantly upgrade ‘not renovated’ buildings and ‘already renovated’ buildings[130]. The high impact of the most ambitious scenarios comes not only from MEPS2, but also from the cumulative effects of the other measures in designed policy packages, notably DEEP2, LTRS3 and BRP3. The latter triggers a more systematic and effective approach to staged renovation. As for **new buildings**, no more NZEBs are built after 2030 in the HIGH scenarios, being replaced by a more ambitious ZEB standard[131]. In the least ambitious scenario, the new standard will be an incremental increase from current NZEB that will last until 2050, while the penetration of the ZEB standard will remain limited.

The effects are therefore very different across scenarios. While in the LOW and MODERATE scenarios a limited share of the building stock is renovated and shallow to medium renovation dominates, in the two most ambitious scenarios a gradual transformation of the existing building stock is achieved. These results can also be illustrated by the evolution of renovation rates as presented in Table 6.4.

Table 6.4: EU average renovation rates (average over 5 years period) and share of deeply renovated floor area in total renovated floor area

	2020	2025	2030	2035	2040	2045	2050
Average renovation rate in full renovation equivalent (over 5 yrs) [%total floor area]							
BSL	1.35%	1.47%	1.65%	1.72%	1.72%	1.72%	1.71%
LOW	1.35%	1.47%	1.85%	2.06%	2.06%	2.05%	2.05%
MODERATE	1.35%	1.47%	1.83%	2.01%	2.01%	2.23%	1.74%
HIGH-I	1.35%	1.47%	2.99%	3.60%	3.34%	2.29%	0.93%
HIGH-II	1.35%	1.47%	2.99%	3.60%	3.34%	2.29%	0.93%
Average share of deeply renovated floor area after 2020 (over 5 yrs) [% of total renovated area]							
BSL	1.0%	1.2%	1.4%	1.7%	2.0%	2.2%	2.6%

[129] For a detailed overview of the energy performance and corresponding savings attributed to each renovation category, see Annex D on ‘Analytical methods’. ‘ZEB partial’ are buildings on the way to ‘retrofit ZEB’ level, but reach this in several steps.

[130] In the high ambition scenarios, the average renovation is no longer implemented after 2035 due to the progressive introduction of stricter requirements and corresponding enabling conditions in favour of ‘ZEB’ renovations. As MEPS2 drives buildings retrofitted to ZEB level by 2050, in the high scenarios ‘ZEB partial’ first builds up after 2030, and then decreases again towards 2050 – by then, most ‘ZEB partial’ buildings will have turned into (full retrofit) ‘ZEB’.

[131] For ZEBs, for new constructions a standard definition of ‘passive house’ is applied for modelling purposes. The impact of potential reductions of embodied carbon content due to ZEB2 is not modelled as it goes beyond the boundaries of the baseline assumed, which only covers CO_2 from energy use. However, the existing literature helps us understand the magnitude of the emissions addressed and the potential for reductions (see Annex H).

LOW	1.0%	1.2%	1.4%	1.6%	1.9%	2.2%	2.5%
MODERATE	1.0%	1.2%	1.6%	3.3%	6.0%	9.6%	10.8%
HIGH-I	1.0%	1.2%	3.9%	18.9%	39.6%	53.6%	59.2%
HIGH-II	1.0%	1.2%	3.9%	18.9%	39.6%	53.6%	59.2%

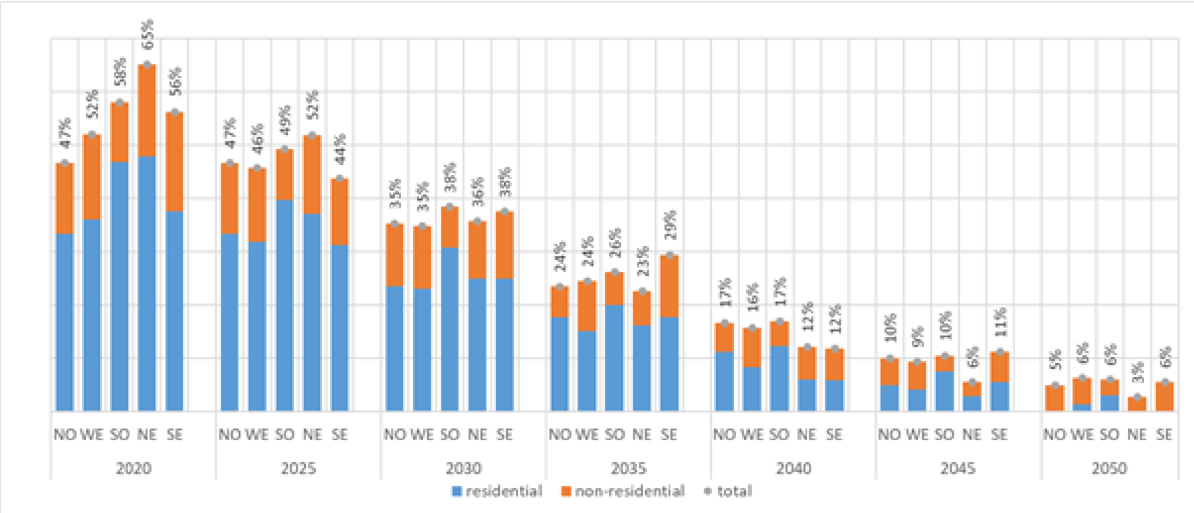
Source: Guidehouse et al.

While the building stock was renovated at an average rate of 1.35% in 2020, the rate increases up to 3% in two HIGH scenarios by 2030. After peaking at 2-3.6% in 2035-2040 across scenarios, the average renovation rate starts to decrease after 2040. As the average renovation rate does not provide information about the level of energy savings achieved due to renovations, it is interesting to also look at the share of deeply renovated floor area (see table above).

Deep renovation takes off in the two HIGH scenarios after 2030, facilitated by the introduction of stricter minimum energy performance standards (MEPS1, 2 and 4). The average share of deeply renovated floor area in total renovated floor area increases from 1% to around 19% in 2035, reaching 60% in 2045-2050. By contrast, in the LOW and MODERATE scenarios the share of deeply renovated floor area remains at 1.6% and 3.3% respectively by 2035 and reaches 11% by 2050.

Thanks to building renovation, the share of worst performing buildings (those 'not renovated') is progressively reduced across all options. In HIGH scenarios, the floor area of worst performing residential buildings decreases gradually towards zero by 2050 through the implementation of MEPS1.

Figure 6.3: Evolution of the floor area of worst performing building stock in the EU regions considered in the model, High I scenario



Source: Guidehouse et al.

There are however differences across the EU, reflecting the different ages of building stock in Member States. The distribution of worst performing buildings, both residential and non-residential, varied across EU regions in 2020 – from 47% of the building stock floor area in the Northern region to 65% of the floor area in the North-Eastern region (Figure 6.3). Residential buildings represent the biggest part of the worst performing floor area in all regions, i.e. 2-3 times bigger than the floor area of the worst non-residential buildings.

6.3.2 Impacts on energy consumption and GHG emissions

Table 6.5: Energy and GHG emission reductions at EU level across scenarios

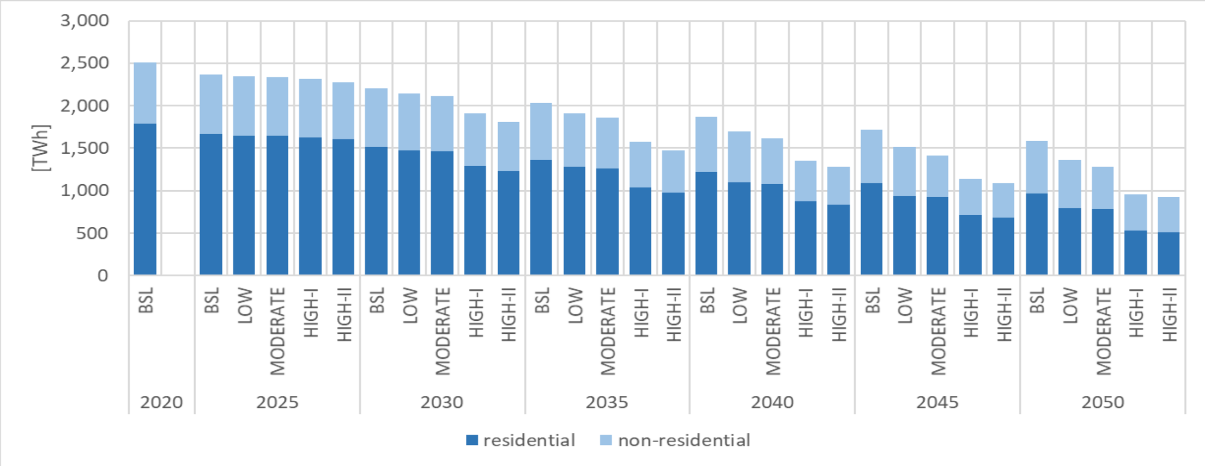
		2030				2040				2050			
Main indicator	**[unit]**	**LOW**	**MOD**	**HIGH-I**	**HIGH-II**	**LOW**	**MOD.**	**HIGH-I**	**HIGH-II**	**LOW**	**MOD.**	**HIGH-I**	**HIGH-II**
Energy savings in space heating/cooling and DHW[132]	[% from BSL]	-2.4	-3.6	-11.7	-16.1	-7.8	-11.3	-24.4	-28.0	-11.7	-15.8	-34.0	-36.0
GHG emission[133] **savings in space heating/cooling and DHW**	[% from BSL]	-3.1	-4.2	-22.8	-28.5	-10.4	-15.7	-49.7	-55.4	-14.4	-20.6	-53.5	-57.1

Source: Guidehouse et al.

The options from LOW to MODERATE show a progressive **reduction in the final energy consumption** used for heating and cooling purposes across scenarios. In 2030, the reduction is in the range of -2% to -11% across scenarios compared to the baseline (Table 6.5, Figure 6.4). In HIGH-I and II, the introduction of MEPS at scale leads to an earlier and then much steeper decrease compared to the baseline scenario. While the reduction in energy consumption is limited for the LOW and MODERATE scenarios, the two HIGH scenarios reduce it by 11-12% compared to the baseline in 2030. The decrease in energy demand in the two HIGH scenarios becomes even more significant in 2040 (-24% compared to baseline) and reaches -34/-35% towards the mid-century.

Figure 6.4: Final energy consumption for space heating across considered scenarios[134]

[132] DHW=Domestic hot water.
[133] "GHG emissions" includes direct emissions from fossil fuel combustion in the buildings as well as indirect emissions from the power and heat production sector corresponding to the electricity and heat used for heating, cooling and domestic hot water.
[134] Based on Guidehouse (2021).

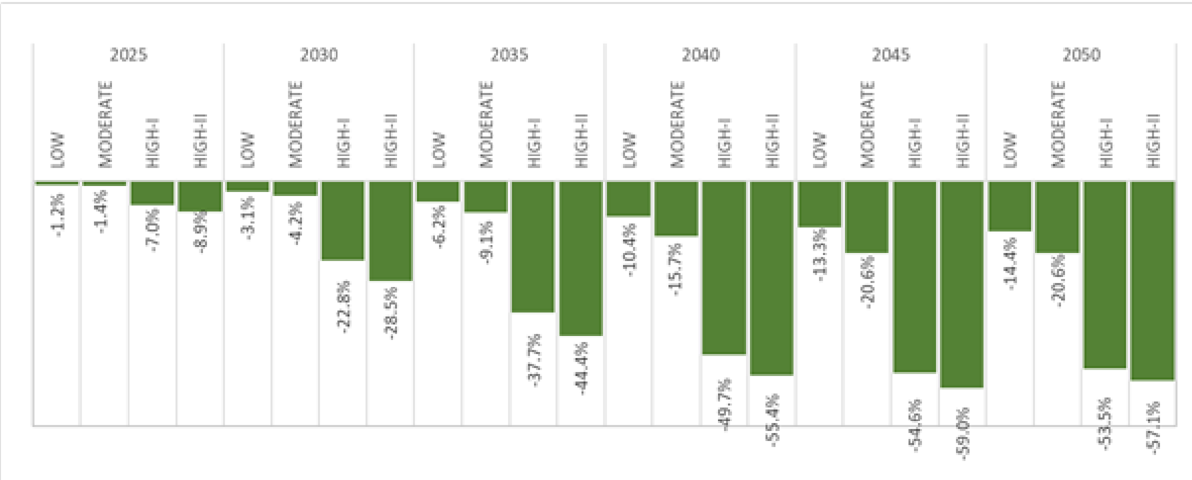


Source: Guidehouse et al.

Besides absolute energy consumption values in HIGH scenarios, the average **annual energy savings** achieved compared to 2020 levels sees an increase from 1.5% between 2020 and 2025 to a peak of 3.2% between 2025 and 2030. The annual energy savings rates will gradually decrease towards 2050 by around 1.1-1.5% in LOW and MODERATE and by 2.1% in HIGH-I and II. The HIGH scenarios therefore achieve almost a doubling of the energy savings in 2030-2035 compared to the baseline scenario.

The reduction in energy consumption resulting from higher rates and deeper energy renovations induced by MEPS, together with higher standards in new construction, leads to a progressive decrease in **GHG emissions** in the building sector in 2020-2050 (Figure 6.5).

Figure 6.5: Evolution of the GHG emission reduction for heating, cooling and DHW in buildings compared to baseline scenario



Source: Guidehouse et al.

In 2030 and compared to the baseline scenario, the reduction in GHG emissions from heating, cooling and domestic hot water (DHW) is in the 3-4% range for LOW/MODERATE scenarios and around 23% in the HIGH-I and HIGH-II scenarios. Around 66% and 62% of these emission savings are achieved in residential buildings in

LOW/MODERATE and HIGH-I and II scenarios respectively[135], while the remaining share is achieved in non-residential ones. These emission reductions are achieved thanks to a combined uptake of deeper and accelerated energy renovations triggered by MEPS1 and MEPS2[136]. In this case, the introduction of DEEP2, LTRS3 and BRP3 in the two HIGH scenarios also amplifies the effect of MEPS.

This emission reduction will be achieved by (i) reducing the energy demand of buildings and increasing the use of renewable energy; and (ii) by a gradual shift from fossil fuels to renewable and electricity-based building systems. As a result, part of the direct emissions of buildings will be shifted to the power and heat sector. The share of direct emissions in the total emissions of buildings – around 80% in 2020 – will therefore gradually decrease in 2030 to around 77-79% in LOW/MODERATE and to 71% in the two HIGH scenarios respectively.

Compared to the baseline, all considered scenarios have a consistent long-term impact. This leads to a reduction of GHG emissions from heating of 14-21% in LOW/MODERATE scenarios and 53-55% in the two HIGH scenarios by 2050.

When comparing the embodied GHG emissions resulting from renovation works (i.e. from the materials used such as insulation) with the reduced operational emissions after renovation, case studies show that renovation can bring about significant environmental gains. For old (poorly/non-insulated) buildings, the material-related impact of energy renovation is low, whereas gains in terms of operational energy are high[137].

Studies of embodied GHG emissions in buildings have shown that the addition of embodied emissions caused by the renovation of an existing building, depending on the nature and depth of the renovation works and the materials used, is typically less than 50% of the embodied emissions for a new building (i.e. less than 125–200 kg CO2eq./m2). It can be much lower if the renovation focuses, for example, on insulation and heating/cooling system improvements without major structural changes. If a renovation using materials with modest levels of embodied emissions, together with decarbonised energy supplies (e.g. renewable electricity), is therefore able to successfully reduce the operating emissions from an existing building to near zero, then the period during which the cumulative emissions are greater than they would have been without the renovation can typically be less than about 3 years[138] (typical values of embodied GHG

[135] This relative distribution of emissions savings between residential and non-residential will gradually decrease by 2050 to 60-64% and an almost equal share (52%) as in non-residential buildings (48%) in LOW/MODERATE and HIGH-I and II scenarios respectively. The lower share of emissions savings in non-residential buildings from the MODERATE scenario is explained by MEPS3, which addresses only large non-residential buildings and is implemented later than others.

[136] The demolition of buildings creates a false improvement in building stock as it reduces the floor area. This effect is however very limited as demolition rates are assumed to be 0.1-0.2% and constant across scenarios.

[137] CA EPBD May 2021, LCA to combine energy and material performance, BBRI.

[138] EASAC policy report 43.

emissions per square metre of floor area for new buildings lie between 250 and 400 kg of carbon dioxide equivalent per square metre (kg CO2eq./m2), whereas the operating GHG emissions from existing buildings typically lie between 30 and 50 kg CO2eq./m2 per year).

The projected GHG emission reductions from the LOW and MODERATE scenarios (3-4%) are considerably lower compared to the reduction level of around 15% (compared to reference) attributed to the EPBD contribution by the counterfactual scenario 'MIXwoEPBD' (Section 6.2). At the same time, the GHG emissions reduction of 23% in the two HIGH scenarios appears more comparable to that attributed to the EPBD.

Similarly, the energy savings in final energy consumption of residential and services sectors by 2030 for LOW and MODERATE scenarios (2.4-3.6%) appear low compared to the projected energy savings of 5.3% from the MIXwoEPBD scenario (compared to reference). However, the energy savings in the HIGH scenarios are by comparison more pronounced.

6.3.3 Air pollution, indoor air quality, water and material use

Table 6.6: Summary of main results on air pollution, water and material use at EU level

		2030				2050			
Main indicator	[unit]	LOW	MOD.	HIGH-I	HIGH-II	LOW	MOD.	HIGH-I	HIGH-II
Air pollution									
Sox	[% from 2020]	0.1%	0.1%	-1.2%	-1.1%	-1.7%	-1.9%	-5.9%	-7.4%
Nox	[% from 2020]	0.2%	0.2%	0.3%	0.3%	-0.4%	-0.5%	-1.0%	-1.4%
PM 2.5 and 10	[% from 2020]	0.1%	0.1%	0.1%	0.1%	-0.3%	-0.3%	-0.8%	-1.1%
Water use	[% from 2020]	0.0%	0.0%	0.4%	0.4%	0.0%	0.0%	0.3%	0.3%
Material use	[% from 2020]	0.2%	0.2%	2.2%	2.2%	-0.2%	-0.3%	1.1%	0.9%

Source: Guidehouse et al.

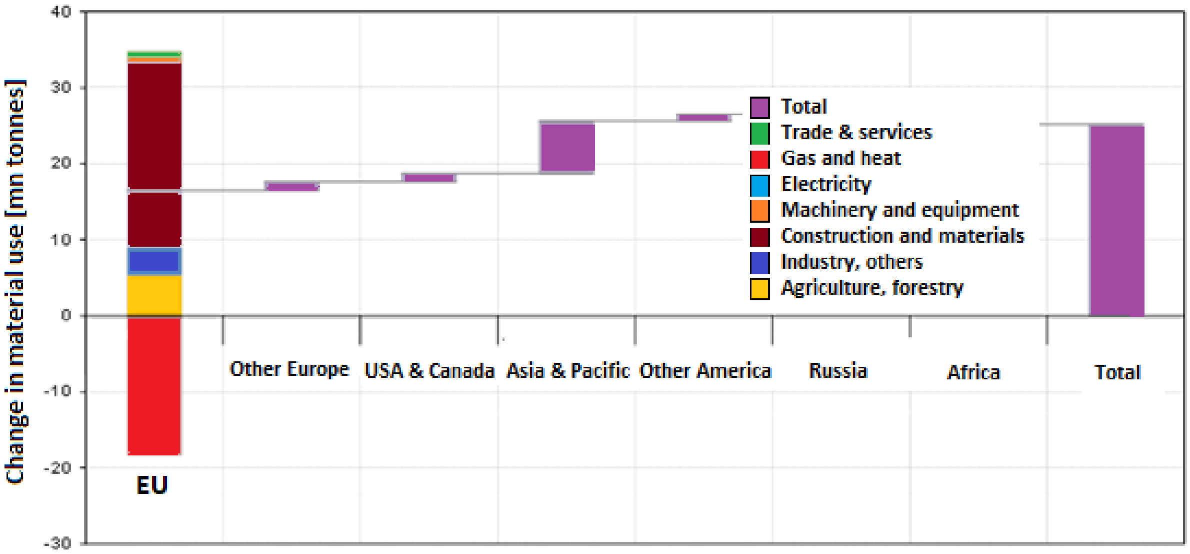
Significant non-energy co-benefits can be achieved thanks to policies that lead to the increased energy renovation of buildings. The **air pollutants** that are reduced as a result of energy savings are SOx, NOx and particulate matters (PM 2.5 and 10, Table 6.6). Their reduction generates co-benefits for human health and ecosystems.

Building renovation also has an impact on health-related factors linked to **indoor air quality** like proper ventilation flow, indoor temperature, air pollution, noise or exposure to toxic substances. Thermal insulation of different parts of buildings, ventilation and renovation in general can have different positive and negative aspects for human health[139]. During the consultation phase, several stakeholders expressed the need for EPBD policies to contribute to better indoor air quality. The increase in renovation activities triggered by MEPS would have effects on the **use of materials for**

[139] Mzavanadze, N. (2018). COMBI: WP5 Social welfare: Final report: quantifying energy poverty-related health impacts of energy efficiency.

construction works[140]. Building renovation usually requires material extraction and use in construction. Demolition activities as well as construction also have impacts on waste production and the environment. Minerals have the highest share of all materials in buildings, comprising around 65% of total aggregates (sand, gravel and crushed rock), and approximately 20% of total metals are used by the construction sector[141]. Growth in construction activities will therefore increase the pressure on the environment. However, embodied CO_2 emissions emanating from building materials could potentially be reduced by 50% or more using circular approaches[142].

Figure 6.6: Impact of renovation and new-build investment on material consumption within the EU 27 and rest of the world, 2030 (difference to baseline)[143]



Source: Guidehouse et al.

Figure 6.6 shows that investments in renovations and in highly efficient new constructions in the high ambition scenario II lead to additional material use of some 16 million tonnes in 2030 within the EU compared to the baseline, and to an additional 8 million tonnes in other countries. This translates into around 0.2% and 2.2% total additional resource use in 2030 in LOW/MODERATE and HIGH-I AND HIGH-II scenarios compared to the baseline. This is a net effect between the increase in resources used for the construction and material sector and a decrease in resources used within the gas and heat sector and also petroleum refining (included in industry) and fossil-based

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[140] For instance iron, aluminium, copper, clay, sand, gravel, limestone, wood, and building stone.
[141] Herczeg et al. 2014: Resource efficiency in the building sector; available at: https://ec.europa.eu/environment/eussd/pdf/Resource%20efficiency%20in%20the%20building%20sector.pdf
[142] Material Economics 2018: The Circular Economy: A Powerful Force for Climate Mitigation. Available at: https://materialeconomics.com/publications/the-circular-economy-a-powerful-force-for-climate-mitigation-1
[143] Exiobase modelling.

electricity (included in electricity). The increased materials mainly come from the EU, although around 30% of the construction materials are traded from Asia-Pacific.

Compared to the baseline, **water usage** rises by around 0.4% and 0.3% by 2030 and 2050 in the most ambitious scenarios. Water usage mainly increases in the agricultural and forestry sector that provides products and services to the sectors directly affected by renovation and new build activities.

6.4 Socio-economic impacts

The increase in renovation activities triggered by the implementation of MEPS will have positive effects of variable intensities across the building renovation value chain, which is quite complex and fragmented[144]. It includes on-site construction activities, together with raw materials supply and the manufacture of construction materials and products, mostly supplied by upstream sectors.[145] Value is unevenly distributed along the chain with developers, material distributors and logistics capturing a rather large share of the value pool[146]. A large number of suppliers are engaged in building renovation, providing services, and intermediate products from sectors further up the value chain, including materials, machinery, electrical equipment, chemicals, metal products, and more. Small and medium sized enterprises (SMEs) play a key role in the build environment. Over 99% of the construction industry ecosystem consists of SMEs[147], either supplying essential technologies and materials or providing services locally in their area. Capacity limitations on their side might limit the renovation rate that can be achieved. New technologies also require know-how and capacity development. All the operators across the value chain would be affected by a positive increase in value and activities, with positive corresponding effects on employment.

While energy costs would be reduced for end-users, building owners would incur investments and other compliance costs, and public administration would face administrative and enforcement costs.

6.4.1 Investments, costs and property values

6.4.1.1 Investments

MEPS and ZEBS uptake results in higher **investments in building renovation and new construction**. Investments sharply increase across scenarios after 2025, when the new standards come into force and require worst performing buildings to be renovated. Compared to the baseline, the relative increase in investment in 2030 is +18% / +22% in

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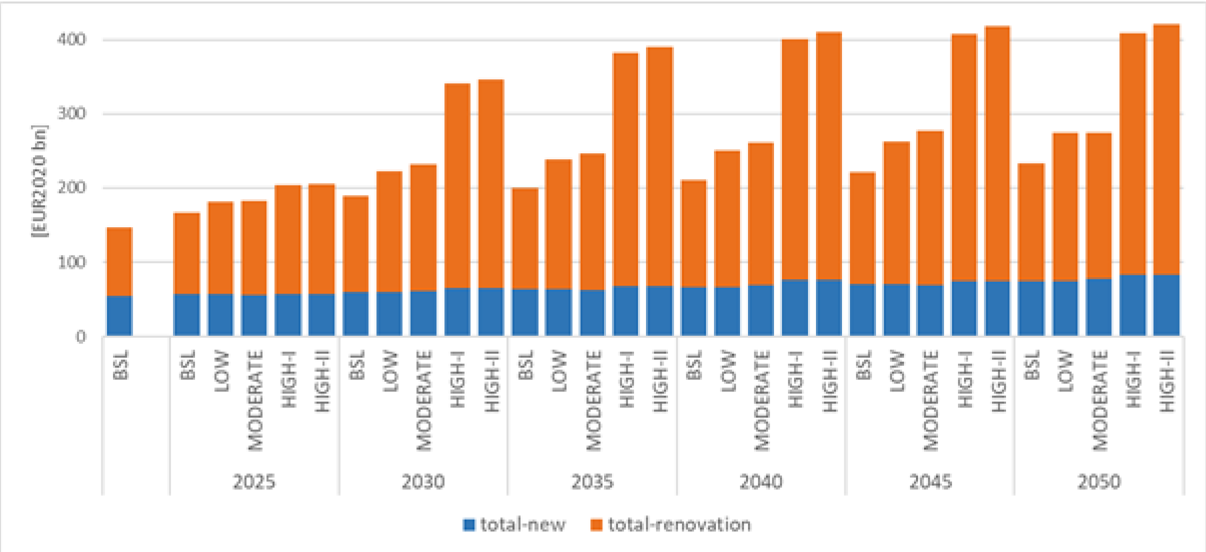
[144] Groote and Lefever, 2016.
[145] Ecorys et al., 2016.
[146] McKinsey & Company, 2020.
[147] https://ec.europa.eu/growth/sectors/construction_en#:%7E:text=The%20construction%20industry%20is%20very,social%2C%20climate%20and%20energy%20challenges

LOW/MODERATE scenarios and around +80% / +83% in HIGH-I/HIGH-II scenarios, slightly decreasing towards 2050 (Figure 6.7).

As explained in relation to environmental impacts, this relates to the 'maximum effect' needed, while the national MEPS scheme could be of lower intensity depending on the specific set-up and interaction with other instruments. The majority of the investments relate to renovations triggered by MEPS[148], while the rest relates to the compliance of new constructions with the ZEB standard. This is in line with the analysis underpinning the Renovation Wave strategy. Following the Climate Target Plan (CTP), the strategy identified that building renovation is one of the sectors facing the largest investment gap in the EU[149].

The dimension of investments is also linked to the financing challenge for building renovations. The supporting tools included in each option are expected to have effects in providing a comprehensive policy framework to facilitate the targeting of available funds to the right renovation projects. While the deep renovation definition would help investors targeting money towards integrated and staged renovation packages – providing a longer-term perspective to building owners – building renovation passports will help identify case-by-case and from a technical point of view the most suitable and cost-efficient refurbishment packages according to building characteristics.

Figure 6.7: Investment cost development at EU level for renovation and new construction (in billion EUR2020/year)[150]



[148] Around 75% in LOW/MODERATE and 81% in HIGH-I/HIGH-II.
[149] The analysis underpinning the CTP and Renovation Wave strategy indicated that to achieve the proposed 55% climate target by 2030, around EUR 275 billion of additional investment in building renovation is needed every year. For the EPBD and compared to the baseline scenario, the additional annual investment costs in the two HIGH scenarios are estimated at around EUR 152-157 billion in 2030 (in fixed 2020 prices).
[150] Based on Guidehouse (2021).

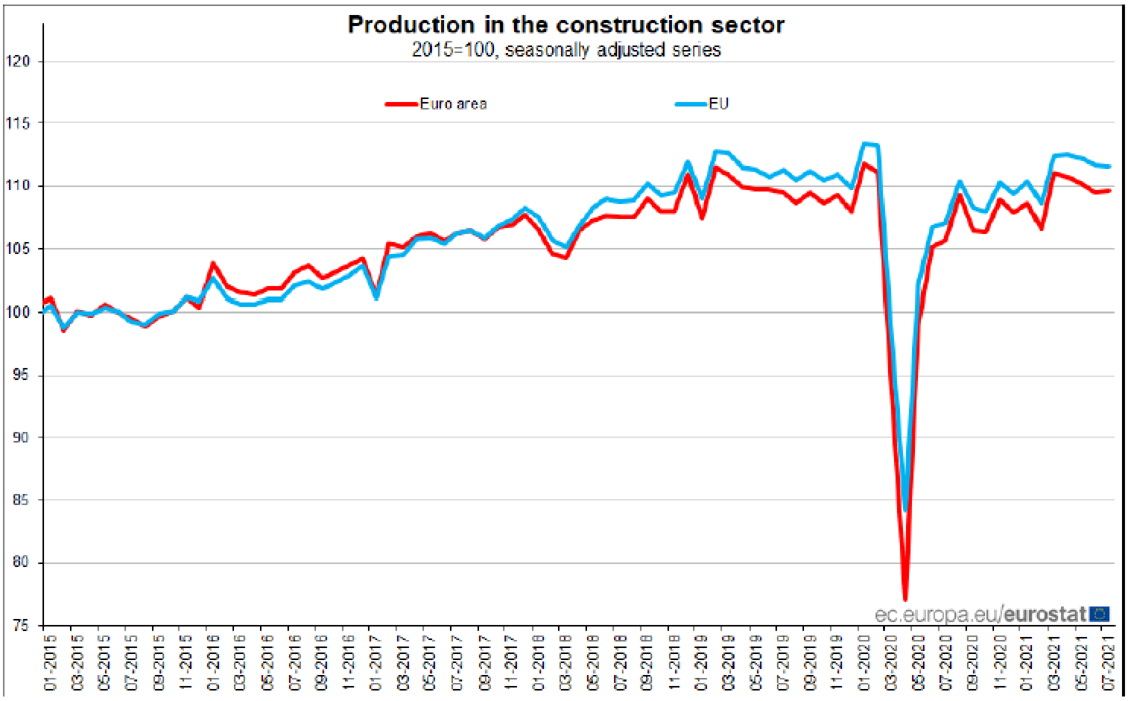
Source: Guidehouse et al.

6.4.1.2. The challenges of increasing capacity in the supply markets

An increase in demand for construction materials, besides generating environmental impacts as mentioned in Section 6.3 above, could also create pressure on markets. This would result in higher prices and potential difficulties in sourcing materials.

This effect has to be carefully considered in the light of the price increases and imbalances observed since May 2020[151]. The COVID-19 pandemic and related containment measures, as well as the follow-up recovery plans, have had a significant impact on the EU industry. On the supply side, the pandemic has led to supply shocks disrupting supply chains within and outside the single market. Global shipping costs for instance have seen huge increases, with container prices increasing several-fold during the pandemic (almost 400% between October 2020 and May 2021). On the demand side, the strong economic recovery during 2021, together with unprecedented public investment plans in the EU, China and the USA, have increased pressure on demand for products. In addition, consumers have partially reallocated their expenditure from services to goods.

Figure 6.8: Production in the construction sector 17/09/2021 (Eurostat)



Source: Eurostat

[151] On this issue, see also Annex D, 8.1 Energy and environmental impacts.

The construction sector has been badly affected as regards wood and metal products and components. In some cases, prices have reached their highest levels since 2008-2011 (the end of the last commodity boom). Between May 2020 and June 2021, the price of aluminium, copper and steel increased by more than 50%, and timber by around 40%. The inflationary pressure has been less significant for glass, concrete and cement, at less than 10%. This is mainly due to the fact that they are mostly produced locally. The delays and increase in prices of raw materials have affected the construction ecosystem, which is largely dependent on primary inputs. During the pandemic, construction output suffered a major decline as a result of lockdown (Figure 6.8) and, in some Member States, the temporary closure of construction sites. However, Eurostat data[152] indicates that EU production in construction increased by 3.8% in July 2021 compared with a year earlier.

As inflationary prices are mainly due to short-term imbalances between supply and demand factors, monitoring and analysis indicate that such steep increases are at least temporary in part. Supply-side issues are expected to be progressively resolved by the easing-off of restrictions on the movement of goods (mainly on freight disruptions), customers' partial move back to services and supply capacities' adaptation to higher demand (supply elasticity, via new investments).

However, macroeconomic trends make it unlikely that commodity prices will fully return to pre-pandemic levels. Global growth is expected to be 4.9% in 2022[153]. Demand, including in the construction sector, is expected to continue to be supported by government support measures and low interest rates until at least 2023 – the date when stimulus packages will start to shrink (the EU Recovery and Resilience Facility in particular will finance reforms and investments in Member States until 31 December 2026). Around that period, the HIGH-I/HIGH-II set of options will start triggering additional renovation works. It is therefore expected that the additional stimuli triggered by the EPBD revision will come at a moment in time (after 2025) in which the current temporal imbalances would either be compensated by additional capacity or prices would have been set at higher levels compared to their historical level. In particular, the use of materials for construction is expected to increase by 7.8% in the HIGH-I/ HIGH-II scenarios in 2030 and by 6.9% and 7.3% respectively in 2050 compared to the baseline[154].

On insulation works specifically, material accumulation in the EU (mainly roads, bridges and buildings) was 2,944 million tonnes in 2019, of which non-metallic minerals (sand, gravel) 2,516 million tonnes, metal ores 324 tonnes, wood 84 tonnes and fossil energy materials/carriers 20 million tonnes. Roughly 60% of insulation materials is glass wool

[152] Eurostat Euroindicators 107/2021: https://ec.europa.eu/eurostat/documents/2995521/11563279/4-17092021-BP-EN.pdf/edff43b7-5ef5-01c8-2cf8-f572825bab56?t=1631867055642
[153] Source: IMF World Economic Outlook Update July 2021.
[154] Based on Guidehouse et al. (2021).

or stone wool (non-metallic minerals), while the rest is mainly divided between fossil-based and renewable materials. A typical average density for insulation results in roughly 5-10 million tonnes annual flow for insulation materials, meaning less than 0.33% of the total yearly material accumulation. Compared to the above-mentioned total flow of raw materials, a doubling of the use of insulation materials does not appear to be a reason in itself for causing a scarcity of materials, as it would only lead to a very low percentage growth in material flows.

On machinery and equipment, in particular heating systems, demand is expected to grow by 4.4%/4.8% in the HIGH-I/HIGH-2 options by 2030 and by 4.5%/5% by 2050 compared to the baseline[155]. Unlike insulation materials, which lead to material accumulation in the building stock, the replacement of heating systems does not add material to the building stock. The majority of heating systems consist of metal. According to Eurostat material flow data, they already have a high recycling rate in waste treatment (around 90%). For this reason, a scarcity of materials for heating systems appears to be rather improbable, as the substitution of raw materials with secondary ones could compensate for the additional demand.

In addition, overall production in the construction industry in the EU is significantly below – more than 10% – the level reached in 2008[156]. This gap illustrates the construction industry's cyclicality and its capacity to expand relatively quickly to its pre-financial crisis levels and beyond, provided the appropriate conditions are met.

The historical capacity of market expansion together with the unprecedented global post-COVID market conditions could lead to a progressive cooling-off over time of the current price shock. However, the linked risks of high prices and lack of key materials and products on the renovation markets cannot be excluded for the future, and other shocks could also arise. Climate change and the global integration of value chains in particular will lead to higher shock frequency and severity in the future. Shocks affecting the supply of materials could stem from events including, but not limited to, extreme climatic events, financial crises, another pandemic, cyberattacks or trade disputes. It is however not possible to accurately quantify upstream the impact of such potential future shocks on the production, delivery and prices of materials in 2030 and 2050.

There are nonetheless mitigation factors that can be supported. Section 8.4 on the 'Challenges of the proposed measures' lays down the conditions to further ensure market scalability and limit those risks.

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[155] Ibid.

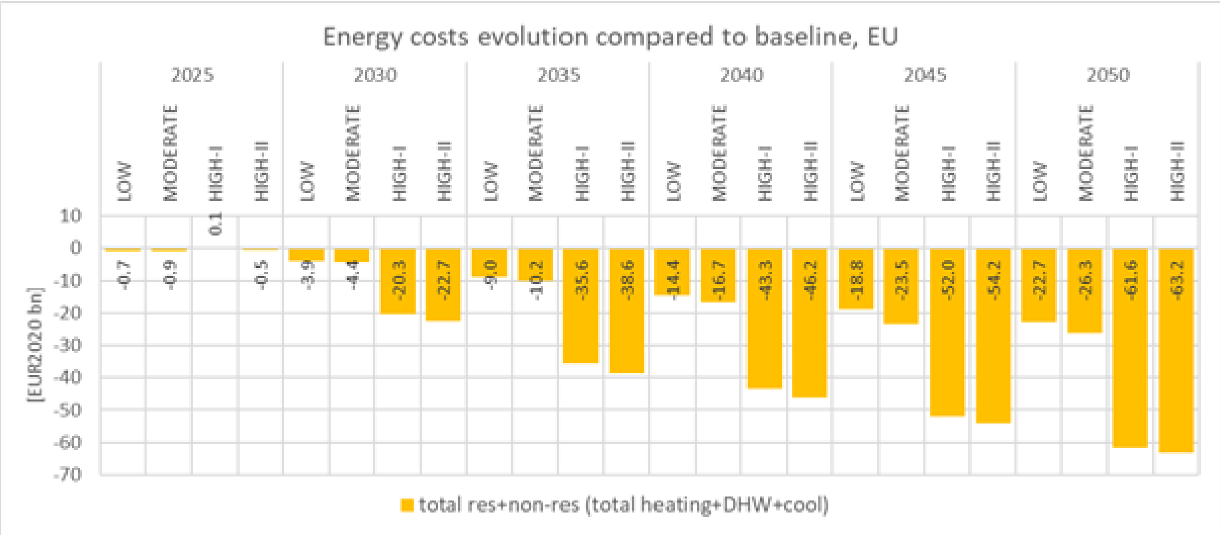
[156] Based on Eurostat data from [sts_copr_m]; with an indicative index of 100 in 2015, by way of comparison, production was 113 in February 2020 and 111 in July 2021, compared to the record of 128 in February 2008. Production in construction means the output and activity of the construction sector. It measures changes in the volume of output.

6.4.1.3 Impacts on energy expenditure, investments and their distribution across income groups and regions

The counterpart of high upfront costs in building renovation, which becomes necessary to implement MEPS, is a reduction of the energy needs of the building, and with it the energy costs to be faced by building occupants.

Figure 6.9 shows how total energy costs in all buildings[157] develop between 2020 and 2050. In 2020, around 80% of energy costs are spent on residential buildings, while only around 20% are linked to non-residential buildings. Compared to 2020, energy costs for heating in the baseline scenario are projected to increase by 17% in 2030, driven by the increase in energy consumption and higher energy prices[158].

Figure 6.9: Energy costs at EU level in the considered scenarios compared to baseline[159]



Source: Guidehouse et al.

The introduction of MEPS and ZEBs has clear effects in **reducing total energy costs**. These become progressively more significant over time (together with more stringent standards) and with a more comprehensive combination of MEPS, with maximum effects in the HIGH scenarios. In 2030 compared to the baseline, the energy cost savings will be around 1.7% in the MODERATE scenario and around 8% in the HIGH scenarios. The impact becomes visible after 2025 due to anticipation effects and first obligations before 2030. In the modelled scenarios, there is a steep decrease in energy costs between 2030 and 2050, induced by a decrease in the energy needs of buildings through implemented measures. The annual energy costs will therefore reach EUR 223 billion by 2020 in the baseline scenario, EUR 197 billion in the MODERATE scenario and around EUR 161

[157] This applies to building services covered by the EPBD, i.e. heating, cooling, ventilation, DHW; other uses, e.g. household appliances, are not included.

[158] Energy price assumptions have been aligned to those used in all the proposals of the 'Fit for 55' package. See Annex D on analytic methods for more details.

[159] Based on Guidehouse (2021).

billion in the two HIGH scenarios. Despite increased energy prices, this means that energy savings in the MODERATE scenario and in the two HIGH scenarios will be around 12% and 28% of the total energy costs in 2050 in the baseline scenario.

It is important to mention that as the baseline only accounts for policies already in place, the introduction of a **carbon price** for heating fuels and its effect on energy prices is not included in the analysis of impacts of energy costs. An extension of ETS to the building sector would cause an increase in heating fuel costs (for fossil fuels), which is expected to reach around EUR 48/tonne in 2030 in the CTP MIX scenario. While providing for an additional incentive to a fuel switch and therefore to more efficient heating appliances that will improve the performance of buildings, it would also lead to an increase in the cost of GHG-intensive heating faced by final consumers. However, an ETS extension would also allow governments to raise the necessary funds to tackle energy poverty and help vulnerable customers.

The reduction of costs in the energy bills of consumers resulting from the implementation of MEPS would be greater if there is a carbon price. The higher the carbon price, the lower the payback period for renovation investments.

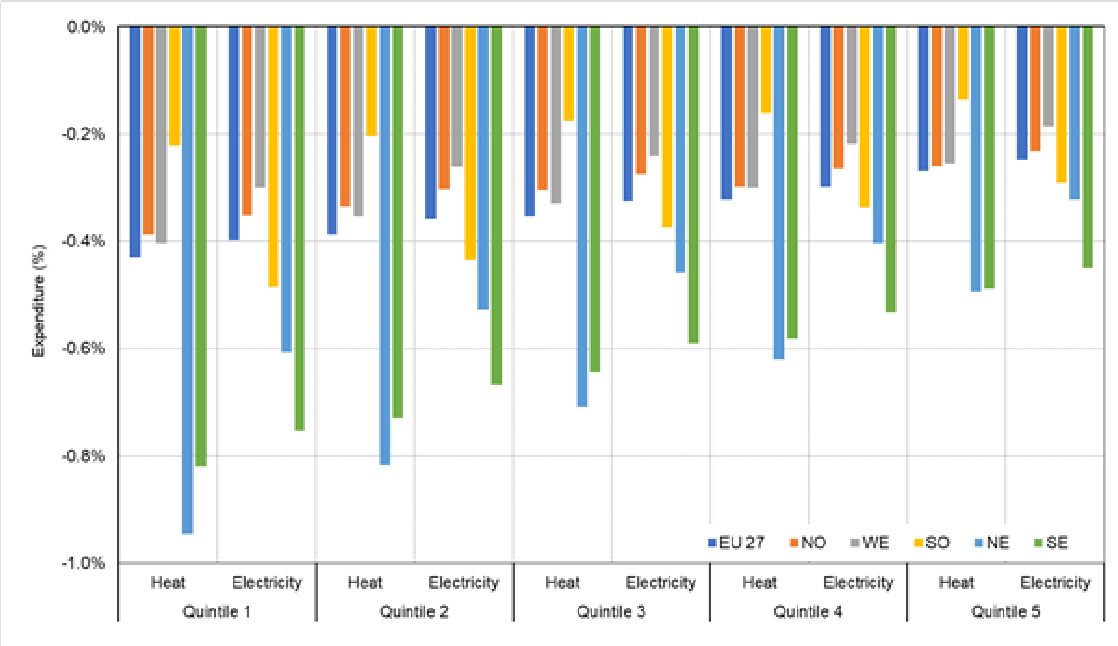
The impact on the share of expenditure that households need to use for energy is different across income groups. For low-income households, the share of energy expenditure in total consumption expenditure is much higher than for higher-income households. Renovations and subsequent energy savings in their homes therefore result in energy savings with positive impacts on energy poverty alleviation. A change in energy expenditure through renovation helps households with lower incomes, in particular those that live in worst performing buildings and are able to save the most.

Figure 6.10 shows the difference between HIGH-I and baseline at EU-27 and EU regional level regarding the share of heat and electricity expenditure in total consumption expenditure by income quintiles in 2030. The distributional impact depends on a number of key issues: building stock efficiency, climate conditions of the Member States, the energy source and energy amount used for heating and electricity combined with the disposable income of EU households. Data on building stock efficiency in the EU and its link to household income and building performance is incomplete. Therefore, the following analysis is based on assumptions about the allocation of energy savings resulting from building renovation measures. Reductions in energy expenditure are attributed to income quintiles according to the expenditure shares in the baseline. This is an assumption taken within the analysis to allocate savings across income groups. It implicitly assumes that renovation projects with roughly the same efficiency improvements are distributed evenly across income groups.

The results show larger savings for households in the lower quintiles for the EU-27 in total. The first quintile saves around 0.8% of energy expenditure in HIGH-I, while the fifth quintile saves around 0.5%. Since low-income households have to spend proportionally more of their income on energy, they also save more within the HIGH-I scenario. A shift in this assumption towards increased renovation of worst performing multi-family buildings would imply an even more pronounced savings effect for low-income households. North-east and south-east EU countries show the highest decrease in energy expenditure. The building stock likely included a higher range of worst performing houses. This results in higher savings.

Due to a lack of data on building stock efficiency, the proportion of energy expenditure savings especially for low-income households in the first quintile is subject to sensitivity: if energy efficiency improvements are predominantly made in buildings inhabited by low-income households, savings would be more pronounced, in particular relating to overall expenditure.

Figure 6.10: Difference between HIGH-I and baseline: share of heat and electricity expenditure on total consumption expenditure by income quintiles for EU-27 (2030)



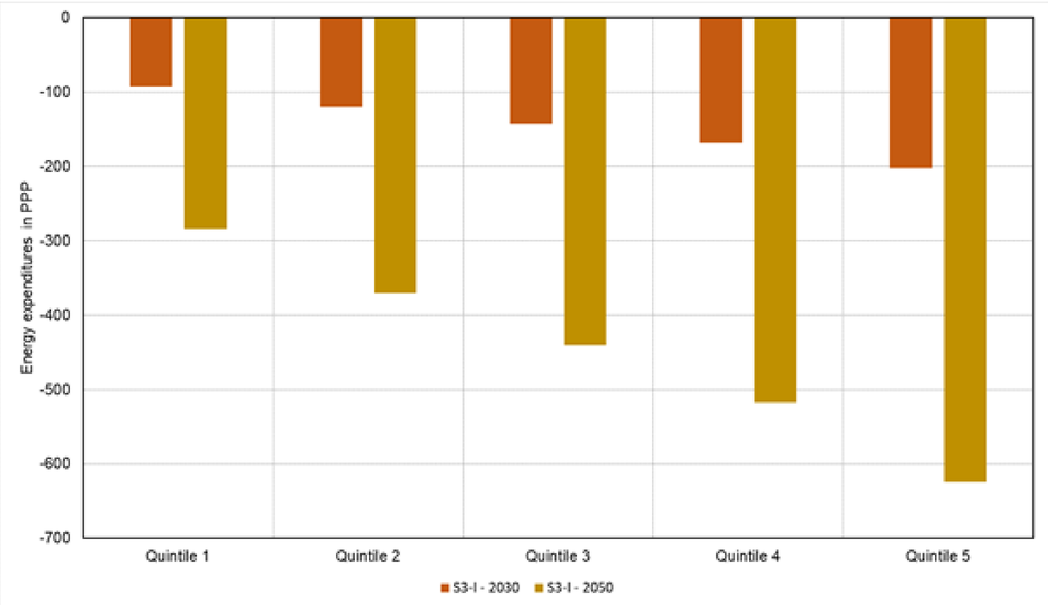
Source: Guidehouse et al. based on Eurostat (hbs_str_t223) and own calculation (explanation quintiles: quintile 1 = lowest income households to quintile 5 = highest income households)

In addition to improving building efficiency through renovation measures, heating and cooling technologies play a major role in energy expenditure. The replacement of old heating technologies can have a large impact on low-income households. From the assessment of options, it seems that as income rises, the share of household income spent on heating energy declines. In Member States with lower mean incomes, expenditure on heating energy is generally higher. This indicates that heat is a necessary good and does not readily respond to changes in income. However, energy prices and climatic conditions in the respective Member States also play a large role. As income rises, households spend a smaller fraction of their income on heating. At the same time, the amount of heating energy consumed rises with income. In fact, the top income quintile regularly consumes 2-3 times as much heating energy as the bottom one.

The results vary between Member States: it clearly shows that eastern European countries (region NE = -1.4%, region SE = -0.9%) benefit much more from the measures in the HIGH-I scenario (compared to the baseline and due to a reduction in heat and energy expenditure). This can be due to the fact that the share of worst performing buildings and therefore energy expenditure is higher. The majority of the population in eastern Europe own and live in single-family houses. The share is significantly higher than in western European countries.

Figure 6.11 shows the difference in energy expenditure between the HIGH-I scenario and the baseline in absolute terms. Following our assumption that renovation and subsequent energy savings are distributed proportionally to expenditure shares, low-income households in the first quintile save around 92 PPP[160] in 2030 and 284 PPP in 2050. High-income households in the fifth quintile save around 202 PPP in 2030 and 624 PPP in 2050. This is due to energy efficiency measures in buildings.

Figure 6.11: Difference between HIGH-I and baseline: heat and electricity expenditure by income quintiles for EU-27 (2030 and 2050)



Source: Guidehouse et al., based on Eurostat (hbs_str_t223) and own calculation

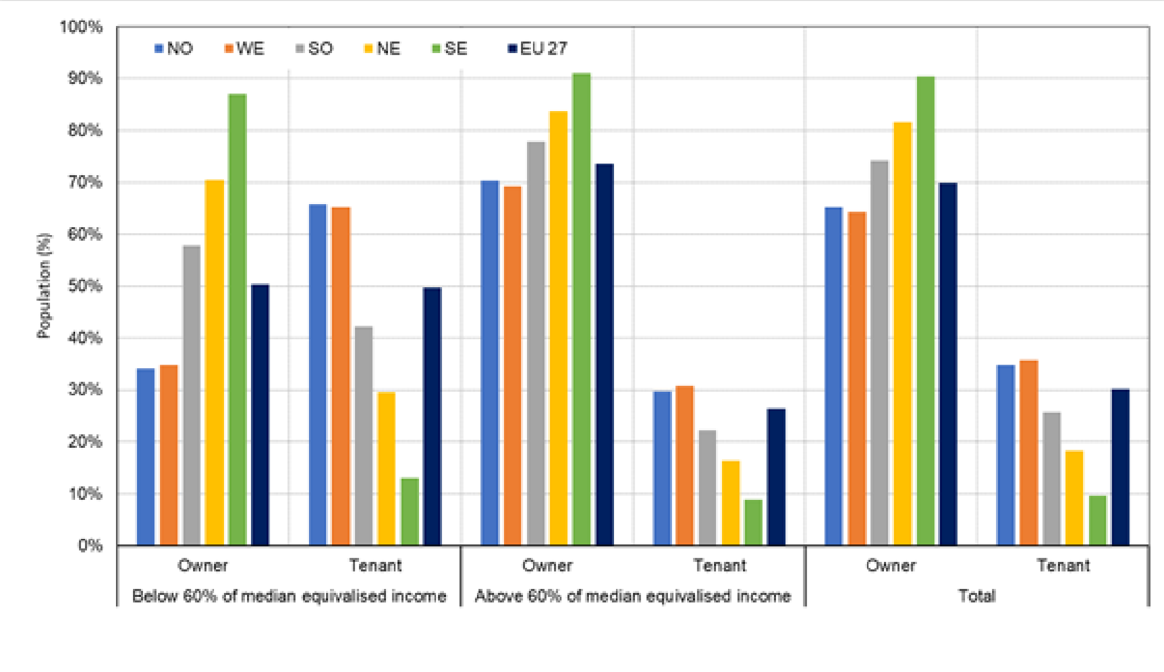
6.4.1.4 Property values and rents

Estimating the impact of energy efficiency on the value of buildings is difficult, as both sale and rental prices are influenced by a multitude of endogenous and exogenous factors (e.g. location), as well as market conditions and general supply-demand balance. There

160 Purchasing power parity.

is, however, some evidence to suggest that higher values are associated with better performance[161]. In addition, buildings with better energy performance have shorter vacancy periods, a lower loss of rental income due to changing tenants and, as such, show a more positive operating impact for the owner. In the commercial sector, buildings that fail to keep up with technological advances, including widespread advances in energy efficiency, risk becoming obsolete, especially in unfavourable market conditions (such as periods of low or negative economic growth)[162].

Figure 6.12: Distribution of the EU population by tenure status, region and income group in 2019[163]



Source: Guidehouse et al., based on Eurostat (hbs_str_t223) and own calculation

We can therefore assume that an indirect effect of the implementation of MEPS on the value of upgraded buildings would be positive. At the same time, worst performing buildings needing renovation to comply with MEPS could be penalised in market transactions by 'brown discounts', which could lead to their depreciation or even stranded assets.

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[161] Zancanella et al. (2018) explain that energy efficiency measures increase the price of residential assets by around 3-8%, with an increase of around 3-5% in residential rents compared to similar properties (https://link.springer.com/article/10.1007/s11146-019-09720-0) . The values vary across regions and countries, as well as due to different property types (e.g. apartments vs. houses). Chegut et al. (2019) show the high variation in energy efficiency values on European housing markets; they find ranges between 0.04% and 15%, depending on the market and transaction type. Chegut et al. (2020): Energy Efficiency Information and Valuation Practices in Rental Housing; https://link.springer.com/article/10.1007/s11146-019-09720-0/tables/6

[162] The Macroeconomic and Other Benefits of Energy Efficiency (europa.eu)

[163] Guidehouse (2021) based on Eurostat (ilc_lvho02).

In turn, MEPS could result in an increase in rents for those buildings that are renovated in compliance with minimum energy performance standards. To cover their investment costs, landlords tend to pass on energy efficiency-related investment costs to tenants by increasing rents. Depending on the extent of the rent increase, this might counterbalance any savings that tenants might experience through lower energy costs[164]. This effect is expected to be variable across countries and income groups as illustrated in Figure 6.12, which shows the variable share of tenancy across the EU.

Aligning the incentives in the rental housing market with efficient climate protection is most important in Germany, Austria, the Netherlands, France, Sweden and Denmark, where more than 30% of households are renters. The effect of higher rents is also expected to be regressive, as tenancy is higher in populations with below 60% of median equalised income. Appropriate policies and incentives can mitigate the possible increase in rents[165].

6.4.2 Macroeconomic impacts

6.4.2.1 Employment and value added

Table 6.7: Summary of key macroeconomic impacts[166]

		2030				2050			
Main indicator	[unit]	LOW	MOD.	HIGH-I	HIGH-II	LOW	MOD.	HIGH-I	HIGH-II
Macro-economic impact									
Additional low and medium skilled jobs	[% from 2020]	0.22%	0.27%	1.24%	1.29%	0.16%	0.13%	1.18%	1.17%
Additional high skilled jobs	[% from 2020]	0.14%	0.18%	0.63%	0.65%	0.12%	0.10%	0.65%	0.66%
Additional value-added created in the EU	[% from 2020]	0.18%	0.24%	0.86%	0.91%	0.15%	0.13%	0.85%	0.86%

Source: Guidehouse et al.

The EU construction industry ecosystem contributes around 9.6% of EU value added and employs almost 25 million people in 5.3 million firms[167]. It consists of contractors for building and infrastructure projects, some construction product manufacturers[168], engineering and architectural services as well as a range of other economic activities such as rental and leasing of machinery and equipment and employment agencies.

Higher renovation rates and higher standards for new constructions will have a multiplier effect on jobs and growth in the construction sector and across the **renovation value chains**. The construction ecosystem is labour-intensive, and over 99% of its firms are

[164] Where the rent includes costs for heating and domestic hot water, the situation is different as the landlord makes the investment and also benefits from the savings.
[165] Renonbill (2021): The Renovation Wave: building renovations to foster EU economic recovery. Policy briefing.
[166] Results of the Exiobase modelling, reflecting changes in jobs and value-added induced by changes of domestic production due to investment impulse on affected sectors.
[167] SWD(2021) 351 final.
[168] Some categories of products that are essential to construction, such as cement, glass, ceramics and tiles, and plastic pipes are covered under the energy-intensive industries ecosystem.

micro businesses or **small and medium-sized enterprises (SMEs)**[169]. They supply essential technologies, materials and services locally[170].

The effects on **employment** and valued added are the economic effects that result from increased investments in building renovation and reduced energy consumption of fossil fuels for heating. These effects can be considered net effects as they account for simultaneous changes due to investment in renovation and a subsequent reduction in energy demand.

However, the expected positive impact is dependent on the availability of financial resources. If financing is not available, the additional expenditure diverts productive resources (either capital or labour) from other productive uses. Such crowding out results in scarcity conditions that have adverse effects on the economy[171]. In addition, budgetary effects (when the funding of energy efficiency expenditure reduces other expenditure to the detriment of private consumption and productive investment) can also reduce the positive impact of energy efficiency spending.

In the HIGH scenarios, the need for **low- and medium-skilled labour**[172] increases significantly, while the reduction in fossil fuel energy demand leads to reduced employment and value added in those sectors that supply fossil fuels for heating, in particular natural gas followed by heating oil and district heating, and also to a smaller extent coal. At the same time, additional employment is needed to provide electricity used in heat pumps. New electricity demand is assumed to be based on renewable electricity, e.g. solar PV, wind and biomass-based electricity. In the HIGH I scenario, a total of around 1.4 million additional low- and medium-skilled jobs will be created by 2030 compared to 2020. These additional jobs will be kept at almost the same level in 2050 compared to 2020 (Table 6.7). Another 450,000 additional jobs will be created in the high-skilled segment. For high-skilled labour, the share of additional employment is highest in the trade & services and construction sectors. This reflects the jobs of architects, real estate, logistics, financial services and several other professions in the construction sector, which are key to renovations. Renovation and new build activities within the EU also further stimulate employment in countries that supply products and services to the EU[173].

[169] SWD(2021) 351 final.

[170] Only companies in the chemicals, rubber and plastic product sectors are likely not to be small or medium-sized.

[171] The analysis underpinning the Climate Target Plan and the EED revision estimated that around 9-20 jobs in manufacturing and construction are created for every USD 1 million invested in retrofits or efficiency measures in new builds in the EU.

[172] The need for additional low- and medium-skilled labour is highest in the construction and material sector, including on-site construction activities, but also glass production for windows, chemicals, rubber, and plastics to provide insulation material, wood for window frames and new construction.

[173] Such employment effects are seen mainly in the Asia and Pacific regions for low- and medium-skilled labour, and to a smaller extent also in other non-EU countries (including the UK, Norway, Iceland etc.) and

Effects on **value added**[174] follow a similar pattern to employment effects and are dominated by stimulus in the construction and material sector through investment in insulation, window renovation and new build (Table 6.7). Trade and services also play a major role. They include installation of machinery and equipment, e.g. heating technologies (boilers, heat pumps, pipes, radiators etc.) but also architects, contracting, real estate activities, renting of machinery and equipment, logistics, transport services, and delivery. The service sector, which consists almost entirely of SMEs, is traditionally heavily involved in the building environment. The effects are almost constant over 2030-2050.

The main positive stimulus can be seen for the construction and material sectors as well as machinery and equipment. This is due to their important role in providing goods and services for wall/floor/roof insulation, windows and heating replacements as described above. A reduction in energy demand only has small negative effects on value added, in particular in the sectors that provide fossil fuels for heating, i.e. natural gas, heating oil and coal. Overall, EU value added in the HIGH-I and HIGH-II scenarios is around +0.9% (or around EUR 115-125 billion additional value added) higher than in 2020 both in 2030 and 2050, while in LOW/MODERATE it is around +0.2-0.25% in 2030 and +0.11-0.14% in 2030 and 2050 respectively (Table 6.7).

6.4.2.2 The challenges of increasing labour

Delays in the construction sector experienced since the beginning of the pandemic call for an analysis of whether the economy can adapt to higher demand on workforce and skills[175]. In September 2021, almost one third (29.7%) of the firms in the construction sector in the EU-27 declared that a shortage of labour is a factor limiting building activity[176]. The average proportion in 2018-2019 was 23.7%, up from 13.2% in 2016-2017 and 6.6% in 2014-2015, showing a clear increase over a five-year period.

We first need to analyse the impact of the measures proposed under the 'Fit for 55' package overall and of the EPBD revision specifically on the availability of labour. On the impact of the 'Fit for 55' package, methods used include a dynamic analysis using the general equilibrium model GEM-E3-FIT. It takes into consideration direct as well as indirect and induced effects on both the demand and supply of labour, also in other

in Africa. High-skilled labour effects in other regions induced by EU-27 activities occur to a smaller extent also in Asia-Pacific as well as in the rest of Europe. While employment effects in Asia-Pacific and the rest of Europe refer mainly to industry and trade & services that get delivered to the EU-27 (e.g. insulation materials), for Africa they are highest in the agricultural and forestry sector.

[174] The main difference between GDP and gross value added is that the gross value added of a sector is measured net of taxes (for instance VAT) and subsidies on products. In the national accounts for the euro area, product taxes (minus subsidies) are recorded for the economy as a whole and added to the total gross value added.

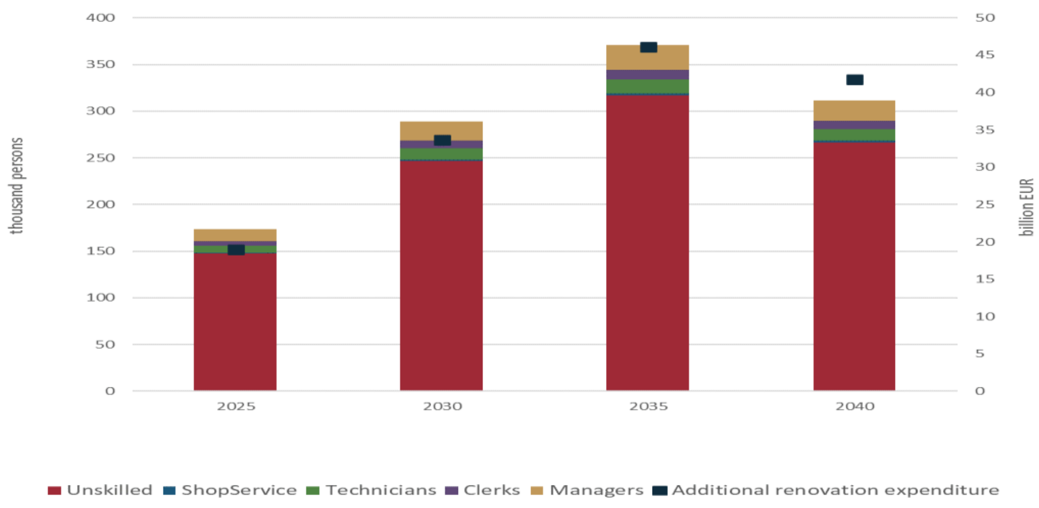
[175] No conclusive data was found on the extent (quantification) of those delays.

[176] Eurostat monthly data from the Business Survey. No conclusive data was found on the extent (quantification) of those delays.

sectors affected by activity in the construction sector. The GEM-E3-FIT model is described in the impact assessment of the 'Fit for 55' package[177].

Figure 6.13 shows the additional demand for labour by occupation type in the MIX scenario compared to REF.

Figure 6.13: Renovation expenditure and additional demand for labour by occupation type in the EU (MIX vs REF).



Source: analysis based on GEM-E3-FIT input-output tables.

To put these changes into perspective, we can compare the values reported in Figure 6.13 to the year-to-year variations of employment in the construction sector as shown in Table 6.8.

Table 6.8: Employment in the construction sector in the EU

	2011	2012	2013	2014	2015	2016	2017	2018
Employment in construction [m people]	11.78	11.46	10.96	11.19	10.97	11.29	11.53	12.14
Change year-to-year [m people]	-	-0.319	-0.498	0.232	-0.217	0.321	0.240	0.608
Change year-to-year [%]	-	-2.7%	-4.3%	2.1%	-1.9%	2.9%	2.1%	5.3%

Source: Eurostat SBS.

177 For example in the annexes of the EED impact assessment SWD(2021) 623 final, Part 2. The setup for the model is similar to the scenarios used to estimate the macroeconomic impact of the Climate Target Plan or the 'Fit for 55' policy initiatives.

The additional demand for labour in the construction sector by 2030 due to the 'FIT for 55' package appears to be smaller (or at most comparable to) than the year-to-year variations in employment. Moreover, the figures from Table 6.8 cumulate the effect of all policies and measures in the 'Fit for 55' package and therefore constitute an upper bound for the impact of the EPBD.

To understand the likely impact of the EPBD revision alone on labour supply, we performed a sensitivity analysis on investments in construction. To find a meaningful range for the change in investments, we linked it to the renovation rate, which depends on the implementation of the revised EPBD. The renovation rate in the residential sector is 1.2% of the building stock per year in the REF scenario and 2.1% in the MIX scenario[178]. The renovation rate could be lowered by 0.6 percentage points without the drivers provided by the EPBD revision. A range of +-0.6% was therefore chosen for the sensitivity analysis, corresponding to renovation rates of 1.5% and 2.7%. This corresponds to a change in investments of +-29% (using the split of investments between renovation and new buildings provided by the PRIMES model).

This investment shock was introduced in the GEM-E3-FIT model. Table 6.9 shows the % change in construction activity and employment. A +-29% change in expenditure on the renovation of old constructions results in approximately a 1% change in construction activity and employment (changes in total employment are negligible[179]).

Table 6.9: Change (in %) due to a +-29% change in expenditure on renovation of old constructions.

	MIX rel. to REF			MIX_minus29% rel. to MIX			MIX_plus29% rel. to MIX		
	2025	2030	2035	2025	2030	2035	2025	2030	2035
Construction activity	1,05	1,25	0,24	-1,02	-0,99	-0,84	1,02	0,98	0,84
Total Employment	0,03	0,01	-0,06	-0,04	-0,03	-0,03	0,03	0,03	0,03
Construction employment	1,27	1,58	0,89	-1,00	-0,95	-0,80	1,00	0,95	0,79
Gross earnings_Total	0,00	0,00	-0,01	-0,02	-0,02	-0,02	0,02	0,02	0,01
Gross earnings_Unskilled	0,06	0,02	-0,14	-0,13	-0,13	-0,11	0,13	0,13	0,11
Gross earnings_ShopService	-0,03	-0,03	0,01	0,03	0,03	0,02	-0,03	-0,03	-0,02
Gross earnings_Technicians	-0,03	-0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Gross earnings_Clerks	-0,01	0,01	0,03	0,00	0,00	0,00	0,00	0,00	0,00
Gross earnings_Managers	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00

Source: GEM-E3 based on Eurostat

This 1% change is substantially and logically below the change to the impact of the 'Fit for 55 Package' overall. As explained above, this is itself in line with or even below the rates of job creation in the construction sector recorded in recent years. According to Eurostat, employment in the construction sector remains well below the peak reached in the late 2000s: 12.6 million employees (6.7% of total employment) in Q1-2021 vs. 16.1 million employees (8.4% of total employment) in Q3-2008. Those historical trends and fluctuations indicate that the construction sector is probably able to further absorb the

[178] Since the only goal is to define a range for investments, for simplicity reasons only the renovation rate in the residential sector was used.

[179] Due to the rest of the impacts via the readjustment of wages, interest rates etc. as explained in the Climate Target Plan impact assessment and under fairly pessimistic assumptions on the availability of capital and labour.

estimated additional jobs that will be needed. The revised EPBD could contribute to a sector severely hit after the 2008 crisis.

This capacity of the construction market to adapt to higher demand should be supported by the fact that the EU-27 is not at full employment at aggregate level. Cross-sectoral shifts and cross-border migration (i.e. from countries with an excess of unemployed workers to those with a deficit) will also help ease potential shortages linked to higher demand for works. Demand in the construction sector is mostly for unskilled jobs, but pressure in this labour market is mitigated by the decline of unskilled employment in other sectors.

Those elements nonetheless have to be considered with care. As shown in the rates of job creation and destruction, the construction sector is particularly cyclical since it depends not only on business and consumer confidence, but also macroeconomic factors such as interest rates linked to central banks' monetary policies and to governments' budgetary programmes. It is therefore not immune to temporary shocks, which may lead to delays and temporary price increases similar to those recorded since the beginning of the pandemic. The lack of even a small number of critical workers in key sectors could also result in significant disruptions.

While those shocks and potential disruptions cannot be fully anticipated, an appropriate package of policies and mechanisms can limit their occurrence and impact. Those responses, including Commission initiatives, are presented in Chapter 8.

6.4.3 Impacts on energy poverty

A fair transition is central to the EU Green Deal. The CTP impact assessment showed that, in the absence of mitigating measures, climate policies could have a regressive impact that negatively affects vulnerable consumers. Policy intervention in the building sector has the potential to mitigate or even reverse this effect, especially with regards to energy poverty[180] and its linkage to poor energy efficiency of homes. The Commission Recommendation on energy poverty[181] highlights the need to address building performance, the fair distribution of burdens and energy poverty simultaneously to ensure clean energy for all Europeans[182].

[180] Caldeira, Igor; Dallhammer, Erich; Schuh, Bernd; Hsiung, Chien-Hui (2019): Energy Poverty. Territorial Impact Assessment. European Committee of the Regions: Commission for the Environment, Climate Change and Energy (ENVE).

[181] Commission Recommendation of 14.10.2020 on energy poverty (SWD(2020)960final) https://ec.europa.eu/energy/sites/ener/files/recommendation_on_energy_poverty_c2020_9600.pdf together with its annex and accompanying staff working document.

[182] According to the Commission Recommendation on energy poverty and Regulation (EU) 2018/1999 and its recast 2019/944/EU, 'energy poverty' means a situation in which households cannot afford the essential energy services necessary for a decent standard of living.

Table 6.10: Summary of main socio-economic impact at EU level in the considered scenario (compared to baseline)

		2030				2050			
Main indicator	[unit]	LOW	MOD.	HIGH-I	HIGH-II	LOW	MOD.	HIGH-I	HIGH-II
Social impact									
Household expenditure									
Share of heating expenditure in total expenditure									
Quintile 1	[% from 2020]	-0.1%	-0.1%	-0.4%	-0.5%	-0.5%	-0.5%	-1.3%	-1.4%
Quintile 2	[% from 2020]	-0.1%	-0.1%	-0.4%	-0.4%	-0.4%	-0.5%	-1.2%	-1.2%
Quintile 3	[% from 2020]	-0.1%	-0.1%	-0.4%	-0.4%	-0.4%	-0.4%	-1.1%	-1.1%
Quintile 4	[% from 2020]	-0.1%	-0.1%	-0.3%	-0.4%	-0.4%	-0.4%	-1.0%	-1.0%
Quintile 5	[% from 2020]	0.0%	-0.1%	-0.3%	-0.3%	-0.3%	-0.3%	-0.8%	-0.9%
Share of electricity expenditure in total expenditure									
Quintile 1	[% from 2020]	-0.1%	-0.1%	-0.4%	-0.4%	-0.5%	-0.5%	-1.2%	-1.3%
Quintile 2	[% from 2020]	-0.1%	-0.1%	-0.4%	-0.4%	-0.4%	-0.4%	-1.1%	-1.1%
Quintile 3	[% from 2020]	-0.1%	-0.1%	-0.3%	-0.4%	-0.4%	-0.4%	-1.0%	-1.0%
Quintile 4	[% from 2020]	-0.1%	-0.1%	-0.3%	-0.3%	-0.3%	-0.4%	-0.9%	-0.9%
Quintile 5	[% from 2020]	0.0%	-0.1%	-0.2%	-0.3%	-0.3%	-0.3%	-0.8%	-0.8%
Energy poverty indicators (mean change across deciles)									
Arrears on utility bills	%points from BS	-0.2%	-0.2%	-1.2%	-1.1%	-1.3%	-1.4%	-3.6%	-3.6%
Inability to keep home adequately war	%points from BS	-0.2%	-0.2%	-1.2%	-1.2%	-1.4%	-1.5%	-3.7%	-3.7%
Low absolute energy expenditure (M/2	%points from BS	-0.3%	-0.3%	-1.6%	-1.5%	-1.8%	-1.9%	-4.8%	-4.9%
High share of energy expenditure in in	%points from BS	-0.3%	-0.4%	-1.7%	-1.7%	-2.0%	-2.1%	-5.3%	-5.4%
Population in a dwelling with a leaking roof, damp, rot frames									
<60% of median eq income	[% from 2020]	-0.4%	-1.0%	-1.2%	-2.0%	-0.6%	-1.4%	-1.8%	-3.0%
>60% of median eq income	[% from 2020]	-0.2%	-0.6%	-0.7%	-1.1%	-0.3%	-0.8%	-1.0%	-1.7%
Total population	[% from 2020]	-0.3%	-0.6%	-0.8%	-1.3%	-0.4%	-0.9%	-1.1%	-1.9%

Source: Guidehouse et al.

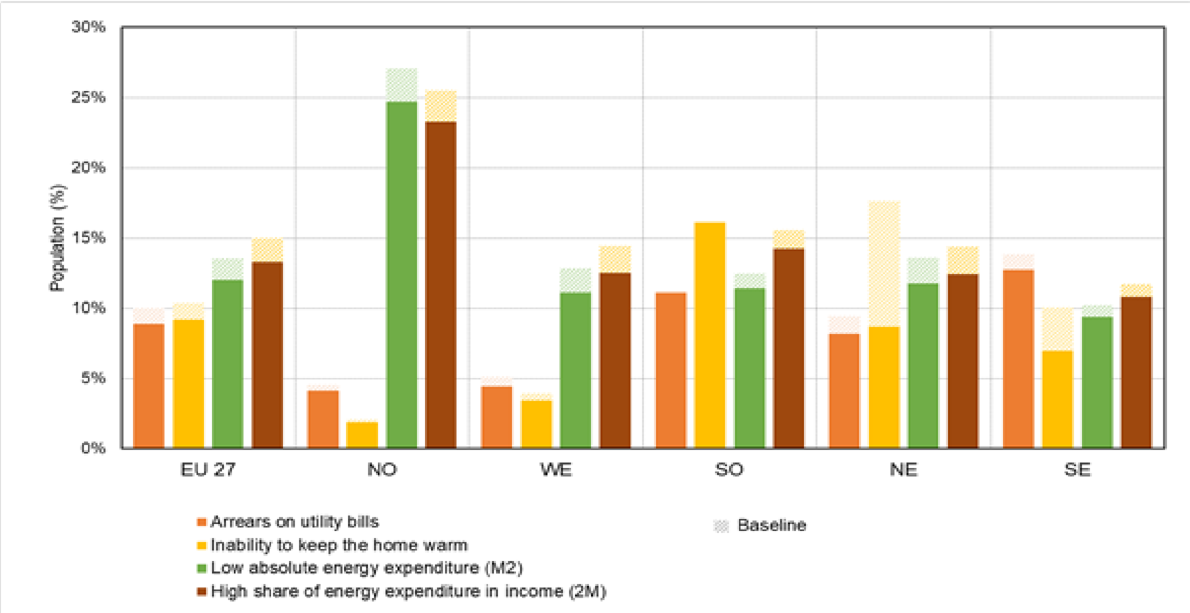
On average, EU consumers spent 31.9% of their overall consumption on housing[183]. The share spent on housing including water, heat and electricity increases when income decreases, therefore low-income households carry a much higher burden for housing than higher-income households[184]. The EU survey on income and living conditions (EU SILC) estimates that 31 million Europeans (7% of the EU-27 population) were unable to keep their home adequately warm in 2019. This is a reduction of 4 percentage points compared to 2014. A similar number is being reported with regard to arrears on utility bills. Around 6% of the EU-27 population were affected by this in 2019. As assessed in the previous section, all options would reduce heat and electricity expenditure (albeit with different degrees of intensity across scenarios). This is expected to have positive effects on poverty alleviation if combined with appropriate funding schemes.

[183] Eurostat (hbs_str_t211).

[184] This is the case even though actual expenditure for energy (heat and electricity) is much higher for high-income households. In fact, the top income group regularly consumes 2-3 times as much heating energy as the bottom one. This is mainly due to larger floor spaces in houses or apartments as well as more appliances in high-income households.

Compared to the baseline, all scenarios lead to a decrease in the share of population in **energy poverty** for all main energy poverty indicators[185]: arrears on utility bills, inability to keep home warm, the proportion of households whose share of energy expenditure in income is more than twice (2M) the median share or whose absolute energy expenditure is only half of (M/2) the median expenditure (Table 6.10). The impact is highest in the two HIGH scenarios – these deliver more and better renovations, which will reduce energy bills and improve indoor conditions. Lower-income households in particular benefit from the policy measures, notably in the two HIGH scenarios. The relative decrease (compared to the baseline) in energy poverty indicators for the poorest decile and in the mean across all deciles is around 3-4 times higher in 2030 and more than twice in 2050 for HIGH scenarios than in LOW and MODERATE ones. In HIGH scenarios, this affects around 12 million households, whose energy poverty is reduced compared to the baseline. In the HIGH-I scenario, the share of the population in decile 1 unable to keep their homes warm decreases from 22% to 19% in 2030 and to 14% in 2050. In the second decile, the share of the population decreases from 17% to 15% (in 2030) and to 11% (in 2050). The high ambition measures therefore result in a decrease in energy poverty as measured by the indicator 'share of population unable to keep home warm'.

Figure 6.14: Comparison HIGH-I and baseline: share of energy poverty by indicators in population of EU-27 and five European regions (2030)



Source: Guidehouse et al., based on data from the EU Energy Poverty Observatory and Eurostat (EU SILC; Household Budget Survey)

[185] The calculation is based on the assumption that energy savings are proportional to energy expenditure across income groups. The expenditure on energy per disposable income is taken from Eurostat (2021) and the Energy Poverty Observatory (2021).

Figure 6.14 provides a more detailed view of the countries affected by energy poverty. Member States like Bulgaria, Croatia, Hungary, Cyprus and Latvia exhibit high rates of energy poverty according to the indicators 'arrears on utility bills' and 'inability to keep the home warm' in 2030. On the two expenditure indicators (M2 and 2M), Nordic countries are most affected (e.g. Sweden, Finland).

While there are benefits in reduced energy expenditure due to energy efficiency measures, there is also the potential of unrealised energy savings as efficiency gains can be counterbalanced by increased energy consumption. The rebound effect leads to fewer reductions than expected. In particular, households who were previously unable to keep their homes warm might use more heat after the efficiency improvements than before. The extent of such indirect effects driven by higher disposable income cannot be anticipated. However, examples from Sweden, which has a high efficiency renovation rate, show that such effects tend to be small[186].

6.4.4 Financing, affordability and distributional impacts across EU regions: a sensitivity analysis

As shown above, investments in HIGH scenarios are much higher than in the baseline or in the LOW or MODERATE ambition scenarios. Additional investments in renovation combined with heating and cooling technology is around four times higher in HIGH scenarios.

Investments can be recovered through energy savings. However, if buildings are not owner-occupied, energy costs are usually paid by tenants. To cover their investment costs, landlords then tend to pass on energy efficiency-related investment costs to tenants by increasing rents. Depending on the extent of the rent increase, this might counterbalance any savings that tenants might experience through lower energy costs, thereby placing an additional burden on households. Therefore, distributional impacts for tenants depend largely on whether and in how far renovation costs can be passed on and whether they exceed savings in energy costs. The possibility to increase rents is regulated in different ways across Member States[187]. As low-income households spend the highest share of income on housing-related costs, they are most vulnerable to any increase in rent, which is not balanced out by energy savings.

Many stakeholders, in particular non-governmental organisations and professional associations, expressed concern about the lack of access to affordable and sustainable energy for all EU citizens. They also stressed the importance of the EPBD revision to tackle energy poverty and vulnerable households in general. The rental market is dominated by the split incentives (or principal agent) dilemma of investing in the energy renovation of buildings. More precisely, tenants have no incentive to invest in a building

[186] Agora (2019).
[187] Castellazzi 2017: Overcoming the split incentive barrier in the building sector.

owned by others, and building owners lack incentives to undertake renovation efforts – tenants are largely responsible for paying energy costs, so they cannot reap the benefits of reduced energy consumption. This non-economic barrier is more prominent in countries from northern and western European regions where the rental market prevails and a lower share of the population own homes (Figure 6.12).

To recover the investment costs, building owners tend to pass on energy efficiency-related investment costs to tenants by increasing rents. Depending on the extent of the rent increase, this might not counterbalance the savings that tenants might experience through lower energy costs, thereby placing an additional burden on households. Therefore, economic impacts for tenants greatly depend on whether and in how far renovation costs can be passed on and whether they are above or below the cost energy savings. As low-income households spend the highest share of income on housing-related costs, they are most vulnerable to any increase in rent that is not sufficiently compensated by energy savings as reflected in the energy bills. For this reason, a rent increase can generate regressive impacts.

To better assess the distributional impact of renovations across income classes and tenure status (owners and tenants), a sensitivity analysis was performed. The impact of two types of renovation was simulated – one in which buildings are renovated to zero-emission level, and the other one to partial zero-emission level. The analysis was applied to two representative residential buildings – a single-family house and a building unit in a multi-family block of flats, transposed to the most representative country from each EU climate zone in question (Table 6.11).

Table 6.11: Reference conditions for the sensitivity analysis of distributional impact of renovation on low-income households

	Tenant Households 1	Owner Households 2
Climate zone	NO, WE, SO, NE, SE	NO, WE, SO, NE, SE
Selected Member States	DK, DE, CY, CZ, SK	FI, BE, ES, SI, SK
House type	Apartment in MFH	SFH
Time-frame	average year (2020-2050)	average year (2020-2050)
Discount rate	6%, over 30 yrs	6%, over 30 yrs
Floor area	75 m²	130 m²
Status	Tenant	Owner

Source: Guidehouse et al.

For each zone and type of building, the investment in renovation and the corresponding energy savings were calculated, annualised (present value) over a 30-year period with a 6% discount rate[188]. The annual income of lowest and highest quintile were also

[188] 6% is the average discount rate used in Member State cost-optimality reports for the 'micro-perspective'.

estimated as well the approximate share of tenure for households below and above 60% of the median equivalised income (i.e. below and above at risk of poverty).

Second, the sensitivity analysis was performed based on 3 scenarios. These represent different possibilities related to the financial support available to owners or to the passing on of investment costs to tenants (Table 6.12).

Table 6.12: Scenarios for the sensitivity analysis

	Owner	Tenant
Scenario 1	No additional support for the investment	All investment cost passed onto the tenant
Scenario 2	25% grant support for investment	75% of investment cost passed onto the tenant
Scenario 3	40% grant support for investment	60% of investment cost passed onto the tenant

Source: Guidehouse et al.

Tables 6.13 and 6.14 present a summary of the results for ZEB and partial-ZEB renovation on each of the two reference buildings and in all three scenarios. Annex D presents a more extensive version of the sensitivity analysis.

In the case of a low-income household living in a rented apartment in a multi-family building that undergoes a ZEB-level renovation, the energy savings as a share of the annual income of low-income households vary from 7.9% in the NE region to 4.4% in the NO region. The sensitivity analysis shows significantly different impacts depending on the share of investment costs compensated by higher rents. When the full investment (annualised) is passed onto the tenant (scenario 1), then the rent increase does not compensate for the reduction in energy expenditure in all regions. The exception is in the NE region, where the reduction in energy costs generated by the energy savings overcompensates for the increase in rent due to the investment. When 75% of the annualised investment costs are passed onto the tenant (scenario 2), there is a positive economic impact (the savings on energy bills compensate for higher rents) in all regions except for inthe NO region. If only 40% of the annualised investment is passed onto the tenant, then there is a positive impact on the rent in all regions since the energy cost reductions generated by the renovation overcompensate for the impact of investment.

This example therefore shows that even with more costly renovations, it is possible that with split incentives, well-designed rules on rent increases, which take into account the impacts on energy savings, can result in win-win solutions for the owners and tenants, or limited net economic impacts for tenants. However, this can be difficult or limited to some regions. Financial assistance to the building owner to cover partial investment costs ensures that win-win situations could be achieved more easily. These results are also sensitive to energy prices. If there is a carbon price on heating fuels, the payback periods shorten and the net economic impact for the tenant becomes larger.

Table 6.13: Impact of renovation on low-income households living in multi-family houses (tenant)

Multi-familiy house (MFH) unit, average floor area of 75m2, inhabited by a tenant, initial status: not renovated

EU Region	ZEB renovation					partial ZEB renovation				
	Investment per MFH unit	Energy savings	Scenario 1 full pass on tenant	Scenario 2 75% pass on tenant	Scenario 3 40% pass on tenant	Investment per MFH unit	Energy savings	Scenario 1 full pass on tenant	Scenario 2 75% pass on tenant	Scenario 3 40% pass on tenant
		low income household	Net Effect on low income HH (Rent increase minus energy savings)				*low income household*	Net Effect on low income HH (Rent increase minus energy savings)		
	Euro	*(% of income)*	*(% of income)*	*(% of income)*	*(% of income)*	*Euro*	*(% of income)*	*(% of income)*	*(% of income)*	*(% of income)*
NO	19,654 €	4.4%	2.3%	0.6%	-1.7%	4,323 €	0.2%	1.2%	0.9%	0.3%
WE	18,718 €	7.8%	0.9%	-1.3%	-4.3%	4,045 €	0.7%	1.2%	0.7%	0.0%
SO	9,160 €	5.2%	1.2%	-0.4%	-2.6%	909 €	0.2%	0.4%	0.3%	0.1%
NE	7,476 €	7.9%	-0.3%	-2.2%	-4.8%	759 €	0.5%	0.3%	0.1%	-0.2%
SE	5,706 €	7.2%	0.1%	-1.8%	-4.3%	785 €	0.7%	0.3%	0.0%	-0.3%

Source: Guidehouse et al.

If the same apartment undergoes only a partial ZEB renovation, this will generate a rental increase in all regions and all scenarios except for NE and SE regions in scenario 3, where only 40% of the annualised investment is passed onto the tenant. This example shows that with renovation that achieves lower savings, even in cases where two thirds of the investment costs are passed on through a rent increase, it is likely that the net economic impact will be rather small or that the extra costs will be compensated. However, compared to the first example, there are net benefits for the tenant only if lower costs are passed on, and the upfront investment is considerably higher.

The case of an owner-occupied apartment is similar to the rented apartment case above[189].

If a low-income household living in their own single-family house undertakes a ZEB-level renovation, the energy savings generated as a share of annual income are higher than in an apartment, varying from around 16% in NO, WE and SO regions to around 27% and 40% in SE and NE regions respectively. The analysis shows that when there is no financial support for investment and the full cost of renovation is paid by the owner (scenario 1), then the housing costs increase in all regions. The exception is in the NE and SE regions, where the reduction in energy costs generated by the energy savings overcompensate for the investment costs. With a 25% investment grant (scenario 2), there is a positive impact on the housing costs in all regions except for in the NO region.

[189] In the case of an owner-occupied apartment in a multi-family building, the scenarios will be such: scenario 1 with no investment grant, scenario 2 with 25% investment grant and scenario 3 with 60% investment grant.

With an investment grant of 60%, there is a positive impact across regions since the energy cost reductions generated by the renovation overcompensate for the impact of investment. Thanks to the significant reductions in energy bills, the investment costs do pay off in some of the regions even without investment support, and in almost all regions with 25% support.

Table 6.14: Impact of renovation on low-income households living in single-family houses

Single-familiy house (SFH), average floor area of 130m2, inhabited by the owner, initial status: not renovated.

EU Region	ZEB renovation					partial ZEB renovation				
	Investment per MFH unit	Energy savings	Scenario 1 no invest. support	Scenario 2 25% invest support	Scenario 3 60% invest support	Investment per MFH unit	Energy savings	Scenario 1 no invest. support	Scenario 2 25% invest support	Scenario 3 60% invest support
		low income household	Net Effect - Housing cost increase minus energy savings (% of income)				low income household	Net Effect - Housing cost increase minus energy savings (% of income)		
	Euro	(% of income)	low income HH	low income HH	low income HH	Euro	(% of income)	low income HH	low income HH	low income HH
NO	56,587 €	15.8%	8.1%	2.1%	-6.3%	20,057 €	1.9%	6.6%	4.5%	1.5%
WE	39,889 €	16.2%	1.7%	-2.8%	-9.1%	10,561 €	3.1%	1.6%	0.4%	-1.2%
SO	22,675 €	16.3%	2.3%	-2.3%	-8.8%	4,467 €	1.3%	2.4%	1.4%	0.2%
NE	34,533 €	26.6%	-1.4%	-7.7%	-16.5%	11,179 €	3.5%	4.7%	2.6%	-0.3%
SE	26,051 €	40.0%	-7.0%	-15.2%	-26.8%	7,968 €	8.5%	1.6%	-1.0%	-4.5%

Source: Guidehouse et al.

If the same single-family house undergoes only a partial ZEB renovation, then the energy savings generated as a share of annual income are consistently lower, i.e. from around 8.5% in the SE region to around 1.9% in the NE region and 1.3-3.5% in the other regions. In this case, the net economic impact on housing costs is positive only for the SE region with 25% investment support (scenario 2) and for WE, NE and SE regions in scenario 3 with a 60% investment grant (scenario 3). Compared to the previous example, repayment is therefore more difficult, but the net impact is also much smaller.

Based on the above case studies, we can draw several conclusions:

- ZEB renovations are more costly than partial ZEB renovations, but the associated energy and cost savings are also higher (across all EU zones and scenarios). Therefore, the net impact on the housing budgets of low-income households is consistently smaller for ZEB renovations.
- The negative impact on the housing budgets of low-income households can be mitigated by additional financial schemes with preferential loans adjusted appropriately to the payback period of the renovation measure.
- Well-designed rules on rent increases that take into account the impacts on energy savings result in win-win solutions for owners and tenants.

- Although the upfront investment is higher for ZEB renovations than for partial ZEB renovations, the benefits are higher in the former. The measure also leads to more consistent savings that have the potential to alleviate energy poverty. Partial ZEB (medium) renovations may be cheaper, but even a high level of subsidies for the upfront investment in some EU regions will not fully mitigate the negative impact on the energy expenditure of low-income households.

6.4.5 Further considerations regarding the impacts of MEPS at Member State level

The effects of the policy options could vary across EU countries for multiple reasons. Some of these are structural, while others can be mitigated by proper policy design. The following circumstances play a role:

- the existing conditions and energy performance of the building stock;
- climatic conditions[190];
- calculation of energy classes in national EPC schemes;
- ownership structure and dynamics of the housing markets.

These aspects are described in Annex F, Section 7.2.

6.5 Impacts of e-mobility options.

The impacts are presented in Annex I.

7. HOW DO THE OPTIONS COMPARE?

In this Chapter, the policy options presented in Chapter 5 and assessed in Chapter 6 are compared from several angles in line with the better regulation criteria of effectiveness, efficiency, coherence, administrative burden, subsidiarity and proportionality.

- Effectiveness: assessment of the extent to which proposed options would achieve the specific objectives of this impact assessment as presented in Section 4.1.
- Efficiency and impacts: assessment of benefits versus the costs, taking into account the quantitative assessment presented in Chapter 6 and based on qualitative assessments for the measures related to information and planning tools.

[190] This could be expressed for instance in heating and cooling degree days.

- Coherence: assessment of the coherence of each option with the overarching objectives and other EU policies, focusing on the policies proposed in the 'Delivering the European Green Deal' package.

- Administrative burden and compliance costs: assessment of the cost and additional burden due to the increased ambition (the analysis is included in Annex L).

- Subsidiarity and proportionality: assessment of how the measures comply with the subsidiarity principle and if they necessary to meet the objectives.

7.1 Comparison of options

Effectiveness

Option 1 offers the lowest level of impact with modest GHG emission reductions, mainly because of the narrow scope for mandatory energy performance standards. Furthermore, Member States' voluntary implementation of the BRP does not sufficiently encourage renovation depth, nor does it significantly increase the renovation rate.

Option 2 offers modest additional final energy savings and related GHG emission reductions compared to option 1 by including all non-residential buildings above a certain size, e.g. 1000 m2 by adding MEPS3. A significant leap can be observed between options 2 and 3. The key element of option 3 is the addition of MEPS2, which goes far beyond and includes standards to be set at national level to all residential and non-residential buildings with differentiated schedules to move towards ZEB level. It also includes mandatory BRP for selected building types and strengthened information tools, underpinning MEPS2 and reducing lost opportunities in addressing the energy saving potentials of buildings renovation.

Finally option 4 adds MEPS4 requiring best in class replacements for technical building systems, mainly heat generators. This leads to additional energy and GHG savings, yet does not speed up replacements of boilers.

Table 7.1: Weighted average of the policy options impacts (ref. Table 6.1)

	Option 1: LOW	Option 2: MODERATE	Option 3: HIGH-I	Option 4: HIGH-II
Effectiveness	0	+	++	++
Efficiency	0	0	++	++
Coherence	+	+	++	++
Proportionality	0	0	0	0

Subsidiarity	-	-	-	-

Negative	Slightly negative	No/small positive impact / adequate	Positive	Very positive
--	-	0	+	++

Table 7.2: Comparison of policy packages

Impact in 2030 at EU level	Option 1: LOW	Option 2: MODERATE	Option 3: HIGH-I	Option 4: HIGH-II
Additional final energy savings (vs. BSL)	-2.4%	-3.6%	-11.7%	-16.1%
Additional GHG emission reduction (vs. BSL)	-3.1%	-4.2%	-22.8%	-28.5%
Increase of average renovation rate (vs BSL)	0.2%	0.2%	1.3%	1.3%
Additional investment in buildings envelope and HVAC system (vs. BSL)	EUR 33.2bn/a	EUR 42.3 bn/a	EUR 152 bn/a	EUR 157.3 bn/a
Additional value added creates including in SMEs (vs. 2020 baseline)	EUR 22bn/ 0.18%	EUR 29bn / 0.24%	EUR 104bn / 0.86%	EUR 110bn / 0.91%
Jobs retained or created (vs. 2020 baseline)	332,000	410,000	1. 833 mn	1 .897 mn
Energy poverty: Impact on high share of energy expenditure in income-2M (vs. 2020 baseline)	-0.3%	-0.4%	-1.7%	-1.7%

Source: Guidehouse et al.

As shown in the above Table, the increase of the policy intensity across options (from Low to High) corresponds to greater impacts and a higher contribution to the overall objectives of the revision of the EPBD in terms of reduced GHG, increased energy savings and energy renovations. Overall, the single policy measure that allows a significant increase in the impacts on energy savings, GHG reduction and renewable energy deployment is MEPS2. As illustrated in Chapter 6, the mandatory national measures in MEPS2 significantly extend the scope of application of minimum energy performance standards and therefore substantially increasing the effectiveness of the package of measures in option 3 in comparison to the others. While the EU measures in MEPS1 cover only a fraction of buildings (those being rented or sold and with a low energy class), national standards in MEPS2 will cover progressively all buildings. MEPS1 will be key in addressing the difficulties of split-incentives in renovations, allowing for the worst buildings in the rental market or being purchased to be renovated to medium level, ensuring enough time to carry out the interventions needed. MEPS2 leaves to Member States the flexibility to design MEPS, while framing them in clear decarbonisation pathways defined in national plans Building renovation Plans with clear timelines and intermediate goals and milestones.

Table 7.3: GHG emission and final energy consumption reduction from F55 due to EPBD

EU27 2030 results	F55 gap in the absence of EPBD revision (MIXwoEPBD-MIX)/REF)
CO2 emission in residential sector	-16.4%
CO2 emission in services sector	-11.0%
CO2 emission in residential and services sectors	-14.8%
FEC in residential sector	-6.3%
FEC in services sector	-3.6%
FEC in residential and services sectors	-5.3%

Source: Primes

On the EPBD's expected contribution to the efforts of the 'Fit for 55' package of measures, options 1 and 2 are insufficient, and only in HIGH scenarios the impacts will be commensurate with the impacts assumed in the CTP. Under options 1 and 2, the EPBD revision will fail to substantially contribute to a doubling of the annual rate of renovations. While the average renovation rate in the baseline scenario increases by 0.3% by 2030, the additional renovation rates increase in LOW (option 1) and MODERATE (option 2) scenario is of 0.2% as MEPS apply only to a limited fraction of the building stock. At the same time, the relative increase of renovation rates in the two HIGH scenarios (option 3 and 4) as compared to baseline is 1.3%, notably due to the extension of MEPS measures to all worst performing buildings from the building stock.

GHG emissions in comparison to the baseline will be reduced by only 3.1% and 4.1% in LOW (option 1) and MODERATE (option 2) respectively in 2030 in comparison to the baseline, while in HIGH scenarios (options 3 and 4) the reductions could increase up to 23%. Only these latter levels are considered commensurate with sufficiently contributing to the 'Fit for 55' package of measures. By comparison, in the counterfactual MIXwoEPBD scenario (see Section 6.2), the reductions to be achieved thanks to a strengthened EPBD were considered to be of an order of magnitude of 15% (residential and services sectors).

Similar considerations can be applied to the reductions achieved in final energy consumption as final energy consumption in LOW (option 1) and MODERATE (option 2) will be reduced only by 2.4 – 3.6% by 2030 respectively, which as a contribution is considered too low. The reductions of final energy consumption achieves -11.4 –11.7% in the HIGH scenarios (option 3 and 4). By comparison, in the counterfactual MIXwoEPBD scenario, the reductions to be achieved by 2030 in comparison to the baseline thanks to a strengthened EPBD were considered to be of an order of magnitude of 5.3% (residential and services sectors).

Options 1 and 2 are therefore failing to achieve the first key objective of this initiative of 'Contributing to reducing buildings' greenhouse gas emissions and final energy consumption by 2030, to a level commensurate to the Climate Target Plan goals.' Only options 3 and 4 score high on effectiveness as their impacts are comparable to those expected from the EPBD revision. This assessment is based on the order of magnitude of the efforts as a clear numerical equivalence between the estimate of the contribution of the EPBD revision, and the assessment of impacts of the policy options is not possible due to the different methodological approaches of the two analysis (system-wide, top-down assessment in the Climate Target Plan; versus sectoral, bottom-up in this impact assessment).

Options 3 and 4 will also reduce GHG at a level compatible with climate neutrality by 2050 (second key objective of providing a long-term vision and ensuring that buildings make an sufficient contribution to achieving climate neutrality in 2050), while under option 1 and 2 emissions in the buildings sector by mid-century will still be significant. However, a (-) is attributed to option 4 as MEPS4 could lead to suboptimal renovations in some circumstances as regards the depth of renovation achieved.

Introducing a definition of 'zero emissions buildings' (ZEB) is expected to contribute to the overall goals of reducing GHG, increased energy savings and deployment of renewables in the building sector. ZEBs will also ensure avoiding lock-ins in new constructions, ensuring that they will be '2050 ready' and therefore in line with the long-term decarbonisation objective. The experience of NZEBs shows that the effectiveness of standards and definition could be limited if benchmarks and clear requirements are not set at EU level. Applying ZEBs following a similar process than NZEBs (as in ZEB1) does not therefore seem to guarantee an effective achievement of the goals. ZEB2 and ZEB3 provide for a more effective framework also addressing emissions across the life-cycle of the building (ZEB3).

The information and planning tools (BRP, DEEP, EPC, LTRS) only in the more ambitious options 3 and 4 will ensure the establishment of an adequate supporting framework, enabling to overcome the existing weaknesses and providing consumers reliable and comparable tools. In particular, BRP3 drives staged renovations, in synergies with MEPS and the establishment of a deep renovation definition under DEEP2 which ensure the strongest links with financial instruments. More reliable and similar ratings achieved thanks to EPCQ3 ensure higher market acceptance and comparable efforts and are therefore preferable to softer approaches in EPCQ2 and EPCQ1. LTRS updates and impacts monitoring as in LTRS3 become essential in view of the establishment of national minimum energy performance requirements, while the other options do not guarantee an adequate update of the current provisions.

As regards the strengthening of EPCs, it is expected that only by requiring mandatory additional information on carbon emissions and other indicators (as in EPCSI2 and EPCSI3) EPC would be able to play a role in properly informing and orientating markets towards the decarbonisation of buildings. Trade-offs exist however between costs, completeness of info and simplicity of the tool, which would need to be balanced. Increasing the scope of information and coverage will also help to ensure that public support such as EU funding can be better targeted towards high-impact projects and qualitative investments. It will also facilitate the follow-up in terms of reporting and monitoring and long-term impact of public support to building renovation.

In the light of higher climate ambition, the relevance of private parking facilities to enable the electrification of transport is of pivotal importance for decarbonising the transport sector and raising the share of renewable energy in the energy system. If the recharging infrastructure does not keep pace with the increase of e-vehicles, there is a great risk that there won't be sufficient recharging points in the future. In the impact assessment for the AFIR[191] it was assumed that around 60% of all recharging events will happen in private buildings, therefore within the scope of the EPBD. In light of this, only the most ambitious option E-M3 would have the potential to ensure sufficient private parking infrastructure and will be coherent with the ambition of the other F55 proposals and overall goals.

Similarly, EPCs to be effective digital tools will need to be strengthened as identified in the most ambitious option EPCI3. This is needed in order to acquire good data on building characteristics, energy use and financial implications of renovation in terms of cost savings or asset values. The current lack of data has negative consequences on the market perception of the cost-effective energy saving potential of the EU building stock, on enforcement tracking and on monitoring and evaluation, both at EU and national level. Effective enforcement of minimum energy performance standards by the EU will depend on the availability of data on national building stocks, which can best be ensured by mandatory EPC databases and the transfer of those data to the Building Stock

[191]https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021PC0559

Observatory[192]. Enhanced building databases could also reduce the administrative burden.

The role of the SRI as enabler of a diffusion of smart technologies especially in non-residential buildings would be maximised under option 3 in line with higher ambition for zero-emission buildings and contributing to highly efficient operation modes and optimal system balance. The ongoing testing phase will provide ground for defining the next phase and mandatory introduction for certain categories of buildings.

Efficiency

Economic impacts

Comparing the four policy options, options 1 and 2 have very moderate positive impacts on value added and employment while options 3 and 4 have substantial positive impacts. Option 4 is slightly more positive than option 3.

Options 1 and 2 lead to a small increase in value added and employment compared to the baseline scenario. Option 2 performs better up to 2045 as more investment is undertaken in non-residential buildings until 2045. By 2050, renovation rates are lower and consequently, investment is lower. Combined with a reduction in value added and employment in energy supply related sectors, this counterbalances some of the positive economic growth after 2045. Economic impact remains positive, though small (about 0.13% higher than in the baseline scenario). About one third of the employment effects relate to low and medium-skilled employment in the construction, material, machinery and equipment sector as well as in the agriculture and forestry sector.

By comparison, options 3 and 4 have substantial positive impacts on value added and employment. Impacts under option 4 are more positive than under option 3. Requirements for building performance are most ambitious under the options requiring investors to implement a significant range of renovation activities in residential and non-residential buildings. Including MEPS4 in option 4 induces additional positive economic effects. Investments activities spur value added and employment, in particular in small and medium size enterprises (SME) as 95% of construction, architecture and engineering related enterprises are micro-enterprises or SMEs. Comparing the four policy options, options 1 and 2 have very moderate positive impacts on value added and employment while options 3 and 4 have substantial positive impacts. Option 4 is slightly more positive than option 3.

Options 1 and 2 lead to a small increase in value added and employment compared to the baseline scenario. Option 2 performs better up to 2045 as more investment is undertaken

[192] EU Building Stock Observatory | Energy (europa.eu)

in non-residential buildings until 2045. By 2050, renovation rates are lower and consequently, investment is lower. Combined with a reduction in value added and employment in energy supply related sectors, this counterbalances some of the positive economic growth after 2045. Economic impact remains positive, though small (about 0.13% higher than in the baseline scenario). About one third of the employment effects relate to low and medium-skilled employment in the construction, material, machinery and equipment sector as well as in the agriculture and forestry sector.

Security of energy supply is positively affected in all options, but only moderately under options 1 and 2 and having the most pronounced effect under options 3 and 4 due to significantly lower energy demand and subsequent reduced needs for energy imports from countries outside the EU-27.

Industrial competitiveness is positively affected. Most activities along the renovation value chain happen locally. For example, renovations needing architects, construction workers, machinery and equipment, project management, installers, rentals and leasing of equipment etc. Raw materials, such as insulation material, can be imported or produced domestically while heavy weight materials, such as cement, are rarely transported over longer distances. A strong EU buildings sector can lead to positive spillover effects outside the EU. Option 3 will deliver a significant contribution, the increased intensity in renovation activities will stimulate the economy, increase jobs especially in SMEs and locally.

Social impacts

As regard social impacts, the options with higher ambition have the potential to deliver significant net social benefits, if accompanied by adequate and targeted funding. Trade-offs however exist between possible regressive impacts in terms of distribution of renovation costs and their affordability, and distribution of benefits which are also expected to be the highest in low-income households. Social impacts, positive and negative, remain limited when MEPS are targeting specifically non-residential buildings, as in option 2.

In assessing the four policy options, option 1 has the lowest impact on energy poverty alleviation. Most measures included under option 1 address single family houses at a rate which is not significantly above the baseline. Option 2 has an overall medium impact on energy poverty alleviation, with more extensive requirements for Member States to implement new provisions. Option 2 has positive impacts on the share on expenditure that households need to use for energy. The effects vary greatly compared with options 3 and 4.

By comparison, options 3 and 4 have the strongest impact on energy poverty alleviation and avoiding negative distributional impacts. The measures include all residential buildings, including worst-performing building stock in multi-family houses. Option 3.b has positive impacts on the share on expenditure that households need to use for energy. For low-income households, in general the share of energy expenditure in total consumption expenditure is substantially higher than for higher income households. Therefore, renovations and subsequent energy savings in their homes, results in energy savings with positive impacts on energy poverty alleviation. A change in energy expenditure through renovation, in particular through renovating the worst performing buildings helps households with lower income. This is due to the fact that a more than average share of low income households lives in worst performing buildings. Additionally, positive effects on health benefits ('non-energy benefits') and positive impacts on social inclusion are stronger than in options 1 or 2.

Environmental impacts

The impacts on GHG emissions and energy savings are assessed under 'Effectiveness' as they are directly related to the achievement of the goals of the EPBD revision. Impacts on pollutants were considered for NO_x, SO_x and PM 2.5 – 10. Impacts are twofold: renovation activities lead to an increase in pollutants in industry while reduction in energy demand leads to a decrease in emissions, in particular in the gas and heat sector. In all four policy options, the reduction effect is higher than any increase by 2050 so that improvements in building performance has positive impacts for pollution abatement.

Effects on pollutants are very small in options 1 and 2 as the increase of renovation rates is rather low and subsequent energy reduction is moderate. Option 2 performs slightly better as more buildings are renovated at an earlier stage with positive impacts on emissions reductions through decreased energy consumption.

In option 3 and option 4 renovation rates are substantially higher leading on the one hand to higher emissions of pollutants from the building industry and industries providing materials to the building industry. At the same time, energy savings are substantially higher as well offsetting the increase in emissions from construction and renovation. Effects for all considered pollutants are most pronounced in 2050 and by then about three times better in option 3 and 4 than in option 1 and 2. SO_x emissions decline slightly more than NO_x emissions because electricity and steam and hot water production are slightly more SO_x emissions intensive.

Coherence

All policy options examined are in line with the EPBD framework. A number of measures aim at strengthening the existing framework and provisions – to different degrees depending on the policy option. This applies notably to requirements such as those related to Member States' long-term Renovation Strategies, the framework for EPCs regarding coverage, scope and quality as well as to the application of the smart readiness indicator. New provisions including the mandatory minimum energy performance standards or the building renovation passport largely build on and work in synergy with other elements of the EPBD such as the EPC framework. The proposed measures also complement each other in addressing different market barriers and failures, e.g. addressing the gradual phase-out of worst-performing buildings on the one hand and stimulating building renovations and new constructions compatible with the EU's medium and long-term energy and climate targets on the other.

Interplay with the 'Fit for 55' / delivering the European Green Deal proposals

To assess the coherence of the policy options in relation to the other key measures of the legislative proposals adopted in July 2021, it is useful to first provide an overview of them.

➢ **Energy Efficiency Directive**

- Set a target of 36% for final and 39% for primary energy consumption and an annual energy savings obligation of 1.5%.
- Introduce an obligation for the public sector to reduce energy consumption by 1.7% per year.
- Set an obligation for Member States to renovate 3% of public buildings to NZEB levels.
- Require systematic consideration of energy efficiency in public procurement.
- Introduce measures to help alleviate energy poverty and help vulnerable households by empowering consumers (one-stop-shops, consumer protection, awareness raising), improving affordability and access to energy and providing financial assistance and incentives for energy-efficient renovations.
- Introduce the energy efficiency first principle in policy and investment decisions.

➢ **Renewables Energy Directive**

- Set a benchmark of 49% of renewables in buildings and the obligation to increase the use of renewable energy in heating and cooling by 1.1 percentage point every year.
- Raise the use of renewable energy in district heating and cooling by 2.1 percentage points every year.
- Requests that the EPBD step-up building renovation across the EU building stock 'to make buildings fit for renewables, as most renewables can work optimally only with high energy performance buildings'.
- Require smart charging capability for non-publicly available recharging points.

➢ **Emission Trading Scheme Directive**

The proposal to extend ETS to emissions in buildings and road transport will provide an economic incentive encouraging producers and consumers of heating fuels to invest on clean energy and on the energy performance of buildings.

➢ **Effort Sharing Regulation**

The ESR proposal sets more ambitious national targets to cut emissions for sectors outside the current scope of the ETS. The revision of EPBD is also a precondition for fulfilling increased ESR national targets. Member States will need to ensure more renovations are carried out in terms of rate and depth) in order to meet the more ambitious national ESR targets.

- **Social Climate Fund**

  The SCF proposal provides for the use ETS auction revenues to provide financial support to the EU public, in particular vulnerable households, to invest in renovation or heating systems and ensure a fair transition.

- **AFIR**

- Introduce capacity-based and distance-based targets for the roll-out of publicly available recharging infrastructure for e-vehicles.
- Require Member States to develop national plans for the roll-out of recharging infrastructure, covering both publicly available and private infrastructure.

As assessed under the 'Effectiveness' criteria, the revision of the EPBD is also in line with and contributes to achieving the EU's overall climate targets of reducing the EU's greenhouse gas emission by at least 55% by 2030 compared to 1990. It also contributes to achieving climate neutrality by mid-century, as set out in the EU climate law. In this regard, the buildings sector is one of the sector where there is a high potential for cost-effective decarbonisation solutions and efforts must be ramped up.

Strengthening and aligning the EPBD with the more ambitious energy and climate targets is part of the European Commission's broader renovation wave, an action plan with specific regulatory, financing and enabling measures published on 14 October 2020. The options are also in line with the NextGenerationEU (NGEU) recovery package, as building renovation stimulates employment and growth in the construction sector, and thanks to a multiplier effect on other economic sectors provides a significant impulse for economic recovery.

As part of the European Commission's 'Delivering European Green Deal package,' the EPBD revision will work in synergy with the proposals tabled in July 2021.

In particular, the proposed policy options provide instruments to achieve the **EED** energy efficiency target:

- Direct complementarity/ interplay: requirement for Member States to renovate public buildings in the EED[193] and public procurement.

[193] Public buildings are part of non-residential buildings, and currently central government buildings are subject under the EED to the obligation to renovate yearly 3% of the floor area to meet at least the minimum energy performance requirements under the EPBD, or to apply measures achieving equivalent

- Direct complementarity/ interplay: the policy options support the achievement of the overall energy efficiency targets under Art. 3 EED and the goals under Art. 7 EED (reference is made to the current article numbers).

The EPBD supports key targets and instruments of the **RED**:

- Direct complementarity / interplay: the policy options support the increase of the renewable energy shares in the heating sector and therefore supports the targets in Article 23 of the RED II.
- Direct complementarity / interplay: the policy options contribute to providing a minimum share of renewable energy in new buildings and in major renovations (Article 15 of the RED II).

The proposed policy options complement the EU ETS (proposal to broaden the scope to cover buildings):

- The revision of EPBD and the revision of the ETS are complementary and mutually reinforcing in driving decarbonisation of the building stock. Targeted regulatory measures under revised EPBD are necessary to address market and non-market barriers to renovations that cannot be incentivised by a carbon price alone. Without such policies, a very high carbon price signal would be needed and had to be born by all consumers using fossil fuels for heating (up to 80€/tCO2 was modelled for the DEGD package and this still without significant impact on renovations but rather delivering a further fuel switch).
- In presence of a carbon price signal delivered through the ETS extension to buildings, the strengthened informative tools of the EPBD (EPCQ, DEEP, BRP), which will include also a carbon metric, will help financial investors to monetize the benefits of buildings decarbonisation and household or commercial actors to better factor in the economic benefits of building renovations and their repayment plans.
- The investments costs measures under area A will become cheaper in presence of a carbon price on heating fuels, which will therefore facilitate compliance with MEPS.

A strong link exists also with the measures under area A and the **Climate Social Fund**, which by targeting specifically the renovation of buildings of low-income households will make more affordable the investments in building renovations. This should significantly reduce their upfront costs and therefore ease MEPS compliance. It should also limit their potential regressive distributional impacts, specifically under the options in which MEPS will target also the residential sector. As illustrated in the analysis in

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savings. This obligation has been proposed to be extended to all public buildings and renovations to reach NZEB levels in the revision of the EED.

Chapter 6, in the context of limited financial support deeper energy renovation can generate net-economic impacts for both building owners and tenants. At the same time, the improved information tools of the EPBD (EPCQ, DEEP, BRP), which will include also a carbon metric, will help the beneficiary of the CSF to plan in an optimal way their building renovations, and national authorities will be facilitated by LTRS in planning the disbursement of the CSF and of the reuse of revenues from ETS.

The proposed policy options are complementary to the AFIR:

- Direct complementarity / interplay: the policy options support the roll-out of charging infrastructure in private buildings which is directly complementary to the AFIR targets for publicly available charging infrastructure.

There is a high complementarity between ESR and EPBD revisions.

- The revision of the EPBD supports the fulfilment of increased ESR national targets, as both EU and national measures can contribute to the achievement of the national targets set in ESR.

- Member States will need to deploy more ambitious measures in the building sector to respect the increased national ESR targets, which provide a safeguard for Member States to put in place sufficiently ambitious policies.

The proposed policy options are also in line with requirements set out in the **Ecodesign and energy labelling** rules:

- Complementarity of requirements for building renovation in MEPS approaches and requirements for efficiency of heating systems under the Ecodesign Directive.
- Synergies between MEPS options that directly set the requirements on the energy efficiency of heating systems.

<u>Subsidiarity</u>

The subsidiarity principle requires that policy measures are decided at a level which is as close as possible to the EU public and at EU level only where necessary. In areas of shared competences, the EU therefore only acts if action at EU level is more effective than action taken at national, regional or local level.

Energy policy is a shared competence between the EU and the Member States. The legal basis for the EU to act is Article 194(2) of the TFEU, which represents the legal basis for EU policy to promote energy efficiency and energy savings. Improving the energy performance of buildings is a key vector for the European Green Deal’s objective to achieving climate neutrality, as subsequently translated into the renovation wave strategy. Improving buildings’ energy performance is also central to the EU’s green recovery.

In the assessment of the four policy options, all options have been assessed with a slightly negative score on subsidiarity, to account for the increased intensity of EU intervention in the buildings sector in relation to the baseline. Option 1 has the lowest impact on subsidiarity. Most measures comprised in option 1 leave significant room for Member States regarding implementation, e.g. by leaving provisions up to Member States for voluntary implementation or by granting significant time for implementing these. Also, many measures are developing existing provisions further or are aimed at streaming those on a voluntary basis. The introduction of minimum energy performance standards (MEPS1) to ban the sale or rental of worst-performing buildings, on the other hand, represents a new measure in the EPBD, even though several Member States already have a MEPS scheme in place.

Option 2 has an overall medium impact on subsidiarity, with more extensive requirements for Member States on large non-residential buildings. This option however also leaves flexibility for Member States regarding the specific design and scoping of relevant measures, and by limiting national MEPS to the non-residential sector, leaves margin of manoeuvre on the most relevant share of the building stock.

By comparison, options 3 and 4 have the strongest impact on subsidiarity, requiring Member States to implement a significant range of more far-reaching provisions, aimed at improving a common level of implementation and better harmonisation. Corresponding elements can for instance be found in measures MEPS1 and MEPS2, BRP3, EPCQ3, EPCSI3, ZEB3 or E-M4.

All options assessed are in line with the intervention logic, yet address the policy objectives to different extents. For assessing the subsidiarity impacts outlined above against the added value of EU action, one has to consider the fact that the existing legislative framework is not sufficient to achieve the necessary decarbonisation of the EU building stock. Stronger EU level action is therefore necessary to ensure policy alignment towards the decarbonisation of buildings, in particular through a higher renovation depth and by comprising all building segments. So far, significant room has been left to Member States in implementing the EPBD. Implementation at national level is very divergent, and sometimes not ambitious[194]. As set out in Chapter 3, with a view to the massive EU-wide challenge of building decarbonisation, a step change with stronger EU level action is now necessary to ensure policy alignment across the EU towards the required contribution of buildings to the enhanced climate and energy targets. On

[194] JRC, Progress of the Member States in implementing the Energy Performance of Building Directive, 2020.

minimum energy performance standards, their introduction would give the missing market signals for the decarbonisation of the existing building stock.[195]

The transaction-based, EU-wide renovation obligation via MEPS1 will give the necessary strong policy signal towards the phase-out of worst-performing buildings. However, MEPS1 will only cover a relatively small share of national building stocks. For the remaining building stock, MEPS 2 and 3 set target dates and benchmarks to be reached at EU level, leaving Member States room to set their national pathways and priority building types. The combination of MEPS1 and either MEPS 2 or MEPS3, possibly complemented by MEPS4, strikes the right balance between a sufficiently strong minimum framework at EU level and sufficient flexibility for Member States to adapt to national and local conditions. The EU-wide introduction of a deep renovation standard and building renovation passports are demanded by the financing industry that operates cross-border.

Stronger EU harmonisation of the new ZEB standard like in ZEB2 and ZEB3 (compared to the greater national flexibility for the current NZEB standard) is justified, especially with a view to the observed lack of ambition and too great divergence of the national implementation of the NZEB standard.[196] As regards the added value of stronger EU action on EPCs, the financing industry that operates cross-border demands a greater harmonisation of energy performance certificates as a basis for EU-wide criteria for the financing of building renovation.[197] Individuals moving within the EU and businesses operating cross-border would also benefit from more comparable energy performance certificates to enable them to make informed decisions about their housing and offices. As regards SRI, the mandatory use of SRI for specific non-residential buildings under option 3 would give an important policy signal to mobilise the industry towards the increased development of smart solutions, but for most buildings, it will be left to Member States to decide whether to require SRI use.

Considering the required step change to reduce emissions from transport to meet the enhanced climate targets, the more prescriptive elements at EU level are justified from the subsidiarity perspective. In terms of EU added value, increased charging infrastructure will accelerate roll-out of e-mobility and thereby support the development of the EU's car industry towards a future-proof business models.

Proportionality

Proportionality relates to the choice of instrument as well as to the scope and reach of requirements in light of their respective contribution and adequacy to achieve policy

[195] The joint EU ambition for all new buildings to be nearly zero-energy by 2020 has shown the significant impact of mobilising the buildings sector around a common objective, see Chapter 3 and Annex H.
[196] JRC report on NZEB implementation, see results presented in Annex H.
[197] The recently developed taxonomy for buildings already today ties certain criteria to EPC classes.

objectives. In order to be proportionate, measures should not go beyond what is necessary to achieve objectives satisfactorily, limit the scope to aspects where EU action brings added-value and limit costs for authorities and economic operators.

The policy options considered were developed in view of revising the EPBD to bring it in line with the EU's upgraded energy and climate targets. Existing legislation will not suffice to achieve the goals, therefore, a revision of the EPBD is necessary and one of the vehicles to deliver on the goals of the renovation wave strategy. Many of the assessed measures are developing existing provisions further or are streamlining these to strengthen a common level of implementation. This applies for instance to measures aimed at enhancing the coverage, quality and scope of EPCs, at advancing the application of the smart readiness indicator or at those relating to Member States' long-term renovation strategies.

A proportionality assessment is particularly relevant for most policy options having the most ambitious and therefore the most stringent measures, i.e. options 3 and 4. Overall, the measures in option 3.a with its comprehensive package of measures appears to be proportionate compared to the very significant impact and contribution it achieves. In its practical implementation and design, MEPS2 will enable the streamlining and alignment with other measures on the building stock, therefore ensuring for more proportionality with regards to national jurisdictions. Streamlining the deep renovation standard, the definition for zero-energy buildings and further requirements being part of the EU taxonomy on sustainable investments would be a further consideration in terms of limiting the complexity of rules to ensure that proportionality is correctly applied.

8. PREFERRED OPTION

8.1 Introduction

This impact assessment identifies and analyses options for revising the EPBD to contribute to reducing greenhouse gas emission, putting the buildings sector at the centre of the digital and energy transitions and on the path to becoming carbon neutral by 2050. It follows the assessment conducted under the CTP which found that without the policy drivers from the EPBD, efforts from the building sector to reduce GHG will be 49% lower than what is required to achieve the Climate Law's goal of -55% GHG.

The EPBD revision is an integral part of the policy mix of measures necessary to deliver the European Green Deal. In this impact assessment, various policy options have been assessed following the guidance provided in the Renovation Wave strategy.

8.2 Conclusions of the analysis and preferred option

The analysis identified the key drivers behind the low renovation rates, the barriers to upscaling buildings and the factors limiting the autonomous development of buildings towards becoming a neutral societal asset. The analysis makes a clear distinction between factors that can be addressed through EPBD revision and aspects that are tackled by other components of the policy mix. There is a strong interplay and complementarity in that respect with the carbon price of heating fuels proposed by the Commission following the proposed extension of the current EU ETS.

Based on the knowledge of building stock characteristics in terms of age, types, tenure, technologies, energy uses and resulting greenhouse gas emissions, the analysis examined how policy mechanisms enforcing minimum levels of performance for certain buildings could prompt more building renovation. As the current EPBD does not include an appropriate instrument triggering renovations, a new one had to be identified. Guided by the feedback collected through stakeholders also in preparation of the Renovation Wave strategy, and based on EU and international experience, four different options for design were identified and their impacts assessed in packages of measures, including a measure to strengthen information tools and support renovation journeys at every stage. Besides standards to increase the performance of existing buildings, the options also consider how to make new constructions compatible with the 2050 objective and how to strengthen the modernisation of the building sector and its role in energy system integration.

Based on the quantitative and qualitative comparison of options against the two key objectives of this initiative, **option 3 'High Ambition I' emerged as the preferred option**. Policy measures under this option will lead to a substantial change and bring maximum benefits compared with current building renovations trends, while optimising the cost and administrative burden. The increase in renovation activities is considered to be in line with the stepping up of efforts needed in light of higher climate ambition, and with renovation efforts expected to be achieved thanks to the EPBD revision. This option proposes MEPSs that would entail an evolving combination of binding EU-level minimum energy standards for worst-performing buildings being rented or sold, complemented by standards set at the national level based on LTRS, gradually covering all building stock as they progress towards decarbonisation. This approach would guarantee clear market signals at EU level and comparable decarbonisation pathways, while leaving flexibility and time to adapt efforts to national conditions and to achieve the best combination of measures at national level.

The preferred option on MEPs and ZEBs will come with a comprehensive package of better information tools. The measures are summarised in the table below; more details are set out in Chapter 5, Annex E and the respective thematic annexes.

Table 8.1: Overview of measures in the preferred option

Option 3 High ambition I	Summary description of the measures of the preferred option for the revision of the EPBD

Area A. Measures to increase the number of buildings being renovated and renovation depth	
MEPS1+ MEPS2	**Minimum energy performance standards established at EU level, to be applied to worst-performing buildings rented/sold**. Buildings under transaction have to achieve at least EPC class D (or similar), and the standard will be gradually tightened. **National schemes setting minimum energy performance standards to be established by Member States**, on the basis of criteria and timeline defined in the EPBD, gradually transforming the building stock into zero-emission buildings by 2050.
BRP3 EPCQ3 DEEP2 LTRS3	Establishment of a **common EU framework for Building Renovation Passports** under the EPBD, to become mandatory for certain financial incentives. **Strengthening of Energy Performance Certificates** with the introduction of a **mandatory common EU template**, **harmonisation of highest and lowest EPC classes**, on-site visit, new quality control and reporting measures. Introduction of a **definition of "deep renovation"** in the EPBD, higher level of public funding for deep renovations. **Strengthened requirements for Long-Term Renovation Strategies (to be renamed Buildings Renovation - Plans),** to follow a shortened cycle, include additional information accompanied by new monitoring and reporting measures.
Area B. Measures to enable decarbonisation of new and existing buildings	
ZEB3	**Introduction of a zero-emission building standard for new and existing buildings**, based on benchmarks, also including a requirement to report whole-life cycle carbon emissions; **new buildings to comply with ZEB as of 2030.**
EPCSI3	**Strengthened content and greater availability of Energy Performance Certificates**: EPCs to include additional indicators (e.g. on greenhouse gas emissions, renewables), and to become mandatory for more building categories.
Area C. Measures to increase the modernisation and quality of buildings and of their systems, enabled by digitalisation of information tools	
E-M3 (ZEB3)	**Extension and strengthening of the requirements on recharging for electric vehicles in buildings**, establishing that all new buildings or buildings undergoing major renovations have to be prepared for EV recharging and have parking space for bikes, and that certain buildings should also be equipped with recharging points. Introduction of measures to enhance the "Right to plug".
EPCD3 SRI2	**Mandatory national EPC databases,** enhancing interoperability with other data sources and facilitating administrative compliance. **Update of the requirements related to the Smart Readiness Indicator,** enhancing linkages with other information tools and to making it mandatory for certain new buildings.

8.3 Meeting the challenges of the proposed measures

Challenges in the implementation of option 3 'High Ambition I' linked to the supply of materials, workforce and financing are set out in Sections 6.4 (see in particular Sections 6.4.1.2 'The challenges of increasing capacity in the supply markets', 6.4.2.2 'The challenges of increasing labour' and 6.4.1.1 'Investments').

8.3.1 Materials, workforce and skills

The availability of inputs for the construction sector is a precondition for the successful implementation of option 3, as the higher renovation rate and depth will entail an additional demand for materials and labour.

In the medium to long term, materials and labour supply appear to be sufficiently elastic to accommodate the additional demand for inputs in the construction sector. Historical trends laid down and compared with additional demand based on the HIGH scenario in Section 6.4.1.2 show that the market has the capacity to expand input supply in response to higher prices. As mentioned in Section 8.2 on the conclusions of the analysis and the preferred option, the Fit for 55 package overall and the EPBD specifically will bring more certainty to a sector that has in the past faced market and policy volatility. In particular, the price signal stemming from the extended ETS[198], regulatory clarity coming from energy efficiency targets under the updated EED and the progressive roll-out of MEPS as well as a higher level of information linked to updated EPCs should incentivise the construction sector to expand its capacities. Expanded capacities of both workforce and investments in fixed costs would in turn give more certainty to input suppliers to invest in expanding their own supply capacity.

However, in the short term, the implementation of option 3 could exacerbate current COVID-19 related market imbalances, as the elasticity of input supply is more limited. As a result, policy responses may be needed to ensure that supply of materials and labour grows at the requirement scale.

Regarding **materials**, increasing recyclability and material efficiency can help ease market tensions, as pointed out by several stakeholders in the consultation on the EPBD revision. Thus, more effective waste prevention and disposal policies together with the re-use of secondary materials could at the same time reduce demand for materials and ensure additional supply. Increased efforts to recycle waste and the increasing cost of landfilling for construction waste[199] already support this trend[200]. The EU will continue to support the application of circular economy principles in the construction sector in the near future. Building on the 2020 circular economy action plan, several initiatives are being developed on resource efficiency, durability and recyclability (including the sustainable products initiative, review of the Construction Products Regulation and the

[198] Positive anticipation of future carbon costs is among the relevant policy drivers incentivising the choice of energy-efficient or low-carbon technologies.

[199] Overall in the EU the landfill rate of construction waste fell by 11.7% between 2010 and 2018 (Eurostat 2021), and the energy recovery rate increased by 27.8% between 2010 and 2018. Eurostat 2021: Number and capacity of recovery and disposal facilities by NUTS 2 regions [env_wasfac].

[200] Overall in the EU the landfill rate of construction waste fell by 11.7% between 2010 and 2018 (Eurostat 2021), and the energy recovery rate increased by 27.8% between 2010 and 2018 (Eurostat 2021. Eurostat 2021: Number and capacity of recovery and disposal facilities by NUTS 2 regions [env_wasfac].

roadmap for the reduction of whole life carbon of buildings). Furthermore, studies are ongoing regarding possible future action on waste prevention and re-use and recycling targets for construction and demolition waste, in the context of the Waste Framework Directive.

On labour supply, the Renovation Wave communication acknowledged the 'shortage of qualified workers to carry out sustainable building renovation and construction'. As indicated in the Climate Target Plan, a key challenge is the capacity of the education and vocational training systems to train or re-train workers, as well as the ability of workers to move from one job and sector to another requiring potentially different skills[201]. For instance, it is expected that appropriate qualifications will play an increasingly important role in the construction, heating technology and refurbishment sector with new technologies and higher levels of digitalisation.

The Commission's initiatives on education, skills and training such as the pact for skills, the green strand in Erasmus+ and the Education for Climate Coalition can help to address these challenges. The accompanying action plan for the Renovation Wave strategy included a deliverable on 'Support[ing] Member States to update their national roadmaps for the training of the construction workforce through the Build Up Skills Initiative and helping implement the 2020 European Skills Agenda'[202].

The proposal for the EED[203] recast also includes provisions for the availability of training programmes and qualification, accreditation and certification schemes as an enabler of energy efficiency improvement measures.

In addition, the updated industrial strategy of May 2021[204] announced the co-creation of transition pathways for industrial ecosystems, including construction. In a process of co-creation with Member States, industry and other stakeholders, the pathways will identify the scale of the needs, including upskilling, resource efficiency and digitalisation, and will propose action to address them.

Finally, an increase in productivity in the sector would allow for an expansion of output with less use of labour. Investments in technologies for the industrialisation of construction[205] as well as project management and collaboration tools therefore have the

[201] Climate Target Plan Impact Assessment, Part 1, p.86. It is important to acknowledge in this regard that transitional costs such as reskilling and upskilling have not been considered in the simulations of the Fit for 55 package's impact.
[202] The European Skills Agenda was presented in July 2020 by the Commission. Action 6 is about 'Skills to support the twin transitions'.
[203] https://eur-lex.europa.eu/resource.html?uri=cellar:a214c850-e574-11eb-a1a5-01aa75ed71a1.0001.02/DOC_1&format=PDF
[204] https://ec.europa.eu/info/sites/default/files/communication-industrial-strategy-update-2020_en.pdf
[205] For example using techniques such as prefabrication and off-site assembly, automation, modularisation and additive manufacturing.

potential to increase productivity and reduce the additional demand for labour. Industrialisation can also result in other benefits, including greater resource efficiency and less time spent on the building site (and therefore less disruption for building occupants during renovation works)[206].

While acknowledging that not all market friction stemming from higher demand and new shocks can be tempered, the combination of the proposed policies and initiatives should help to substantially address them.

8.3.2 Financing: EU, national and private financing to support the investment needs

The impact analysis identifies an additional need of EUR 152 billion annual investment in the renovation of buildings to meet the requirements and targets of the revised EPBD according to the preferred option 3 – HIGH I. This is in line with the 2030 climate target plan and the Renovation Wave communication and action plan, which identify an additional investment need of EUR 275 billion per year in building renovation to meet the RW objectives and the building renovation contribution to the 2030 emission reduction target. It will be a considerable challenge to obtain the additional EUR 152 billion on annual investments in energy renovations of buildings stemming from the preferred option for the revision of the EPBD and in particular from the introduction of MEPS.

To be able to deliver on the needs, financing should be stepped up across the board. Three main areas of actions are therefore considered key to ensure support for the revised EPBD: (1) support for building renovations for low-income households and to meet Minimum Energy Performance Standards; (2) technical assistance to develop sound building renovation projects, support programmes to develop public administration technical capacities, and programmes to train energy renovations skills; (3) cost-effective use of EU and national financing and mainstreamed information tools on the energy performance of buildings to mobilise private capital.

At EU level, compared to previous multi-annual programming periods, the current Multi-Annual Financial Framework 2021-2027, in line with the European Green Deal, has considerably increased the amount of financial support and budgetary commitment allocated to achieve EU climate and energy goals. Of the overall EUR 1 800 billion committed in the 2021-2027 MFF and the Next Generation EU (NGEU) package, 30% of it, i.e. around EUR 550 billion, has been set aside for climate-related spending. In the context of the post-COVID-19 economic recovery, significant additional financing resources have been made available to Member States through the Recovery and

[206] D'Oca et al 2018. Technical, Financial, and Social Barriers and Challenges in Deep Building Renovation. Available at https://www.mdpi.com/2075-5309/8/12/174.

Resilience Facility (RRF) under NGEU. For that purpose, the European Commission has collected on the financial market and made available to Member States a total of EUR 672.5 billion in grants and loans programmed through the national Recovery and Resilience Plans (RRPs). A mandatory climate-key in which spending for climate-related objectives[207] must represent 37% of the total expenditure under RRF and across each RRPs have been proposed by the RRF Regulation and taken up by Member States in their RRP.

The Renovation Wave strategy played a central role in the EU recovery package stimulating MS to provide for regulatory and financial support for building renovations and energy efficiency measures in their RRPs. This was also supported by the widely recognised benefits of building renovations and energy efficiency measures for economic recovery and growth, in particular for SMEs, as well as for local jobs growth potential. Therefore, as part of the RRF guidance for Member States on the preparation of the national RRPs, the Commission has published the 'Renovate' priority flagship component.

In the 22 adopted plans, so far EUR 41 billion of climate-related investments have been allocated to energy renovations in buildings, of which EUR 14.3 billion with a focus on public buildings and EUR 26.5 billion on private/residential buildings. This corresponds to 23% of all costs related to climate-related measures, or 9% of the total 22 RRPs allocation (EUR 445 billion).

Thanks also to the alignment with the EU Taxonomy, on 12 October 2021 the European Commission issued the first NGEU 15-year green bond for a total of EUR 12 billion, establishing a relevant standard on the market, achieving a strong oversubscription rate and offering excellent pricing conditions[208]. The objective will be to issue NGEU green bonds in the years to come to leverage a total amount of EUR 250 billion on the financial market. The financial resources leveraged through the NGEU green bonds will finance the programmed energy renovations in buildings to achieve a minimum threshold of 30% reduction in energy consumption, in line with the objectives and framework of the EPBD revision. The positive reply from the financial market to the European Commission's first green bond bodes well for future operations to support decarbonisation efforts in buildings after the current MFF 2021-2027. Such large oversubscription of the first NGEU green bonds, which includes the RRF planned investments in energy renovations

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[207] Measures can also include measures for adapting to climate-related risks and also non-climate-related natural risks (for example earthquakes, fire and accidents). This is in line with the methodology for climate tracking set out in Annex VI of Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021.

[208] Press Release: NextGenerationEU: European Commission successfully issues first green bond to finance the sustainable recovery. https://ec.europa.eu/commission/presscorner/detail/en/IP_21_5207.

with a minimum threshold of 30% energy savings, is therefore a positive sign of financial market support for EU policy and investments in this area.

Beyond the EU recovery package, financing available at EU level in the current MFF to step up energy renovation in buildings has been clearly identified as part of the SWD on 'Support from the EU budget to unlock investment into building renovation' accompanying the Renovation Wave strategy[209]. The SWD provides an overview of EU financing incentives and founding programmes to support the uptake of energy renovations in buildings towards the achievement of the Renovation Wave and climate target plan objectives. In terms of financing support for direct investments on energy renovations in buildings, beyond the RRF, the 2021-2027 MFF intervenes as well with the cohesion policy funds, the Just Transition Mechanism and REACT-EU. The cohesion policy funds remain one of the main EU instruments supporting energy renovations. In the 2014-2020 period, energy efficiency in buildings represented approximately EUR 13 billion of planned investments. It is expected that the 2021-2027 programming period will continue this support, as 30% of the European Regional Development Fund and 37% of the Cohesion Fund investments are expected to contribute to climate objectives. This will especially help Member States, regions and local authorities to boost building renovation.

Additionally, ETS auction revenues can be used by Member States to finance ambitious energy renovation in buildings. The Modernisation Fund was planned to support investments on clean energy transition in the 10 lower-income MS with 2% of the revenues from the total ETS allowances. Now, in addition, the proposed Social Climate Fund[210] will support investment to mitigate the impacts of the clean energy transition in all Member States, with 25% of the revenues from the total ETS allowances. As regards buildings, the SCF is aimed at targeting specifically energy renovations in low-income households. The SCF is considered to be a key instruments to make renovations affordable and to support the roll-out of MEPS.

To support the upscaling and mainstreaming of energy efficiency and building renovation investments and to appropriately leverage private financing, under the European Green Deal Investment Plan and the 2021-2027 MFF the Commission has also developed dedicated financing products and advisory services under InvestEU. These include the ELENA Facility and the Clean Energy Transition sub-programme of the LIFE Clean Energy Transition (CET) sub-programme. In particular, LIFE CET finances market uptake activities for larger building renovations such as the setting up of one-stop-shops; project-development assistance; a number of activities to foster behavioural changes; the

[209] SWD on 'Support from the EU budget to unlock investment into building renovation', SWD(2020) 550 final, Brussels, 14.10.2020.
[210] Social Climate Fund (europa.eu)

societal uptake of energy performance certificates; and a greater citizens-led focus on the multiple benefits of energy renovations. Research and innovation in solutions for upscaling and for deeper energy renovations will be supported through the Horizon Europe programme and in particular through the dedicated destination on energy use in buildings and the private-public partnership on 'people-centric sustainable built environment' (Built4People), a continuation of the previous energy-efficient buildings private-public partnership with a broadened scope.

National financing for energy renovations in buildings, in line with the Renovation Wave communication and following the EU's support for economic recovery through the RRF, has also been strengthened in recent years. Historically, a large majority of Member States have had in place financing schemes, direct subsidies and tax reduction to support energy efficiency measures in residential buildings[211]. Compared with financing schemes and public support for energy renovations in residential buildings, support for commercial or residential buildings owned by economic operators is less common[212]. In 2019, the JRC overview estimated a total of EUR 16 billion in national public resources spent annually across the Member States on energy efficiency renovation in buildings. Studies, including the 2019 JRC policy report, point to a necessary shift from direct grants and public direct investments to the development of more innovative financial instruments to achieve the uptake of a larger rate in terms of energy renovations. The need for a more standardised framework for energy performance certificates and deep energy renovations should be underlined here. This would make the best use of available national public resources and target public financial support in a cost-effective way where it matters most and where it is possible to reap larger benefits in terms of the energy performance increase of national building stocks. In particular, deeper energy renovations, low-income households and worst-performing buildings should have priority access to national public financing support if the 2030 energy and decarbonisation targets for buildings are to be achieved. The submission of the most recent 2020 LTRS gives a positive but rather general overview of the planned financing schemes.

The EPBD revision, and in particular the proposed new building renovation action plans to substitute the existing long-term renovation strategies, will reinforce provisions on accessible and targeted funding supported by technical assistance to fill the investment

[211] JRC, 'Accelerating energy renovation investments in buildings Financial and fiscal instruments across the EU', Economidou Marina, Todeschi Valeria, Bertoldi Paolo.
[212] Ibidem.

needs. This will increase the volume and impact of EU funding, attract private investment and mobilise further financial instruments and private financial products[213].

Building renovations are currently the subject of an unprecedented level of public financial support, which will nevertheless not be sufficient if private financing and dedicated private financial tools are not adequately mobilised. The new policy measures proposed in the EPBD revision are expected to have a strong positive effect on mobilising additional private capital, scaling up investments for energy renovations in buildings, and in general improving market conditions and investment opportunities for energy renovations in buildings.

The introduction of MEPS addresses one of the main barriers to energy-efficient renovations of buildings by intervening in building owners' demand and thus improving market conditions for energy efficiency measures in buildings. Additionally, revision of the energy performance certificates framework through increased harmonisation, reliability and comparability across the EU, as well as the introduction of building renovation passports, a definition of deep renovations, and a long-term decarbonisation trajectory toward zero-emissions buildings, will provide financial institutions, public administration, the construction industry ecosystem and building owners with more stable and harmonised information tools. It will also ensure a more certain long-term policy environment for a greater uptake of investment opportunities, development of business solutions and public strategies.

More accurate and comparable information on the energy performance of buildings and the setting up of national EPCs databases will support the de-risking of private investments in energy-efficiency renovations across the EU. This will reduce financial costs associated with energy renovations in buildings while making the targeted financial products for energy renovations (energy efficiency mortgages) more attractive for FIs to develop. It will also make it easier for building owners to access dedicated loans. Similarly, the long-term trajectory established through building renovations passports and the definition of deep renovations up to zero-emission standards allow for the long-term programming of public administration support, real-estate enterprises and building owners' business development and planning of energy renovations.

8.4 REFIT (simplification and improved efficiency)

The EPBD was revised in 2018; the main purpose of the current revision is to align the EPBD on the enhanced climate ambitions. The key objective is to increase effectiveness.

[213] This is in line with specific recommendations from the European Court of Auditors, Special Report 2020 'Energy efficiency in buildings: greater focus on cost-effectiveness still needed', https://www.eca.europa.eu/Lists/ECADocuments/SR20_11/SR_Energy_efficiency_in_buildings_EN.pdf.

Strengthened regulatory requirements will increase the administrative burden somewhat, notably for building owners and administrative authorities in the Member States at national and local level. However, the planned digitalisation of Energy Performance Certificates and related databases aims at reducing administrative and compliance costs.

Table 8.2: REFIT

REFIT Cost Savings – Preferred Option(s)		
Description	***Amount***	***Comments***
Digitalisation of EPCs and databases	Low	The monitoring of the building stock would be facilitated by the availability of data collected by digital tools, thereby reducing administrative costs. Digital EPCs have the potential to reduce compliance costs for building owners, if interoperability with national databases and buildings permitting procedures is ensured.

9. How will actual impacts be monitored and evaluated?

The impacts of the revised EPBD on the policy objectives set out in Chapter 4 on energy consumption, greenhouse gas emissions and renovation rates will be monitored and progress will be evaluated mainly on the basis of the provisions already in place in the current EPBD and in Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action.

Data collection and assessment will be the key monitoring tool to support Member States in keeping track of progress in the achievement of the milestones established in national long-term renovation strategies and later the national targets developed under the Building Renovation Plans, following a call from the Council.[214]

The Governance Regulation established an integrated energy and climate planning, monitoring and reporting framework. Under the Governance Regulation, Member States had to submit their integrated national energy and climate plans to the Commission by the end of 2019. The plans have to cover the five dimensions of the Energy Union for

[214] The Council Conclusions of 11 June 2021 on the Renovation Wave, call the Commission to "[…] monitor the progress made in the implementation of the renovation wave by: o analysing the domestically established progress indicators set out in Member States' long-term renovation strategies which would measure the evolution of renovation activity at European level and the energy performance of the European building stock, including deep renovations where applicable; the need to avoid a bureaucratic and further administrative burden as far as possible has to be considered; […] o developing ways to assess the economic impacts of the improvements achieved through renovation and track their effect on the real estate market; and […] o expanding the overall progress report on the renovation of the national building stock envisaged in its biennial State of the Energy Union report into a comprehensive report on all aspects of the renovation wave; […]"
https://data.consilium.europa.eu/doc/document/ST-8923-2021-INIT/en/pdf

2021-2030, including energy efficiency and buildings[215]. The link and interplay of the EPBD and the Governance Framework will be maintained with the revised EPBD provision.

To this end, Article 17 of the Governance Regulation provides that by 15 March 2023, and every two years thereafter, each Member State shall report to the Commission on the status of implementation of its national Energy and Climate Plan by means of an integrated national energy and climate progress report, which also includes specific indicators on buildings and their renovation. The biennial integrated reporting under the Governance Regulation will collect information on the progress in Member States, which will be monitored and evaluated periodically by the Commission services.

The revised EPBD will provide a clear structure for what is to be included in the Building Renovation Plans: an overview of the building sector, a roadmap with specific national targets for 2030, 2040 and 2050, implemented and planned policies and measures and the budgetary resources to implement the renovation plan. The process of monitoring the national Building Renovation Action Plans includes their assessment by the Commission services, in line with the provisions of the Governance Regulations.

Reporting on progress for key indicators and other important elements under the EPBD, together with an analysis and breakdown of the factors influencing it, also takes place periodically through the 'State of the Energy Union Report' required by Article 35 of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action[216].

Key indicators and data to be used for reporting purposes will also rely on statistics already available from Eurostat energy balances. Data collection for energy consumption in households by end-use type allows monitoring of the specific use of renewable energy in households' heating and cooling. Additionally, Eurostat structural business statistics allow monitoring of the overall evolution of workforce, turnover and value-added in the construction sector. The impact on household energy expenditure and effects on energy-poor households will be monitored through the Eurostat household budget survey (HBS) and the survey on income and living conditions (SILC), following the indicators set out

[215] In particular, the national Energy and Climate Plans should include information on the national long-term renovation strategy, the cost-optimal minimum energy performance requirements, the number of nearly zero-energy buildings and the equivalent to inspections of heating and air-conditioning systems reports.

[216] The Commission has to submit a State of the Energy Union report by 31 October of every year to the European Parliament and the Council, and the report must include, biennially, an overall progress report on the renovation of the national stock of residential and non-residential buildings, both public and private, in line with the roadmaps set out in the long-term renovation strategies that each Member State has to establish in accordance with Article 2a of the EPBD. Every four years, an overall progress report must be submitted on Member States' increase in the number of nearly zero-energy buildings.

in Commission Recommendation (EU) 2020/1563 and associated SWD (2020) 960 final. There is continuous cooperation between DG Energy and Eurostat to improve the statistical basis for monitoring energy efficiency in buildings. As a result, an hoc data collection exercise under SILC contained a module for collecting data about households' heating systems and fuels used, recent renovation (thermal insulation, windows, heating systems) and building component affected, type of windows (optional) and year of construction (optional). There are also discussions with the Eurostat population and housing statistics team to further improve building-related data availability on similar lines as for SILC.

A big step towards transparency and monitoring of national methodologies to calculate the energy performance of buildings is represented by updates to the provisions in Annex I, requiring Member States to describe their national calculation methodology following the key European overarching standards on the energy performance of buildings, namely EN ISO 52000-1, EN ISO 52003-1, EN ISO 52010-1, EN ISO 52016-1, and EN ISO 52018-1, or superceding documents. Member States must also report the choices made and the data sources for the definition of primary energy factors or weighting factors according to EN 17423 or superceding document.

The monitoring and evaluation would be facilitated by the increasing availability of data collected by digital tools. The EU Building Stock Observatory collects, and makes public and accessible, data on the transformation of the building stock which would allow for systematic monitoring of key parameters, including renovation rates of the EU building stock. The digitalisation of energy performance certificates and their national databases could gradually feed into it, allowing for systematic tracking of the EU building stock's performance.

The JRC will continue developing specific analyses and studies focusing on the implementation of EPBD measures that contribute to its overall policy objectives.

An additional data source for monitoring the impact of end-use energy efficiency policies in buildings are the databases of Odyssee-MURE[217], an EU project running for almost two decades which collects relevant energy consumption and energy efficiency data through a network of energy agencies from all the EU countries.

The transposition and implementation of the Directive will be followed up by the Commission after the transposition deadline. In addition, the Commission will work with the Member States through the Committee of Article 26 and other well-established

[217] Odyssee-MURE website at: https://www.odyssee-mure.eu/.

networks such as the Concerted Action on the EPBD[218], which provides a structured dialogue on transposition as well as a forum for the exchange of best practices.

[218] Concerted Action on the EPBD website at: https://epbd-ca.eu/.